CASSELL'S POPULAR GARDENING

THIS EDITION

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ORNAMENTAL FOLIAGE PLANTS.

CASSELL'S

POPULAR GARDENING.

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LA BELLE SAUVAGE

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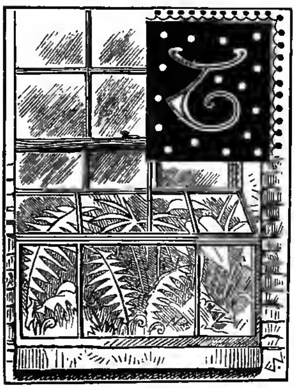
CASSELL'S
POPULAR GARDENING.

HOUSE, AREA, AND WINDOW GARDENING.

By William Thomson.

INTRODUCTION.



THE subject of House and Window Gardening, under which title it is proposed to treat of plants in windows, balconies, verandahs, porches and areas, and upon house-tops, may be regarded from so many different points of view that it is difficult to say which should have priority of consideration. The invalid who is confined to the house grows his three or four plants on a shelf or table in the window of his room, and cares nothing for what the pedestrian in the road may think of his pets; while the man in health, who is able to be much out of doors, thinks as much of the external decorative effect produced by the careful arrangement of the plants, as of their culture. But wherever they are placed, there is much to be thought of and attended to if good results are wished for; and though reading about what ought to be done is doubtless of great assistance, there is no teaching so good as practical experience in overcoming difficulties as they arise, and thus learning how to prevent their recurrence.

It must not be expected that we are preparing a series of papers upon the decoration of houses with plants, or upon the preparation of plants for decorative domestic purposes. Our subject is Gardening, not Decorating, which latter subject has been more specially treated of in the preceding volume; nevertheless it will be our desire always to keep the decorative effect of plants before our mind's eye, and to be guided by that effect in all our suggestions and recommendations.

While it would scarcely be correct to speak of House and Window Gardening as a new subject, it may fairly be described as an art in its infancy, so little has yet been done in it compared with what might be done. A few years ago the only illustrations of it were to be found inside the windows of cottages, where some of the commonest half-hardy plants were grown, more for their use as a blind or screen than for the sake of the plants themselves, or for the pleasure of watching and attending to their growth. Latterly, however, the horticultural element has received much more attention, mainly resulting from the establishment of societies which offer prizes for the best specimens of plants grown in the windows of cottagers. This movement has for its object not so much the improved appearance of our suburban roads and country villages, as the moral improvement of the inhabitants; for a love of gardening in-doors is invariably found associated with neatness, cleanliness, and good order in the house generally. Occasionally instances may have been observed of growing plants for the decoration of windows externally, and for covering some rustic porch in the country; but these examples are far from being as common as they ought to be.

It must not be supposed that we are ignorant or unmindful of the wonderful stride that has been made during the last few years in London, in the decoration of the window-sills with plants, arranged in boxes of endless variety. In these, evergreen shrubs in winter, and flowering plants through the summer, have improved and beautified our streets to an extent that could scarcely have been imagined. But there is in all this very little "gardening" in the majority of cases; it is merely furnishing and decorating with well-grown plants, not cultivating them. If the watering-pot is used, it is merely to wash off the dust from the leaves, regardless of whether the roots do or do not want water. The dead leaves are not picked off, the decaying branches are not cut out, the insects are not killed or removed, the soil is not renewed or manured, the plants are not screened from hot sun or cold wind; in short, nothing is done for them that could be called gardening. When they begin to get shabby they are thrown away, and replaced by fresh plants.

Inasmuch as plants cannot grow without light, it is not our intention to treat of plants in rooms or halls, excepting in those parts which are well lighted, and this of necessity restricts us to positions in or near the windows. It is a common error to believe that some foliage plants and most Ferns will grow in dark places. Some may exist for a time under such conditions, but it cannot be for long; all plants must have light, though some require much more than others.

It will be found convenient to regard the window-pane as a boundary-line which separates our subject into two parts, in-door and out-door gardening; and these parts will be further subdivided in the following manner:—

In-door House and Window Gardening.—This may be treated of conveniently under two divisions. The plants may be either uncovered or covered. *Uncovered plants* are those which have to put up with all the changes of light, heat, and draught to which every sitting-room is more or less liable.

Covered plants are those which are more or less protected from these influences, by being grown in a case, or under a shade, or between the window and a second window built inside.

Out-door House and Window Gardening.—This may be similarly divided under two headings, according to whether the plants are protected or exposed.

Protected plants are those which are grown in miniature green-houses built outside the windows, which are commonly known as conservatory windows.

Exposed plants are those which are placed on window-sills, in balconies, verandahs, porches, and areas, and upon house-tops, and which are not provided with any permanent protection from wind or weather.

House and window gardening, when practised by amateurs, is generally undertaken for the pleasure and amusement of the individuals who live in the house. There are some, however, who work for the pleasure of others as much as for their own gratification; and these take as great an interest in the appearance of their windows as seen from outside, as they do in the view of their window-plants from the room.

The Obtaining of Plants.—Everything must have a beginning, and domestic gardening is not an exception to the rule. Plants must be obtained. Fully-grown plants can be purchased, or accepted as presents from friends; but it is far more satisfactory to have grown your own plants from seed or from cuttings.

Fully-grown plants doubtless give the least trouble, and many who have no conveniences for keeping a store of soils and pots of different sizes are obliged to be contented with this restricted form of horticulture. For them window gardening is nevertheless a subject requiring much care, thought, and attention, and what they have to do for their plants must be done regularly and systematically. It is not a matter that can be attended to for a day or two, and then forgotten for a week. No doubt there are certain plants that require a great deal less attention than others; some have to be looked after twice a day, while others only want attending to once a fortnight, but even this slight attention must be given with regularity if good results are to be obtained.

Watering, removing dead leaves and branches, cleaning when attacked by insects or fungus, and protecting from hot sun, cold wind, and draught of any kind, are all points that must be remembered in the care of plants, whether in windows or elsewhere.

Soils.—Though many plants will grow and do well for a long time in the same soil, yet there must come a time with every plant when fresh soil is necessary. It may be that only a little is required on the top of the pot; it may be that the roots require shifting into a larger pot without disturbing them more than can be helped, in which case fresh soil is placed round the sides; or it may be desirable to shake off all the old soil from the roots, and to re-pot them in entirely fresh soil. In either case it is necessary to understand what are the different soils likely to be wanted, and it will facilitate a clear understanding of this if we commence with a short explanation of how soils are formed.

The crust of our earth is composed of rocks of various kinds, most of which when exposed are acted upon and decomposed by certain chemical constituents in our atmosphere, breaking up and pulverising the surface and forming a dust, which is washed down by rain into hollows, where it accumulates, and becomes soil or mould. When we think of the great variety of rocks that are to be met with, and remember that the dust from several of these may get washed down together from the hills and mixed in the valleys, we need not be surprised at the still greater variety of soils that are found, containing these decomposed rocks in varying quantities. The soils so formed are called clayey, chalky, or sandy, according to the degree in which clay, chalk, or sand preponderates in their composition.

But often, before the rain has washed away this dust, the spores of Lichens and of other allied plants lodge and begin to grow on many parts of the partially decomposed rocks. These die, and their remains are mixed with the dust, and thus a soil is formed upon which plants of a somewhat higher degree can grow, such as Mosses. Again, these decay, and prepare the soil for plants of higher orders. At times portions of these more or less manured soils get washed down into the valleys, and mixed with the pure soils before mentioned.

From this it will be inferred that most soils have in their composition some portion of organic remains, though in many cases the portion of decayed vegetation is very small.

Thus we see that all soils are composed of inorganic and organic constituents in very variable proportions.

Sand is the soil which contains less organic or vegetable matter in it than any other, and is consequently spoken of as a "poor" soil.

Peat, on the other hand, is almost entirely made up of decayed plants, and has a very little sand or clay in it; hence gardeners value this highly for mixing with other soils.

Leaf-mould is the result of leaves being kept in heaps and occasionally turned over, and thus allowed to rot gradually. It takes two or three years to thoroughly rot most leaves, at the end of which time they become converted into a valuable manure for plants in pots.

Loam is the soil of most importance to gardeners. It consists of clay and sand mixed in different proportions. When there is but little sand in it, it is called "stiff" soil, because the roots of plants cannot readily make their way through it. Although it absorbs water very slowly, it holds moisture for a long time when it is once wet; but when sand preponderates over clay the loam takes in water very readily, and roots have no difficulty in permeating through it. Hence sandy loam is the gardener's best friend.

Having procured a supply of each of these kinds of soil, a very little practice at mixing them in different quantities, and observing the appearance and the feel of the mixtures, will enable the amateur to determine what sort of soil any plant has been growing in, and to add more of the same if it requires it.

Drainage.—When plants are grown for sale it does not pay to waste much time or trouble over drainage. But when plants are grown for the pleasure which their beauty affords, the question of proper drainage becomes of importance.

"Crocks" is the term which gardeners use when they are talking of pieces of broken flower-pots. In breaking these into small pieces much grit and powder is unavoidably made; this must be washed out, and the remaining pieces form the best drainage that can be used for pot-plants.

The man whose only object in growing a plant is to dispose of it, contents himself with putting one piece of crock over the hole at the bottom of the flower-pot; but this will not do for plants that have to be grown in windows. For such plants the hole of the flower-pot must be covered with a slightly curved (not a flat) crock; upon and around this must be arranged a layer, about an inch deep, of crocks of the size of a small walnut; over these a half-inch layer of crocks of the size of a hazel-nut, and upon this a very thin layer of moss, just enough to prevent the soil being washed down in amongst the crocks when the plant is watered. Ferns grow all the better if the layers of drainage are each twice as thick as those described; and the same applies to marsh and aquatic plants, whose pots have to stand in pans of water.

When a plant looks sickly, and does not repay you for all your care and attention, the probabilities are that something is wrong with the drainage. Turn the plant upside down, rap the rim of the pot on the bench or table, to loosen the ball of earth; remove the pot, and you will most likely find that the earth has got washed down amongst the crocks, that the water cannot drain off, and that the points of the rootlets are rotten. Such a plant must be at once re-potted in a proper manner.

Receptacles for Roots of Plants. — The commonest receptacle in which to cultivate plants that are not grown in the open ground is an earthenware pot. But pots may be made of other materials than clay. Plants may also be grown in boxes, which in some respects are better than pots, though there are several disadvantages in using them.

Baskets also are very convenient, when lined with moss to prevent the mould running through. These may be made of wire in many very ornamental forms, and also of strips of wood. The half of a husk of a cocoa-nut makes a very useful basket.

The tins which have held preserved meats and fruits are often used by poor people, who pick them off dust-heaps, and punch a hole in the bottom for drainage. These, of course, can only be used temporarily, as the damp soil soon makes the tins rust, and this is inimical to healthy growth when roots come in contact with it.

Pots.—It is a generally-received opinion that, in order to grow a plant properly in-doors, it must be grown in a porous pot. But however convenient a porous clay flower-pot may be for most purposes, it has often been proved that it is not a necessity for good cultivation. Nevertheless, it is the cheapest receptacle that can be made, and with proper care and attention there is nothing in which plants do better, though pots have been used of other materials in which plants have grown just as well. It used to be said that plants could not be grown in a pot which is glazed, but this assertion has been disproved. Indeed, they can be grown perfectly well in zinc, and in iron pots, and in earthen pots glazed inside and outside. But as all these forms of pots are more expensive than the common flower-pot, it is natural that preference should be shown for the most economical form.

Practically, however, the porosity of the ordinary pot is an objection in one respect for in-door use, because it causes too great a variation in the temperature of the roots. If a plant be watered with water of the same temperature as that of the room or balcony in which it is grown, evaporation takes place over the surface of the pot, and the roots round the inside of the pot are colder than the roots in the middle of the pot. Again, this evaporation causes the sides of the pot to become dry, and draws the moisture out of the earth near the sides, so that after a certain time the earth near the sides of the pot is not only colder but also drier than the earth in the centre. A plant with its roots in the open ground is not subject to these changes and alternations of heat and cold, of dryness and moisture; and consequently all hardy plants grow better out of doors in the garden than in pots. It is by attention to these facts, and by care in permitting these changes to be as slight as possible, that the clever gardener shows his superiority over others. But amateurs cannot always devote to their protégés that regular attention which it is the business of the professional gardener to give; consequently, any little hints or advice which will help to minimise the bad effects of unavoidable irregularities will doubtless be acceptable. Upon these grounds we recommend pots to be used (especially for window-sills) which are glazed outside and rough inside. If the pot be glazed inside, and the watering of the plant be accidentally neglected, the earth shrinks and comes away from the smooth sides of the pot, and the roots are exposed to the action of the air; this would not take place so readily if the inside of the pot is rough, since then both the roots and the earth seem to cling more firmly to the pot. On the other hand, it is an advantage to have the outside of the pot glazed, because the glazing prevents evaporation, and consequently the roots are not so much subjected to those vicissitudes of cold and dryness to which we have already called attention.

Pots made in this manner are not, however, always obtainable, except at a price which amounts to a prohibition of their general use. The next best thing to do is to paint the outsides of common pots with two or three coats of oil-paint, taking care that each coat is thoroughly dry before the next coat is put on. Good taste will dictate the use of dull sombre colours for this purpose, as it is the plant, and not the pot, which should be the object of attraction. Greater skill is needed to grow plants well in painted or glazed than in common pots; and where paint is used, only the warm tints of common pots, or different shades of stone-colour, should be used. At the same time, the paint need not be all of one colour, and a little decoration of the pot is not to be objected to provided that it is of a quiet and subdued character; the tints of browns, reds, and olives are so numerous that there is a wide field opened here for the exercise of taste in improving the appearance of plants by the appropriate decoration of the pots in which they are cultivated.

The form of a pot is not a matter of much importance to a plant, provided that there is room enough for its roots to grow in a natural direction. Some roots grow deeper than others, and for them taller flower-pots must be obtained. But for most plants it is found best to use a pot which has about the same depth as is the width across the top; this allows of a good supply of drainage being put in, and still leaves plenty of room for the necessary quantity of earth, which should not quite fill the pot. The surface of the earth should not be flat, but lower in the middle than at the sides, which insures the water going into the middle of the ball of earth, and not down the sides only, as is so often the case with plants badly potted. This only applies to rapid-growing short-lived plants, and would injure hard-wooded plants, such as Heaths, &c.

Square Pots.—Pots are usually made round, and smaller at the bottom than at the top; but for window gardening it would be, in some respects, much better if they could be had square and straight-sided. Each plant would thus have allotted to it a larger quantity of earth to grow in, and would have more room for its roots. Again, if each square pot stood close to one or more other square pots, the extent of external pot-surface exposed to the air would be by so much reduced. The greater bulk of earth and the diminished exposure would both tend to keep the soil in a more even condition of moisture, and would render watering less frequently necessary. There need be no difficulty in procuring pots of square or any other shape, if a model be made in wood of the full size, and be sent to the potteries as a pattern.

Pots for Suspension.—The accompanying sketch (Fig. 1) will show what we mean by Hanging Pots. If a common pot could be cut in halves vertically, and a flat back could be fitted to each half, it would make two hanging pots.

Hanging Pots are most useful in many places where ordinary pots could not be used. Where windows have no shutters, nails can be driven in to the woodwork of the window-frame, and hanging-pots can be suspended on the nails. Where shutters are used, neither nails nor screws can be used to hang the pots upon; but holes may be made in the shutters, resembling key-holes, and into them hooks can be placed of the form of Fig. 2. The hole must be just long enough to admit of the part marked A going through it, while the width of the hook at B must be regulated by the thickness of the shutter. During the daytime the hook goes through the face of the shutter, and the plant hangs in front of it. Before closing the shutter, the pot and hook must be removed; when closed, the hook is put through the back of the shutter, and the plant hangs in the room. If these key-holes are made at regular and suitable distances apart, they are not objectionable when not in use for hanging-pots; but if it is not desirable to make holes in the shutters, then hooks can be attached to a stout wire, one end of which can be bent, and hung over the top of the shutter. If this be hung as nearly over the hinges as is possible, there will be no undue strain on the shutter.

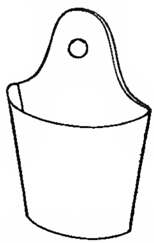


Fig. 1.—Hanging Pot.

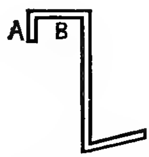


Fig. 2.—Hook for Hanging Pot.

Saucers.—These are a necessary adjunct to pot-plants in rooms. It is a very difficult thing to give exactly the quantity of water which the ball of earth that a plant is growing in may require. Hence, it is usual to give an overdose, knowing that the saucer will take what is not wanted by the earth. As it is unnatural and very detrimental to most plants to have their roots standing in water, this use of saucers necessitates the employment of more crocks for drainage than would be required for pots in a green-house; the drainage must be deep enough to keep the roots above the level of the water even if the saucer were full. This is illustrated by Fig. 3. But no amount of drainage will prevent the water rising by capillary attraction, to the ruin of the soil in the pot. A much better plan is to place in the saucer a block, which will raise the bottom of the pot nearly to the level of the rim of the saucer, as shown in Fig. 4; when this is the practice, it is evident that much less drainage is necessary, with the additional advantage of more room being provided for earth. This block must be grooved on its upper surface, or perforated, or otherwise so constructed that it shall not prevent an overdose of water running freely away from the pot. When water is kept in the saucer, no slug can get at the plant.

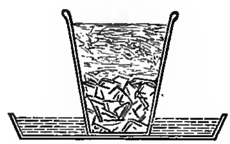


Fig. 3. — Pot sunk in Saucer.

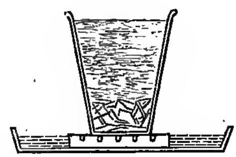


Fig. 4.—Pot raised on Block.

Where it can be arranged to substitute for saucers one large zinc tray, this is a much better plan to adopt. Each plant that has had an excessive supply of water may want its saucer emptied if it is undesirable that it should stand in water. But if a tray is provided for the pots to stand in, it is an easy matter to draw off the superfluous water from a hole made at one corner and filled up with a cork or tap.

Some plants are best grown in double pots, one being much larger than the other, and both having the hole at the bottom stopped with a cork. The inner pot, which has more drainage than usual, is placed inside the larger pot, which is filled nearly full of water. This keeps cool and moist the roots of the plant in the inner pot. If the pot is at all porous, however, the soil is apt to get saturated, and the plan is not a safe one for general adoption.

Hanging Baskets.—Nothing is prettier than a well-furnished basket, hanging in the middle of a window. It may consist either of a single plant or of a group of plants; and these may either be growing in the basket, or growing each plant in its own pot, which is concealed amongst moss in the basket. Inasmuch as plants in baskets must be taken out of a room to be watered, we do not recommend that plants should be grown in the baskets, believing it to be better for the plants, and more convenient for the grower, that baskets should only be used as receptacles for plants growing in pots. This remark applies to wire baskets more particularly (Fig. 5, A).

Very pretty hanging baskets are to be had in other materials. China or earthenware baskets, of the patterns shown in Fig. 5, B, C, D, are to be preferred to baskets made of wire or wood, as they are more durable than wooden ones, and do not require to be lined with moss as wire baskets do. If wooden baskets are used, they should be provided with a zinc lining. Baskets of a light description may easily be made out of a number of square or round strips of wood, of equal length, laid across one another as shown in Fig. 6, and built up to any height required. These are to be kept in their places by wires passed through holes made at the places where the strips overlap.

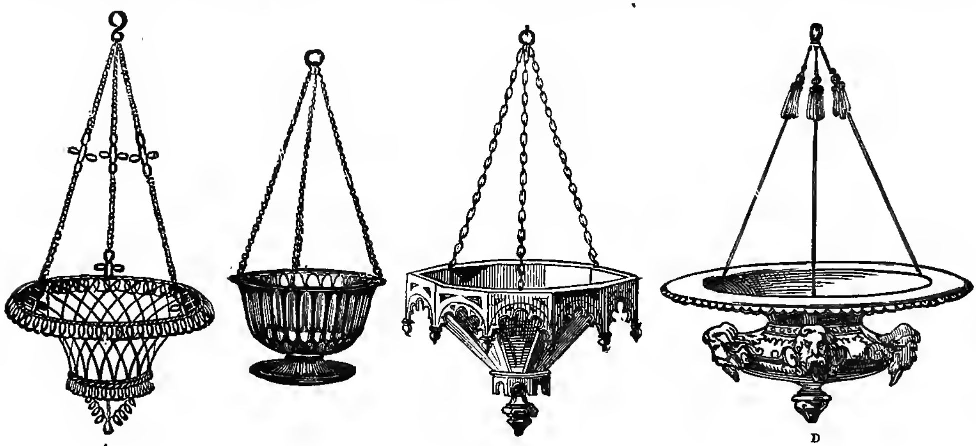


Fig. 5.—Hanging Baskets.

A, Wire. B, China. C, D, Earthenware.

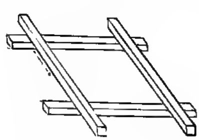


Fig. 6.—Mode of Building a Wooden Basket.

Jardinières.—This word is used to designate movable stands, or other receptacles for plants in pots. They are of various forms, and made of all kinds of materials.

Those most commonly used are made of wire, of which Figs. 7 and 8 are good illustrations. The manufacture of these is a trade in itself, and is one that is not at all difficult to learn; the tools required are few and cheap, and the designs which any one possessed of ingenuity and good taste could invent are endless.

A more useful form is that made of wood, which may be described as a tray, or lidless box, with four legs. If the sides of the box be decorated with china or glass panels, or covered with tiles, it forms a very ornamental piece of furniture for a sitting-room. The box should have a zinc tray fitting into it, and in this the pots can be stood without injury to the woodwork. We need hardly remark that the pots should be concealed from view by a layer of fresh green moss laid over them.

Under the title of Jardinières we may also include china or glass bowls supported upon metal frames of various heights, which are useful for holding a plant in a pot, or for cut flowers, as shown in Figs. 9 and 10. The former is chiefly suitable for placing in a window, in which position it has become very familiar; the short form is adapted to a much wider variety of purposes, being capable of effective use on the floor, or placed upon a table in various positions.

Boxes. — Where windows go down to the floor of a room, plants in pots do well and look well in boxes. If prettily grained wood be selected, it is better not to paint them, but merely to give them one coat of size, and then two or three coats of varnish; this will be an effectual preservative of the wood for use in-doors, and bring out the beauty of its grain. We shall have more to say about the construction of boxes of this kind when we come to treat of those required on window-sills, which must be painted to preserve them from rain and damp weather. If boxes for in-door use are neatly dovetailed at the corners they will want no further decoration. But if the amateur wishes to make his own boxes, and is not enough of a cabinet-maker to undertake this dovetailing, let him nail the box together, and cover the angles with strips of L-shaped brass, which he can fasten on with brass-headed screws. These strips should be of very thin metal, as they are not so much wanted for strength as to hide the nail-holes, and to give a finish to the box. Another way of finishing off the angles of a box of this kind is to put on pieces of small wood mouldings, which can be bought or made in many patterns and sizes. It looks best when these mouldings are of a darker colour than the wood of the box. They should be fastened on with needle-points before the box is varnished.

Some people may like to carry the moulding all round each side of the box, to which there is only this objection, that unless very securely put on along the top edge it is very liable to be pulled off in moving the box about; and housemaids, who never get up too early, must move them for sweeping, and are not likely to be very thoughtful how they move such things.

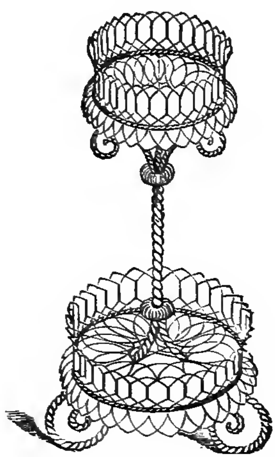


Fig. 7.—Wire.

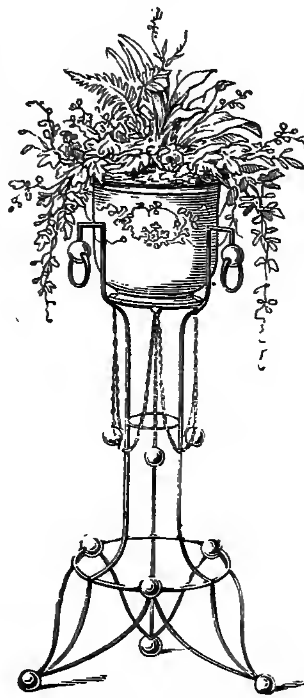


Fig. 9.—China on Stand.

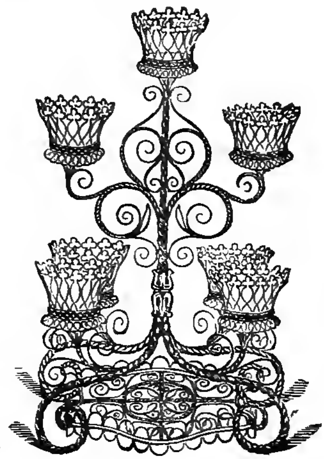


Fig. 8.—Wire.

JARDINIÈRES.

Fig. 10.—China Jardinière on short Stand.

Those who wish for more decoration on the sides of their boxes can tack on Fir-cones cut in halves, and arranged in patterns, one way of doing which is shown in Fig. 11. Pieces of rustic stick, &c., also admit of being used to ornament boxes in rustic fashion in a great variety of ways. These when varnished have a very pretty effect. Virgin cork is a great boon to a clumsy carpenter, as it covers all defects in construction, and needs no varnishing. It is generally used in a much too formal manner; but a little ingenuity is capable of producing very pretty effects in this material. The smaller the scale of the box to be decorated, the greater the need of taste and ingenuity to avoid a formality which should be quite foreign to the rustic style of decoration.

Fig. 11.—Box with Rustic Ornaments.

Brackets will be found very useful for pot-plants in a window. A narrow strip of wood may be hung from a screw in the shutter on either side of the window, and if three or four small shelves be fixed to each strip one over another, with sufficient distance between the shelves to allow of a pot-plant standing on each shelf, the plants will be in a good position for light and air all through the day, but they must be taken down at night if it is wished to shut the shutters. Smaller brackets will sometimes be found more convenient, each to hold only one pot; these can be hung upon screws put into the upper bar of the lower sash of a window. Strong swinging brackets of the pattern in Fig. 12 will be found very useful on either side of a window; but they must be very strongly fastened to the wall, as the weight of four pots with earth and plants in them is considerable, and the leverage consequently great. The advantage of these swing-brackets is that the plants need not be taken off every night, since they can be turned back out of the way of shutters and curtains.

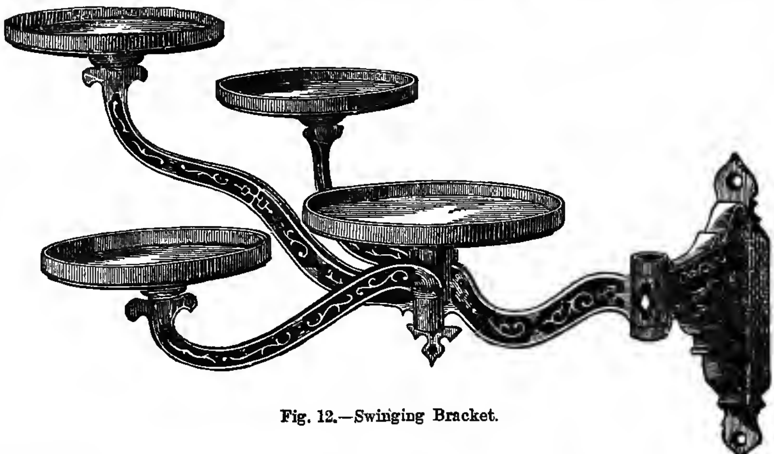


Fig. 12.—Swinging Bracket.

Shelves will often be desirable where many plants are wanted to go in a window. If they are fixed the shutters cannot be used, and the curtains when drawn will leave the plants between them and the window, which is not where they ought to be in very cold weather. It is better, therefore, that shelves should not be fixed to any part of the window-frame or sashes, but that they should be supported by a table, or independent frame, which can be moved into or out of the window at pleasure. Fig. 13 illustrates this. If there are no backs to the shelves, the plants will get all the more light.

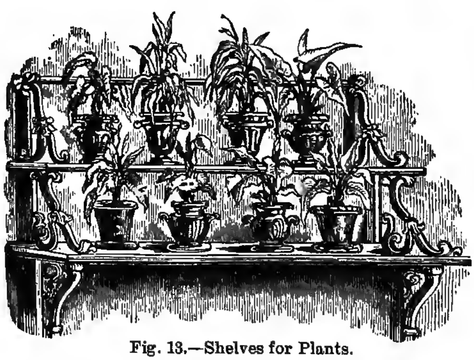


Fig. 13.—Shelves for Plants.

THE LIFE-HISTORY OF PLANTS.

By Dr. Maxwell T. Masters, F.R.S.

PRUNING.

NOW that the life-history of plants has been sketched, so far as regards the processes of nutrition and growth and their attendant phenomena, we are in a position to understand more clearly than we could otherwise do certain garden practices, which have been taught by experience and handed down from our forefathers with comparatively little thought as to the principles underlying them. One consequence of this is that improvement and progress, if not absolutely arrested, have been rendered slower than they need be; and by ignoring the lessons which the first principles of botany, anatomy, physiology, and chemistry are calculated to teach, we deprive ourselves of the means of accommodating ourselves to new conditions and new combinations of circumstances. On the principle of the dominance or survival of the fittest, we must, as a consequence, be prepared to see ourselves distanced in the race by those who have unfathomed the secrets of nature, and applied them to their own purposes more efficiently than we have done. At the present moment the depressed condition of agriculture is a case in point. New circumstances and new combinations of circumstances have arisen, and agriculturists are not able to cope with them, partly from circumstances quite beyond their control, but partly also from addiction to routine and unwillingness to adopt new methods, or to avail themselves of new resources. They have metaphorically put all their eggs into one basket, and when disaster arises, they have no compensation left. The gardeners and market gardeners are in advance of the farmer in these particulars; but who can say that they have availed themselves of more than a fractional part of the advantages which diligent investigation into the operations of plant-life is calculated to afford them?

Adverting to the practical operations of the gardener, little need be said here about them, as they are treated of under their separate headings, and reference to the foregoing articles should supply abundant hints as to the *rationale* of the methods of tillage and drainage of the soil, according to its nature and that of the roots to be grown in it, of the art of potting, the application of water and of other plant-foods, of the necessity for cleanliness, for exposure to sun, or to shading at certain times and under certain circumstances, of the requirements of temperature, ventilation, and the like. It is for the scientist to find out, and when found out, to explain "the reason why" of all these matters—it is for the practical man to avail himself of the information, and adapt it according to his requirements and the circumstances of the case.

Pruning.—The subject of pruning has not been dealt with except incidentally, but before passing on to the consideration of the multiplication and reproduction of plants, a few remarks on this matter seem called for. For practical details relating to it, the reader is referred to the several articles on the cultivation of the Vine, of fruit-trees, the Rose, &c. The practice necessarily varies according to circumstances, but in all cases it consists in the removal by the gardener of a number of shoots or buds, now for one purpose, now for another, as Shakspeare indicated—

> "Go thou, and like an executioner
> Cut off the heads of too-fast growing sprays,
> That look too lofty in our commonwealth;
> All must be even in our government,
> . . . .
> . . . . superfluous branches
> We lop away that bearing boughs may live."

Considered abstractedly, the practice seems barbarous and destructive; considered with reference to the plant in a state of nature, it may sometimes be injurious; but from the practical point of view, if it be judiciously carried out, either no injury results, or whatever damage be done is more than compensated for by the advantages which accrue; and if, as is sometimes but not always the case, the result be the shortened life or diseased condition of the plant operated on, the evils are easily remedied by the propagation of new trees to replace the old, or by other means known to the practitioner.

Natural Pruning.—Nature herself accomplishes a good deal more pruning than is usually believed. The fine root-hairs previously mentioned, and even the finer fibrils, are very often thrown off at one time to be replaced at another by new formations. We have an instance of this in Pot Vines. A liberal "top-dressing" of manure will insure the formation of a large number of feeding roots, but when the season's work is over and the leaves fall off, the smaller root-fibrils wither and decay. The fall of the leaf itself may be regarded as a kind of pruning. As we have seen, the fall of the leaf is provided for from a very early period of its growth—in the ordinary course of things it is inevitable. But the decay of the root-fibrils and the fall of the leaf do not occur till the resting-period begins, till the time when no more supplies are required, and when the leaves have yielded up their contents, to be safely stored in the bark or other store-place. This furnishes a hint when to prune, which Virgil did not overlook—

"What time the Vine her sere leaf lays aside,
And cold north winds smite down the forest pride,
E'en then the gardener, keen amid his cheer,
Forecasts the business of the coming year.
With Saturn's hook the widow'd Vine pursues,
And pruning forms her as himself may choose."
Georgic, ii., *Blackmore's Translation.*

Saturn's hook, by the way, seems to have been more of a sickle than a pruning-knife. But it is not only the leaves which fall, but sometimes the smaller branches also. This is a common occurrence in the Oak, and a still commoner occurrence in Thuyas and other Conifers. The death and fall of the branches may be seen on a large scale in Fir-forests, where the trees are so crowded that the lateral branches, deprived of their share of light, dry up and die. Summer pruning or "pinching" is a less severe operation, which frequently obviates the necessity for more serious mutilation later on. Once more to quote Virgil—

"But while young life is nestling delicate
In callow leaflets, spare their tender state;
And while the glad shoots frolic on the breeze,
Loose-rein'd on space, and prancing as they please,
Apply not yet the pruning falchion keen,
But nip them with your nails and thin between."

Under ordinary circumstances, a great many more buds are formed than can possibly be advantageously brought to maturity. Those buds that have the advantage as to position, exposure to light and warmth, and so forth, will develop into shoots, the others will form feeble growths or die outright. Under some circumstances, this partiality of nature suits the cultivator's purposes, as when he wishes to secure long straight poles or "sticks" of timber, and accordingly he plants thickly. In other cases he uses his endeavours to prevent any such partiality, and to secure even, uniform growth and proper balance of parts, as in a fruit-tree; and this he effects by various methods of pruning and training.

It will be obvious from what has been said that the propriety of pruning at all, and the methods of accomplishing it, depend upon the requirements of the cultivator, and next upon the conformation and mode of growth of the plant. Pruning for timber is one thing; pruning for flowers, as in a Rose, is another; pruning for fruit is yet another thing. Even in pruning for timber the methods vary, according as bulk of timber or long unbranched poles are required. Under ordinary circumstances for timber-trees, practice and science alike prescribe the less pruning the better. A well-grown tree under favourable circumstances should need no mutilation save what nature herself, with a far more delicate appreciation of the necessities of the case than we are likely to possess, gradually and surely effects. But disproportionate, ill-placed, over-crowded, or diseased branches may require removal; if so, the sooner and more effectually the better; or there may be some special requirement of the cultivator, as in pollarding willows, which necessitates pruning. In all cases the natural arrangement of the buds and the direction in which they push should be borne in mind, and the cut should be made as cleanly as possible and as near as possible to the main trunk or branch, in such a direction as to expose the least amount of surface to air, moisture, or insect depredators. Such wounds heal over by the rolling inwards of masses of new wood, which gradually converge and finally close the wound, but always leave a layer of dead tissue in the wood, which, of course, is an element of weakness and possible decay.

In pruning for flowers, as in the Rose, the first thing to be considered is the position and habit of growth of the buds; not only is it requisite to be able to distinguish between leaf-buds and flower-buds, but also to know how, where, and when they are produced. Sometimes, as in most Roses, *Ceanothus*, *Hibiscus Syriacus*, the Vine, some of the Clematises, &c., the flowers are produced on the young, still soft or herbaceous shoot of the year. The object here is to secure the production of strong, healthy shoots terminating in a flower-bud, not in a leaf-bud, as an extension shoot would do. In such cases pruning is generally performed in autumn, after the leaves have fallen off, or in spring, before the leaves expand. In the Vine, as in the Rose, the flowers are formed at the end of the young shoot of the year (that is, they are terminal, in botanical language, although in process of growth they become turned to one side). The buds are therefore formed with great relative rapidity, and the matter out of which they are constructed must be derived from the branch from which they spring. The newly-formed leaves are neither numerous enough nor physiologically active enough to aid much, if at all, in the early stages of the growth of the flower in these cases. It is last year's leaves which did the work of accumulating, as those of this year will have to provide for the necessities of the next.

In the case of many Roses, practical men advise "hard pruning," or what surgeons would call "heroic surgery," and there is no doubt of its appropriateness in certain cases, but it must not be adopted universally, or the Rosarian will find himself minus the flowers; nor can the same degree of hard pruning be as safely extended to the Vine as to the Rose, because in the latter case we want the flower only, and the fruit and seed are usually matters of quite secondary consideration; moreover, the Rosarian is often content to sacrifice quantity to quality. In the case of the Vine, such wholesale removal of the sources of food-supply would entail great loss of time, deficient supply, and deficient quantity; and a consideration of these facts has led some to advocate the "extension system," wherein pruning is reduced to a minimum and the plant pretty much left to itself. This practice is undoubtedly more in accordance with the natural habit of the plant, and may be recommended where there is ample space and no demand for variety or exceptional weight of bunch, but it is inconsistent with the requirements of most gardens as to variety and size of bunch.

In another class of cases the flowers are produced on the old wood, that is to say, they are formed in summer, remain inactive through the winter, and expand in the following spring, such as Lilacs, Laburnums, Rhododendrons, Cratægus, Weigelas, Elders, some of the Clematis, as those of the *patens* type, and many others. Such plants are pruned immediately after flowering, while the leaves are still on, and opportunity is given for new buds to be formed at once before the advent of winter.

In the case of most of our fruit-trees the flowers are borne on the shoots of the previous year, as in the Peach, and very generally on short contracted branches called "spurs," as in the Pear, whose structure, as before pointed out, is different to that of an ordinary branch, and adapted to the storage of a relatively large quantity of food-stuff, to be used up by the buds as they develop. Pruning in these cases is done in winter after the leaves have fallen, and its object is to insure the due proportion between fruit-shoots and extension-shoots, and by the removal of such of the latter as may be needed, to favour and hasten the development of the fruit-buds. Summer pruning and pinching, the bending down or partial fracture of a leaf-shoot, will often effect the same results.

Root-pruning.—When fruit-trees growing in unsuitable soil are unfruitful, this undesirable state of things is sometimes remedied by the process of root-pruning, which essentially consists in the severance of the larger, coarser roots, and the production in consequence of a much larger number of the small feeding-roots, upon which, as we have seen, root-absorption depends. This practice has been adopted from time immemorial, and is still carried out by the Italian peasantry in the case of the Olives. The benefits of root-pruning appear to be dependent on the increased formation of fine feeding-roots near the surface, and to the check to vegetative action on the part of the branches which injury to the roots entails.

Lifting the roots of fruit-trees every two or three years, or exposing them to the sun for a short time, are processes the success of which in inducing fruitfulness is probably due to the same causes as in the case of root-pruning. All these processes seem to induce a certain amount of precocity or premature development, in consequence of which food-stuff is accumulated at an earlier period than it would otherwise be, and the production of flower-buds thereby favoured, but the exact *rationale* of the process is not thoroughly understood. (See on root-pruning of the Apple, pages 320, 321, 322, Vol. II.)

Propagation. — The injunction "Be fruitful and multiply" applies to plants as to other living creatures, and it is provided for by the processes of nutrition and growth already treated of. For our present purpose it is admissible to distinguish between fruitfulness or reproduction, and multiplication. In plants the formation of buds or of structures equivalent to buds, which may be detached from the parent plant and give rise to new individuals, enables the gardener to multiply his plants almost at will. The action of the male pollen upon the germ contained in the ovule, as hereafter to be explained, results in the formation of an entirely new individual, a composite of two previously distinct elements. Propagation or multiplication then may be compared to the separation of one body into a number of parts, each of which is capable of growing on its own account. Reproduction requires the co-operation of two elements. The subsequent phases of growth are pretty much the same in both cases.

Propagation by buds is seen in a very simple form in some Liver-worts (*Hepaticæ*) and Mosses, wherein small outgrowths take place from the surface of the frond, and, falling into suitable soil, develop into new plants at once.

On a larger and more complicated scale as to structure may be mentioned the bulbils of the Tiger-lily, the buds of Viviparous Ferns and of Begonias, the tubers of the Potato, and other similar structures familiar to gardeners, and by means of which the plants may be propagated. All these offsets contain a store of food, and are adapted to take on growth immediately circumstances are propitious. Even where under ordinary circumstances such separable buds are not formed, their development may sometimes be promoted artificially; thus some plants—*e.g.*, Gloxinias—may be propagated by pegging the leaf down on to the surface of the soil, and by maintaining a suitable temperature. In some cases it is requisite to break the leaf to insure the formation of buds. It is curious to note that the production of tubers on the haulm or stem of the Potato, which is a not uncommon occurrence, is due in like manner, as observed by Mr. A. Dean, to some injury to the stem by twisting or the damage inflicted by grubs, &c.; and Mr. Burbidge found that on attempting to strike a cutting of a species of tuber-bearing Solanum, the result was the formation of a tuber in the axil of the leaf of the cutting.

The operations of budding and grafting depend on the successful removal and implantation of a bud or a shoot from one plant on to another. In these cases the transferred buds feed upon the food in the stock to which they are transferred, instead of that in the soil from which detached buds derive their sustenance.

Cuttings or Slips.—These consist essentially of one or more buds or "eyes" carefully detached from the parent plant and induced to "strike," that is, to form roots. The method of making these cuttings and inducing them to strike varies in detail according to the particular plant. While in some cases, as in the Willow, all that is necessary is to stick a slip into moist ground without other care, in others all the skill and devices of the gardener fail to produce the desired result. Leaving practical details to be dealt with in other sections, it is here sufficient to say in general terms that the conditions for the successful striking of cuttings are essentially the same as those already mentioned in the case of the germination of the seed. Previous to the production of roots, especially if there be not a supply of food-stuff in the bark of the cutting, a swelling is formed at the end of the cutting, called by gardeners the "callus." This consists of an outer layer of cork-cells, which serves to heal over and protect the wounded surface. Beneath it is a mass consisting of cells which divide and subdivide with rapidity, and in which starch and other building material is rapidly accumulated. This must be transferred from the upper parts of the cutting or from its bark, as it is hardly likely that it can be formed to any extent by the leaves on the cutting itself, though that possibility furnishes a justification for the practice of retaining the leaves on the cuttings. Be this as it may, from the callus speedily protrude fine fibrous roots and root-hairs, and when these are fairly developed, the young plant becomes established.

The regulation of heat, the moisture, the shading from too fierce light, the prevention of undue evaporation, all points of cardinal importance in the raising of cuttings, are matters the necessity for which is easily understood from what has been said of the mode of growth of seeds and roots. It may be well, however, to say that "damping-off" and other mishaps often arise from over-care: the cutting is kept in too damp an atmosphere, so that it cannot transpire freely, or the stimulant effect of light is too long withheld.

Budding, In-arching, Grafting.—The practice of budding has been already described in the case of the Rose, and demands no further notice here. Grafting differs from budding merely in the fact that the "scion," instead of being a single bud or eye, is a shoot with several eyes. The practical details of the process have been given elsewhere. Here it is only necessary to say that the contact must be complete, bark to bark, wood to wood, so that the growing tissues of the scion and of the stock respectively may be in contact, that it must be effected at the right season, and that there must be a close family relationship between the plant producing the scion and the stock respectively. The old stories of Apples growing on Plane-trees, of Pear-blossoms adorning the Ash, are myths or misrepresentations. The Pear will engraft on the Quince and Hawthorn, the Peach on the Plum, the Orange on the Lemon, and so forth, but in all these cases the affinity is close; nevertheless, close relationship is not the only requisite condition, for, as Mr. Barron tells us, some Peaches, such as Grosse Mignonne and Bellegarde, will take freely on the Brussels Plum-stock, but not on the Mussel. Damsons will not graft well on the Plum. Most Pears will succeed on the Quince, but Marie Louise will not do so. The records of grafting are full of apparent anomalies of this kind, which cannot at present be explained.

The object of budding and grafting is to secure the multiplication of any variety with greater celerity and certainty than could otherwise be done. It is possible by this means to secure flowers and fruit of the particular variety desired much sooner than if it were raised from seed or from cuttings. Again, some plants will succeed when grafted on a hardier stock, but fail to grow, or succumb to frost or other injury, when on their own roots. The large use of American Vine stocks whereon to engraft the French Grapes in the Phylloxera-infested districts of France depends on this fact. The American Vines are subject to the attacks of the Phylloxera, but take little harm from them, while the more susceptible roots of the French Grapes are destroyed by the insect.

Influence of the Stock on the Scion.—At one time it was stated that no influence was exerted by the stock on the scion, or by the scion on the stock, except of a physiological nature; but although it most frequently happens that no change is obvious, the characters of the stock and of the scion respectively remaining apparently unchanged, yet it is unquestionable that changes of constitution, and sometimes of outward form, do occur. We have already spoken of the increased hardihood conferred on the scion in some cases by working it on a hardier stock, as when *Cupressus macrocarpa* is grafted on

Juniperus Virginiana. Another frequent change is a change of habit. By grafting an Apple on a dwarfing stock, like the Paradise, or the Pear on the Quince, a giant is, as it were, converted into a pigmy, and the fruitfulness is not only greatly increased, but much hastened, so that the old proverb that "he who plants Pears, plants for his heirs," is no longer wholly true.

In "double grafting," again, the effect of stock on scion is shown. In some cases the Pear will not graft readily on the Quince, and the advantages of such a graft would consequently not be available were it not for this process of double grafting. This is effected by first of all grafting a scion of some other Pear on to the Quince stock, and then grafting on to this first scion the particular Pear it is wished to propagate. In this indirect manner the Quince stock is made to affect the second scion through the first, and to hasten and increase its fruitfulness.

Fig. 55.—Shoots prepared for grafting by approach or in-arching.

Influence of the Scion on the Stock.

—The effect of scion on stock is perhaps less conspicuous, but occasionally becomes very manifest, as where a shoot of the same character as the scion breaks out from the sides of the stock below the original graft. Such cases are not infrequent, and prove the reciprocal influence of scion and stock. Sometimes even intermediate forms of fruit or of foliage are produced, which suggest a commingling of elements, as in cross-fertilisation or hybridisation. If stocks induce dwarfing, promote early flowering, or in other cases retard it, if they alter the flavour and general character of the fruit, it is difficult to see why changes in the form of the fruit should not occur likewise. Those who deny this say that the intermediate forms, which undoubtedly do occur, are instances of variation not greater in amount than such as are known to occur naturally without grafting. The difficulty of explaining these cases was greater when it was believed that each cell of which plants are built up was a closed bag independent of its neighbours, fluids only passing from cell to cell by exudation and osmosis; but improved methods of research and more delicate observations have proved the passage in so many instances of very fine threads of protoplasm from one cell to another, that "continuity of protoplasm" may be considered a general occurrence in the younger tissues where growth and physiological activity are most intense. Assuming its general occurrence in the younger-growing tissues of plants, as we have every reason to do, the explanation of some of the effects of grafting and of "sports or bud variations," wherein from a

Fig. 56.—In-arching: the stem of the plant in the pot is inarched on to the stem of the plant growing in the ground; and when union is established between them, the stem of the plant in the pot will be cut across below the ligature.

branch of the ordinary character suddenly emerges one more or less widely different, becomes much more easy.

In-arching consists simply in bringing two stems of different plants into contact by their denuded surfaces, and keeping them in contact till union takes place. Figs. 55 and 56 will show at a glance how this is effected, and how the scion is ultimately detached. Such unions, either between branches of the same or of different trees, are not uncommonly met with in a natural state.

Layering is a form of progagation often practised with trees and shrubs, in which a branch is bent down to the ground, and retained there by a peg or hook till roots are emitted, when the layer may be severed between the newly-formed roots and the main stem, and the new plant thus liberated. The chapter on the propagation of the Rose shows how this is accomplished, and Fig. 57 shows a modification of the process when it is desired to "strike" the top of a large tree, so as to reduce the size of the tree, and enable it to be grown in a smaller house than would otherwise be possible.

Fig. 57.—Shows the method of securing the production of roots from branches, so as to enable the cultivator to reduce the size of a plant.

The layering of Carnations is effected by bending down the shoot as in ordinary layering, and in addition, severing it longitudinally, so as to leave a tongue in the form of the letter <. Roots are formed from the lower limb of the section, and when produced the rooted portion is severed from the plant as in ordinary layering.

THE HARDY FRUIT GARDEN.

By D. T. Fish, assisted by William Carmichael.

THE TRAINING OF APPLE-TREES INTO DIFFERENT SHAPES AND SIZES.

Variety of form is one of the chief charms of the Apple in the mixed hardy fruit garden, as it is of the landscape. No matter how pleasing or profitable any one form may be, it is better alike for the eye and the pocket to introduce variety into our fruit gardens. Not only may more trees, as a rule, be successfully grown in a given space if they vary widely in form, but there is a far better chance of some escaping the spring frost that so often wholly wrecks, or partially destroys, much of our hardy fruits.

The relation of height and form of trees to climate has only begun to excite attention. When more carefully and generally noted, probably a body of evidence may be collected that will go a considerable way to make the form and height of the tree contribute to its safety. That the cold sweeps over the earth in lines of differing heights from the ground in different localities is pretty well known. Hence it is no uncommon thing to find that at times the heads of tall pyramids will be blighted while their bases escape. At other times, and especially at other places, the reverse order of destruction may be observed. Ground cordons eighteen inches from the ground will at times have their blossoms destroyed, while oblique cordons running up, either single or diamond-fashion, will altogether escape. The latter has been observed for many seasons in succession, and it almost seems established that the diamond form of cordon (Fig. 23) offers more resistance to the radiation of heat than any other form. Each square of wood does of course act as a conservator of warmth, and as the lines of radiation are vertical between the earth and the open sky, it follows that these cross-branches must intercept, and so conserve, a considerable amount of the warmth of the earth.

The old Espalier, or horizontal-shaped tree (see Figs. 28 and 29), was probably almost equally efficient in moderating or subduing the force of radiation, and as a matter of observation and experience such shaped trees are found to pass through spring frosts with more safety than those of pyramidal form. Perhaps the latter are almost the worst for exposure, in the early spring, to a clear frosty atmosphere radiating the earth's caloric away with intense activity and force from bank to sky. For the pointed form of these trees, tapering at their summits into a sheer point, and widening as they descend into a base from three to six or more feet in diameter, exposes them at all points of their height to the full and unfettered influence of radiation. The wide-spreading standard and irregular bushy dwarfs of the old orchards were far better adapted for contending successfully against, and carrying their blossoms safely through vernal frosts, than the prim model pyramids or semi-weeping and freer-trained cones of to-day.

Fig. 20.—Single Cordon.

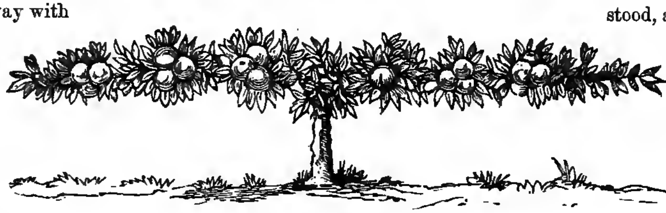


Fig. 21.—Double Cordon.

Best Height for Escaping Spring Frosts.—Sufficient data are not yet in our possession to enable us to determine this matter with sufficient accuracy to lay down any practical rules for our guidance. But it often seems as if the nearer the earth the warmer the local atmosphere. And this will hold good with greater force when the tree itself is of such form, or is so protected, as to conserve the heat of the earth under it. For example, cordons running along fifteen inches from the ground, and protected on their upper surface with a few boughs, have brought their blossoms and embryo fruits safely through frosts that have cut off the whole of the bloom from a row of pyramidal Apples growing within four feet of the cordons—the latter, in fact, forming an edging to the larger trees. It is well known that though on a large scale, and writing in general terms, the higher we ascend the colder the air becomes, yet the cooling does not proceed in regular planes of degradation like ascending the steps of a stair. Within that very limited altitude of the air with which our fruit-trees are brought into contact, disturbing causes of mountain and plain, water and solid land, grass land and arable, plantations and heaths, prevailing winds, coast-lines, and points of compass, and, as we have seen, form and even height of fruit-trees, all go to make up that most important of all factors in fruit production with which the cultivator has to contend, local climate. The more this is studied the better it is understood, and the more skilfully our fruit-trees are matched or mated with it, the greater the success in growing Apples or any other hardy fruit.

The Formation of Cordons.—These are best grown into shape from the first. Most maiden Apples naturally run into a single or multiple cordon. If they seem disposed to produce too many shoots, these should be thinned down to one or two. As the season advances, and these selected shoots seem inclined to run too fast or too far, nip the point of the shoot out when, say, two feet long, towards the end of June, or early in July. If at the same time the cordon have its head bent down towards the earth, as in Fig. 20, this will result in a twofold benefit: it will retard the breaking into a shoot of the terminal bud, and plump up every bud on the embryo cordon so bent into almost an equality of size and plumpness. Should the autumn prove hot and dry, most of these buds will be developed into fruit-buds during the first season. (See Fig. 6.) And if not, it is a great point gained to be assured of a good break of buds of almost equal strength from base to summit of the future cordon. Should the front bud, or several towards the end of the cordon, break, all save the leading shoot should be pinched back to three leaves or so, the leader only being allowed to grow throughout the season. The attempt to suppress it too severely only aids in forcing the lower buds of the cordon to break during the current year, a misfortune that no amount of future pruning or skill can quite counteract.

With the base of the cordon well furnished with fruit-buds at the earliest possible moment, and these resulting in a fine crop of fruit, there is little fear of any excessive growth in the future, if the plan of top growth and summer pinching of the side shoots already pointed out is carefully carried into effect.

Modes of Training Cordons.—The simplicity of the primitive form lends itself to several modes of training, as, for example, the vertical, the horizontal, the oblique, the single and double (see Figs. 20 and 21), the curvilinear, with the curves vertical with the earth like a barrow-wheel, or horizontal or corkscrew fashion, diamonded, vandyked, &c. Perhaps the oblique, diamond, and spiral, of which see illustrations of the latter (Figs. 22 and 23), are as good or better than any other, but the primitive form equally yields to every other method, such as the horizontal, vertical and winding, or vandyked. Probably the horizontal, at distances from the ground varying from nine to eighteen inches, is as generally useful as any other; but for clothing walls of limited height, say from three to five feet, oblique cordons are to be preferred to vertical ones, inasmuch as they give the cordon a longer run before reaching the top. (See also Fig. 30.)

Horizontal cordons are also sometimes planted from a foot to two feet apart, and trained along, one on the top of the other, at the same distances until the wall is furnished. In this method of training and utilising cordons, though the last planted can hardly be the first, it assuredly has the furthest to run.

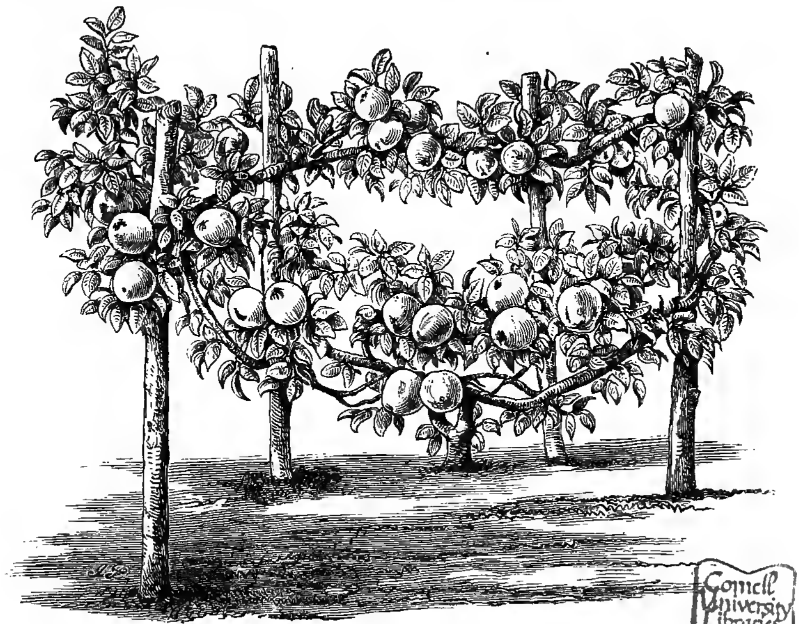


Fig. 22.—Spiral Cordon Tree.

In one of the most novel and satisfactory results the writer ever had with Apple cordons, the trees were planted on the top of a raised bank, eighteen inches apart. The bank was ten feet long on the southern side, with a sharp pitch to the south. All excepting about two feet of its crown was surface-concreted, and finished of a dark colour by the use of a considerable amount of soot in the concrete. Wires were run up and down the bank, eighteen inches asunder and fifteen inches from the ground. The maiden trees were partly cut back, for this first experiment was made many years ago. They grew so strong that they were stopped early in June, and again in August. The season being hot and dry, the power of the sun on the hard sloping bank was so great that the whole of the three growths were ripened, unless just at the tips of the shoots. These were cut off in the winter, and the next season the cordons fruited on the first and most of the second-made wood. This crop of fruit and the subsequent effects of drought and heat very nearly abolished the necessity of future pruning, and resolved their further training into a mere matter of tying in their heads to the wires. The fruit, too, was exceptionally good in colour and flavour, the size being somewhat reduced by over-cropping.

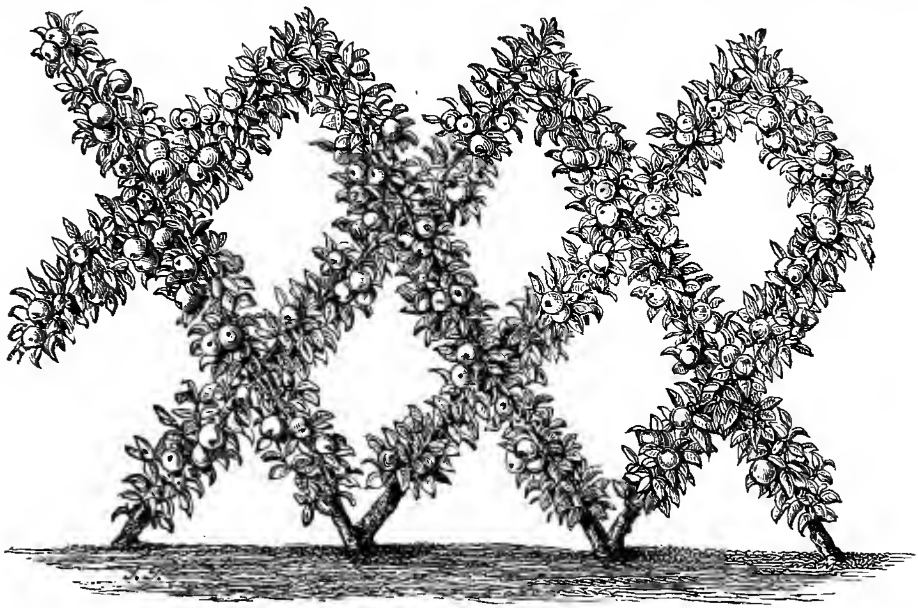


Fig. 23.—Diamond Cordon.

As a rule, however, as already remarked, the fruit on cordon Apples is far above the average size, and not a few grown by us on horizontal, oblique, and zigzag cordons, are models at once of beauty and quality. We use the latter form (Fig. 30) frequently, to fit into vacant spaces between Peach or Apricot trees on walls, and such trees have been much admired for their effect, as well as greatly prized for their full yield of fruit of the highest quality. Horizontal Apple cordons are also run along the bases of walls within a few inches of the ground, with equally satisfactory results.

Bush Apple-trees.—In Fig. 24 we give an illustration of the most useful form for small or other gardens. It will be easy to see how our Figs. 8 and 9 may be converted by a series of stoppings and winter prunings, such as we have described, into these forms. It is found in practice that bush Apples under proper management produce quantities of the very finest fruit. After growing into fair size—say four feet high and one yard through—top growths should be discouraged by heavy crops of fruit, and root-pruning, as under such repressive treatment the trees continue in good condition and carry capital crops of fruit for many years without greatly enlarging their size. The system of shortening back and thinning out fruit-hearing spurs, as illustrated in Figs. 18 and 19, is also of great importance in the proper management of bush Apple and other fruit-trees. But once fruit-trees get into the habit of producing such clusters of fruit-spurs as those exhibited in Fig. 17, it is seldom that they grow so much wood as is there shown, but more commonly only a few shoots a few inches in length, and not seldom merely a cluster of leaves. With a fertile habit thus firmly established, it reproduces itself year after year, in accordance with the great law so potent among fruit-trees of like producing its like.

Pyramidal or Conical Apple - trees. — These have become the most common of all in gardens. Nevertheless, the Apple does not grow into this form so naturally as the Pear, and there is one form of it, the semi-weeping conical, that very few apples are sufficiently slender, or semi-pendent, to be moulded into. Still, the Apple may readily be grown into a pyramid, albeit it has a tendency to become broad at base and upwards in proportion to its height. So much is this the case, that most pyramidal Apples are really of a sort of hybrid form between a bush and a cone. Nor are these at all objectionable, as they suit the idiosyncrasy of Apple habit, and continue healthy and fertile for years.

Fig. 24.—Bush Apple-tree.

It may seem to the amateur a great leap, from the maiden tree one year from the graft, to the finished pyramidal Apple; but it is hoped that our text and illustrations will prevent its being a leap in the dark. Starting with Figs. 10 and 13 as a basis, it is obvious that if the side shoots are stopped in year by year, the leader is forced to advance very slowly; and care is taken by means of the summer pinching of the top (see Fig. 10) to insure a sufficient supply of semi-horizontal shoots on the annual vertical one; all else is merely a matter of shortening back and occasional tying into exact position, in order to produce a perfect pyramid or cone. To this end vertical growths should proceed somewhat slowly—at, say, a mean rate of a foot a year. But a yard may be made, provided that by twice stopping during the summer a sufficiency of side shoots are formed at regular distances to furnish the side of the pyramid with regularity. Failing this, then the vertical shoot must be cut back so severely at the winter pruning as to force most of its buds to break right back to its base. Otherwise, not only will gaps be made in the tree, but its chief strength is likely to get into its head instead of being diffused with regularity through its base and sides. Provide for the base and sides, and the crown of the tree will take care of itself, is a wise saw in training that should never be departed from. Other mistakes may be rectified by care and skill, but once start a pyramid with a weak basis or irregular sides, and the form of the tree is marred for life.

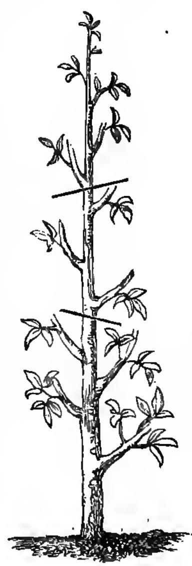


Fig. 25.—Pyramidal Pruning.

Fig. 25, with the lines across the central stem, shows the points of stoppages, and the results in furnishing it with a good supply of well-placed side branches, which after three or four years results in such a finished pyramid as Fig. 26.

This is rather shorter and wider than many pyramidal trees, a form, however, which the Apple and the Cherry are far more prone to grow into than the Pear or even the Plum.

There are also many other forms of the pyramidal type, such as the Chandelier Pyramid of the French, which consists of a series of three, five, or even more side branches, being forced out and diverging from the main stem almost like the spokes of a wheel, at regular intervals of two feet or more from each other on the main stem. When these cannot be produced near enough to each other for symmetrical effect, then wood-buds are inserted all round the stem to furnish the necessary number of shoots on the same plane. When the lower series of branches are grown out considerably wider than either of those above them, and the latter become narrower, as they ascend, to a mere point or small circle on the crown of the tree, the effect is highly artistic. The interstices between the flowering and fruiting branches not only display these to the best effect, but are also most useful for the free admission of light and air to all parts of the tree. It, however, needs a good deal of skill to form and keep in good shape one of those so-called Chandelier conical trees, which are oftener seen in France than in England.

However, in small gardens where only a very few trees can be grown, and the fruit-trees may be almost the only ornaments, skilful training into artistic forms is often an unfailing source of pleasure, and fortunately it need not lessen the fertility of the trees.

In small gardens the interest and pleasure may be greatly augmented if each ray of branches, or each branch forming part of the ray, be formed of a separate variety With a little skilful manipulation in regard to grafting and training, a single tree, where space is limited, may be made thus to produce almost any number of sorts, and Apples enjoyed all the year round from a single root-stock.

The Vase Pyramid is another ornamental and useful form of Apple or other fruit-tree seldom seen in this country. It is, however, well adapted for amateurs who have time for tasteful training. The base of the tree is moulded into the form of a vase by setting out the base branches, as in Fig. 27, only the boughs may be more curved at the bottom, and brought up at regular distances to form the sides of a vase, say a yard or four feet in depth. In the centre of the vase, however, a branch is brought up like the centre stem or jet of a fountain, and this, so soon as it gets a foot or two above the line of the outer framework of the vase, is forced to break into the production of side shoots, and then is moulded into a pyramid.

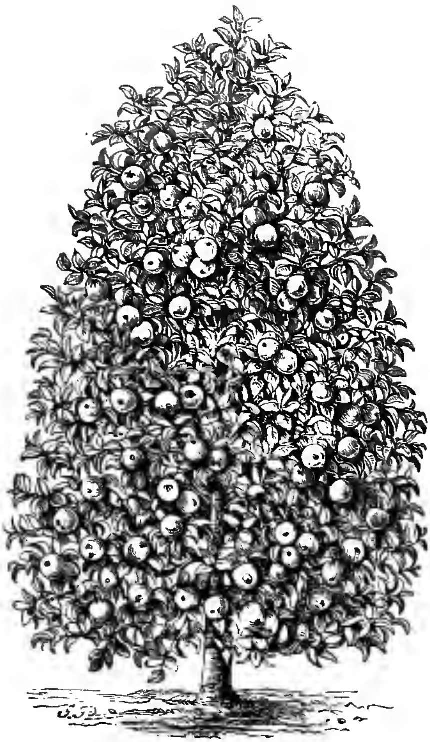


Fig. 26.—Pyramidal Tree in a finished state.

A yet better and more effective style of combining two forms of training into one, is to start with the vase shape for a base as in the foregoing, and run up the centre stem to a height of a yard or a yard and a half, and then prune and train the top at that lofty elevation into a weeping standard. By keeping the circumference of the top well within the diameter of the base, the effect, when fully formed, is something analogous to the circular distributors in the centre of fountains, that return the waters in semi-spherical lines or unbroken sheets into the central basin. The effect of the weeping centre may be enhanced, and the analogy to the vase or fountain be made more exact, if the base branches are wound round the top of the base so soon as sufficient height has been reached, thus forming a fruitful rim of beauty to the vase, as in the spiral cordon, Fig. 22. Those who wish to imitate the vase more closely at the base may raise it on a stem or pedestal of any height, then form the vase pure and simple, or add any other combination to it that they may think desirable. The vase pure and simple is however, as a rule, a dwarf tree with an open centre, as shown in the making, not the finished state, in Fig. 27.

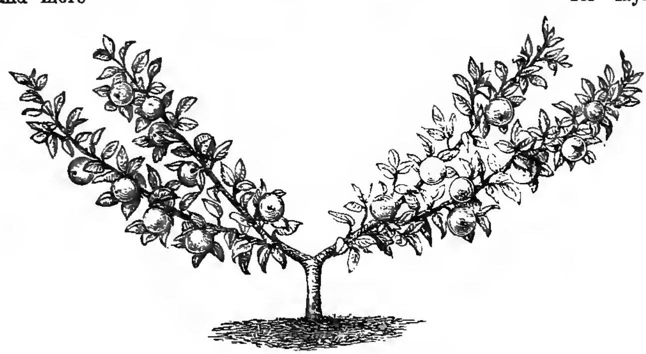


Fig. 27.—Vase-shaped Tree.

The open centre has considerable cultural advantages as well as artistic merits. It may also be formed in various ways—as, for example, by upright branches at equal distances, for laying the basis of which see Fig. 27, or by winding cordons round and round lines of stakes, and so forming a vase with circular branches as in the spiral cordon, Fig. 22. Even this mode of forming an Apple-tree into a vase may be improved upon by planting two cordons, or training a dual cordon, and starting the two leaders in opposite directions, this resulting in a vase with diamonds at sides as in the diamond cordon, Fig. 23.

For trees with open centres of large size this is the best method, and the slightest assistance in removing the outer portions of bark wherever the main branches cross each other, and then binding closely together, would result in a series of almost natural grafts, that would enable the vase Apple-tree to stand steady against the most violent attacks of wind and storm.

In open and exposed districts this method of making dwarf trees perfectly self-supporting should be more generally adopted. The mere adoption of the vase form, by bringing and keeping the trees so near to the ground, and the resistance their well-furnished sides offer to the force of the wind, are powerful arguments in favour of such forms as well as cordons. While crops are frequently wrecked within sight of fruit store, on tall orchard trees, and even on pyramids, those on bushes, dwarf standards, vases, pyramids, and espaliers, mostly escape.

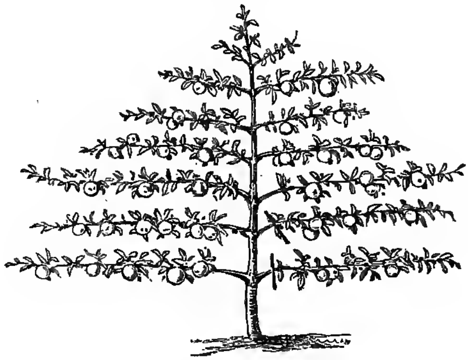


Fig. 28.—Espalier Tree.

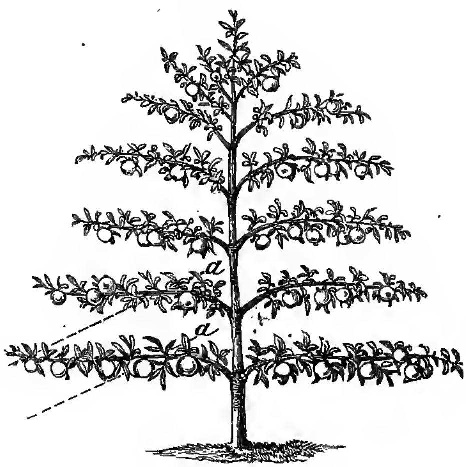


Fig. 29.—Espalier or Wall Tree.

The Formation of Apple-trees for Espaliers and Walls.—This form of tree, for they are both alike, is less common than it was, the other forms already illustrated and described having largely superseded this older and still very useful form; though until a very recent period the horizontal or fan-shaped espalier, and the standard and dwarf orchard trees, were almost the only forms known to Apple-growers. Now there is considerable danger of all these being wholly superseded by cones, bushes, and cordons. This would be a misfortune, for the old form has merits of its own very favourable to the growth of Apples and Pears in unfavourable localities. Horizontal training, the only form dealt with here, may be described as a sort of multiple cordon training. Each branch should resemble a cordon in its fertility from base to summit, and the summer pinching and winter pruning may be exactly the same as if each branch were independent of the parent tree. The one root having thus virtually many semi-independent cordons to support, the latter—that is, the branches — make less wood than cordons with independent root-force all and wholly to themselves are too prone to do. Backed up against walls or espalier rails, now mostly formed of iron, this form of tree is fully exposed to all the light and heat the climate affords, and hence the finest Apples, such as the Ribston, Golden, and Newtown Pippins, may be thoroughly ripened in many localities in which it would be hopeless to attempt their cultivation on any other shaped trees. The semi-skeleton form, and the long far-extending branches to right and left of their boles, hit the happy mean between the diffusion and concentration of vital force most favourable to health and fertility. The cordon, unless worked on a dwarfing stock and skilfully managed, is apt to break away into an excess of vigour, or pine and dwindle under its severe repression. But espalier and wall trained Apple-trees escape these dangers, and continue to yield magnificent crops of fruit for a quarter or even half a century.

Not a few of the older cultivators believed that the older the trees the higher-flavoured the fruit. Possibly: but in any case a few fine Apple-trees on espaliers or walls were invaluable in refilling the fruit stores year after year with fruit far above the average of much of that gathered now.

The mode of forming espalier and wall trees may be said to be identical in its main principles with that already described in the moulding of pyramids (see Fig. 25). There is this difference, of course, that whereas the pyramid needs branches all round its stem to furnish and complete its form, the wall or espalier Apple only needs two sets of branches as nearly opposite to each other as possible (see Figs. 28 and 29). Though they are drawn opposite in these figures, they are seldom found just so in nature, unless indeed buds are inserted on purpose, nature as a rule seldom showing such complete regularity of development. A great deal, however, depends on the leader, and that is amenable to gentle compulsion as to the number and position of its breaks. It is, however, the business of the trainer to get the framework of the tree—that is, its leader and divergent branches—into as regular and orderly a form as practicable, and hence these two models (Figs. 28 and 29) are placed before him.

At first sight they seem so much alike that one might very well have been spared. A glance up the centre of the two trees will show, however, wherein they differ, and the merits of 29 over 28.

In Fig. 28 we have the commonest mode of horizontal training, and the main stems in both these illustrations are left bare, the more clearly to exhibit the difference in the bases of the side branches in the two modes of training. The side shoots, starting directly at right-angles, are apt to run off so freely at first and afterwards as to neither produce fruit-spurs nor break their wood-buds at the bases. The close cutting back of the old cultivators to the lines on the right of Fig. 28 remedied this evil. But modern growers remedy it in a much simpler manner. By curving the side shoots at starting, as in Fig. 29, though that is a mild example of the practice, the side shoots break into wood or fruit buds back to their base. If in any case, however, the branch bending at the line of divergence is not sufficient, the branches are brought down to the level of the dotted lines on the left side of Fig. 29. The curve at *a* is thus made much sharper, and the sap having to travel downwards and against nature along its entire course (see dotted line), the buds at *a*, and beyond, are more thoroughly matured, and sooner converted into fruitful ones.

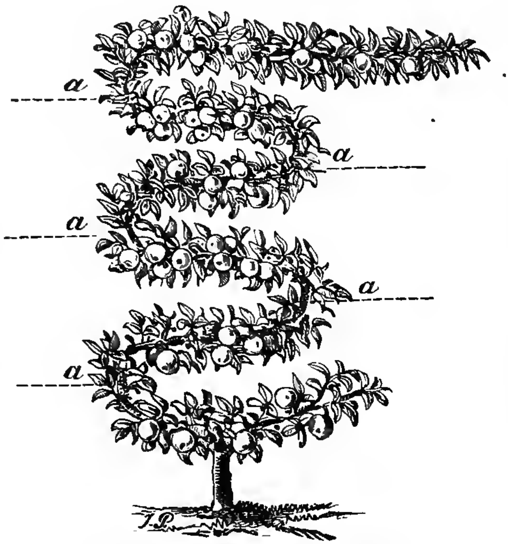


Fig. 30.—Zig-zag Cordon for a Wall.

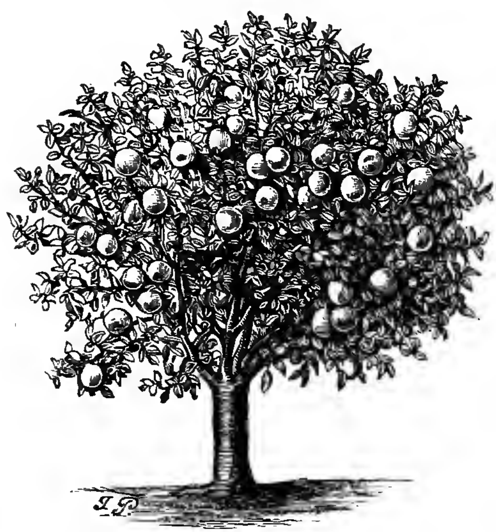


Fig. 31.—Orchard Standard Tree.

Twisting the Stem to Force Side Shoots. — To give greater variety of form to espalier or wall Apples and Pears, the system illustrated in Fig. 30 may be adopted most successfully. The buds of trees break with most force where the sap finds the greatest resistance to overcome. Without resistance it rushes upwards, and finds its outlet at the highest point of the tree. But the highest art of the cultivator is to force sap and vital force to distribute itself equally all over the tree. And as the sap approaches the curves, as in Fig 30, *a a a*, it will burst the buds, and produce shoots in the direction and at the spots indicated by dotted lines. This is not theory, but simple fact, and a bald record of every-day experience. Hence the practices of tying down Vines, and twisting the branches of fruit-trees in various ways to bring forth shoots where wanted, and to force all the buds, in such plants as the Grape-vine, to break almost simultaneously, and with an equality of vital force and growing power. The cordon, Fig. 30, is another illustration of the same principle, and I have not seldom converted cordons into a loose hoop towards the autumn, to equalise the powers of growth, and especially to plump up the base-buds of free-growing shoots.

The Common Orchard Apple - trees.—This (Fig. 31) is almost too well known to require much to be said about it. A great many varieties of Apples will grow up into this form if simply left to themselves. After planting in such soil and in such manner as have been already pointed out, most of them do much better if a little pruning and training is given for the first five years or so of their life. Less formality is needed, and more freedom should be given than is desirable or possible with most of the other forms. Still, cross and badly-placed shoots should be promptly removed, and overcrowding avoided if the trees are expected to last long in health, and continue fertile.

A glance at Fig. 31 will show that the main branches were well started, and the top is fairly open, though so freely furnished. Some contend vigorously for orchard trees with open centres, severely pruned into form. Round-headed trees, however, are to be preferred for the orchard, inasmuch as they are more picturesque as well as more profitable, and the far-spreading boughs afford one of the most potent means of protection to the trees against spring frosts.

During their earlier stages, orchard trees should be carefully pruned and trained if needful, to furnish sufficient base-wood well posted. But once form and fertility are firmly established, give them their heads, and prune or train but little, or not at all.

This does not run counter to the instructions already given—circumstances alter cases. In fruit gardens the exigencies of space, conveniences of culture, and even the pleasures of manipulating fruit-trees, watching, gathering, and enjoying their produce, plead for small trees, and of course repressive measures of pruning and training to keep them so. But in the orchard, that charming border-land between lawn and park, so often the joy of childhood and the delight of age, the larger in reason the trees grow the better, so long as fertility runs abreast of growth, and hence the soundness of the advice, prune them not at all. Leave well alone, amid the orchard trees, and sheathe the knife, unless wanted to amputate weakly and diseased limbs, or prevent or cure overcrowding.

FLORISTS' FLOWERS.

By Richard Dean.

The Polyanthus.—This is generally known as *Primula veris*, and in all probability originated from a cross between the Cowslip and the Common Primrose, *P. vulgaris*. Polyanthus is derived from two Greek words, and means many-flowered; that is to say, instead of having the individual flowers attached to a stem rising up from the roots, it throws up a stout petiole or flower-stalk, from the point of which branch out many flowers on short stems, and so it is spoken of by florists as a "truss." Polyanthuses are now divided into two main classes, viz., the Gold-laced, and the Fancy or Giant varieties.

Gold-laced Polyanthuses.—These have for many years been a marked favourite of the florists of Lancashire, Yorkshire, Cheshire, and other of the Northern and Midland counties, and in Scotland, where they are much grown for exhibition purposes. In the case of the Gold-laced varieties, the centre of the flowers, and the sides and points of the segments, are edged with gold. A perfect flower is very beautiful; those who make the Gold-laced Polyanthuses pets, speak and write of them in enthusiastic terms. One of them states: "My flower is the Polyanthus: a gem, than which no flower can more justly lay claim to the title of being beautiful. Its varied tints, the richness of its colouring, the grace and elegance of its form, agreeable fragrance, easy propagation, hardy nature, and being one of Flora's early visitors, it is welcomed with no ordinary feeling of satisfaction by every one who possesses the least taste for flowers."

A cultivator of Gold-laced Polyanthuses requires that what he regards as a fine variety should possess the following characteristics:—The stem strong, elastic, and erect, and of such a height that the truss of flowers may be above the grass or leaves of the plant. The foot-stalk stiff, and of a proportionable length to the size and quantity of the pips, as the individual flowers forming the truss are termed: these, not less than five in number, and more, that the truss may be close and complete. The pipe, tube, or centre of the pip should rise above the surrounding surface, be short, and finish fluted to the eye; the anthers cover the neck of the tube: this is what the florists term a *thrum eye.* When the style perforates and shows its stigma above the circle of anthers, this is called a *pin eye*, from its resembling a pin-head. Such a flower is rejected, however good may be its other properties, though it is often used with advantage as a parent. This is how one who may be said to write with authority, sets forth the characteristics of a perfect flower: "The tube should be round, of a bright yellow colour, well filled with anthers, bold and distinct. The eye should be round, of a bright clear yellow, and distinct from the ground or body colour. This last should be of a dark, rich crimson, resembling velvet, quite free from specks or blemish of any kind. The pips should be large, and of rich or lively colours, and nearly all of one size, and lie quite flat and smooth, as free as possible from ridges or fluting, and as round as they can be to preserve their peculiarly beautiful figure, which is circular, excepting those small indentions between each division of the limbs, which divide it into five or six heart-shaped segments. The edging should resemble a bright gold lace, exactly the same colour as the eye, and go perfectly round each petal; also down the centre of each division of the limb to the eye, and the lacing or edging be of all one width." The writer of this omits to mention that the ground or body colour may also be red, a dark velvety red, but perfectly clear and unshaded. Thus florists speak of black-ground and red-ground flowers.

Some thirty years ago these fine Gold-laced varieties were much more numerous than they are now. Those who grew them then subsequently died, and their collections became lost, and for a time there were but few to be found in the country. During the past ten years it has become much more popular, and now collections are grown round London and elsewhere; and as many persons are now raising seedlings, we have given above a description of an ideal flower, that they may possess something in the way of a standard by which to appraise the merits of their most promising productions.

The fine named varieties of Gold-laced Polyanthuses are generally of somewhat delicate constitution, from the fact that they are severely propagated because so much in demand. They can be increased only by division of the rooted side growths thrown up during spring and summer. It is, therefore, customary to grow them in pots; and the success of a cultivator depends in great measure upon the convenience he possesses for growing them, and the care and attention he bestows upon them. The Polyanthus is grown to the greatest perfection in an airy situation, yet sheltered from the rays of the sun, as any excessive heat has a tendency to impair its strength. Those who grow them altogether in pots find it necessary to have their plants in a cold frame during the late spring and summer months, standing the pots on a bed of cinder-ashes; and during the autumn and winter in a frame facing the south, giving plenty of air on all favourable occasions, watering when necessary, and shading the plants from the sun when required. In the spring it is necessary to examine the plants night and morning, to destroy snails, slugs, and other vermin that may gather about them, as they are great enemies to this pretty subject. The Polyanthus has another enemy, though small; this is the *Acarus*, or red spider. When this destructive insect attacks the plant, which it is very apt to do during hot, dry, sunny weather, the leaves become yellow, and spotted with brown, and they wither away. The best plan is to remove the infected plant away from the collection, place it in a more distant situation, and then wash the leaves with tobacco-water, or with an infusion of soft-soap and sulphur. A sprinkling of quick-lime upon the plants has been found beneficial and effective.

The Polyanthus should be re-potted at least once a year, and the best time to do it is immediately after flowering, say in June. The pots must be well drained with crocks, some very fine pieces being placed on the surface of the drainage. The plants must be turned out of the pots in which they flowered; the soil shaken from the roots; and the tap root cut away to within one inch or two of the leaves, taking care to have some nice young fibrous roots attaching to the portion retained. The roots should be spread out so as to reach the sides of the pots as soon as possible, the lowermost leaves touching, or, better still, a little below the soil, for it is from about these that new roots will be produced. After potting, a good sprinkling of water overhead should be given, so that the soil may be settled about the roots, and the pots placed in a shaded and yet airy situation, and be watered only when it is actually necessary, else there is a possibility of their being subject to rot. During the time the plants occupy frames, they should have plenty of air on all favourable occasions. In March gentle showers may be allowed to fall upon them, which is found of great advantage. It is the practice with some growers to top-dress their plants at the end of February, or early in March, removing some of the surface soil, and adding in its place soil of a rich character.

Some persons who have a favourable situation and soil, instead of potting these plants, plant them out in a cool shady border of suitable soil for the summer, and re-pot in autumn. Or they will sometimes re-pot only a portion of their plants in August, and allow the remainder to stay in the open bed, lifting them in spring just as they begin to come into bloom and re-potting them. But so much depends upon the character of the garden soil.

A good compost for the culture of the Polyanthus in pots is made up of the following ingredients:—one part light yellow loam, one part silver sand, one part well-decomposed cow or horse dung, and one part leaf-mould. A light sandy soil of this character, pressed very firmly about the roots, is one which has been found to suit this plant well.

The Fancy or Giant Polyanthus. — This is a new race of strong-growing, fine, and showy Polyanthuses, which, for the purpose of distinguishing them from the Gold-laced types, have been designated Fancy varieties. They are all of vigorous growth, the flowers large, stout, and of various hues of colours, from pure white and yellow, to deep purple and crimson. Some of the finest varieties have been selected and named, and they are found competing on the exhibition table. But they are much more generally grown for the decoration of the flower garden, and are very effective in beds and in the open border. But to do the plants full justice they should be in good soil; a deep, sandy loam, with some dung and leaf-mould dug into it, will grow them to perfection. At the time of planting the plants should be placed deeply in the soil, and the soil pressed firmly about them. The tendency of nearly all the Primula family, including the Auricula, is to elongate its stem, and to thrust itself out of the soil. At the end of the summer, when the plants have lost their leaves, they present to view naked stems two or more inches above the soil. Therefore it is necessary in the first place to plant deeply and firmly, and this done, to lift in early autumn the plants that have unduly thrust themselves up out of the soil, cut away any decayed portions of the main root up to the fibrous roots, and then again plant in deeply so that the leaves may touch the surface; one great advantage will be that the stem will thrust forth fresh roots, and so add to the strength of the plants.

A Seedling Polyanthus.

If it be inconvenient to lift and re-plant, then the plants that have thrust themselves up out of the soil should be top-dressed, by having some fine mould heaped up about the stems, which will answer much the same purpose. In all cases where the plants are lifted and re-planted, whether they be Auriculas, Polyanthuses, or Primroses, some fresh, light, rich soil should be placed about the roots to encourage action. If the fine named varieties of Fancy Polyanthuses are grown in pots, or if any selected seedings are employed for this purpose, they should be treated as recommended for the Gold-laced section.

Semi-duplex or *Hose-in-Hose Polyanthuses.*—A very interesting section of Fancy Polyanthuses is that known as the Semi-duplex or Hose-in-Hose varieties, in which the calyx is transformed into a perfect pip, and so they are two-flowered, one pip issuing from the other. This type has been known by the name of Hose-in-Hose for many years past. Of late years they have been greatly improved by seeding, and now there is in cultivation a batch of beautiful named varieties that are charming whether they are grown in pots or in the open ground. We cannot commend them too highly.

Hybrid or *Primrose Polyanthuses.*—There is a section of the Polyanthuses which for the sake of convenience has been denominated Hybrid or Primrose Polyanthuses. They form an intermediate group, as they first of all send up flowers on long stems like the common Primrose, and these are followed later by Polyanthus stems and trusses. They are generally early to flower, and very continuous also. They will come among seedling Primroses, and also among seedling Polyanthuses; and we would recommend those of our readers who may take an interest in Primroses and Polyanthuses, if they succeed in raising some good varieties of the intermediate type, to propagate them by dividing the roots, and plant them out for increase as above directed. The early-flowering forms are very useful for growing in pots, and wintering in a cold frame, as they can be had in flower some weeks before the plants bloom in the open ground.

True Single Primroses.—The common Primrose has been greatly improved during the past ten or twelve years. For years past there had been noticed a tendency on the part of the common Primrose, when subjected to garden cultivation, to throw flowers having pale hues of lilac and rose. But it was reserved for the writer of this paper to make a distinct start in the way of producing new, and it might be added, unimagined colours in the common Primrose. For some time there has been in cultivation in English gardens a pale mauve-coloured Primrose under the name of *P. altaica.* It is not this species, but by some means or the other it came to take its name. The writer discovered in the South of England a very rich maroon-coloured single Primrose of great beauty, having also a brilliant golden centre. This he secured, named it *auriculæflora*, and sent it out. By using this and *P. altaica* as pollen and seed parents, quite a new and striking progeny resulted, and by following up the work of crossing year after year, varieties of great beauty were obtained in pure white, deep yellow, lilac, pink, rose, mauve, purple, and crimson colours. They proved so attractive that they have found their way into many gardens, where they are grown for their sweet vernal beauty, and these Primroses have now a world-wide reputation. But one thing has to be noticed, that seed from true Primroses, however carefully saved, will produce a number of Polyanthus types, which fact attests to their common origin. Therefore any one who may raise Primroses from seed should select the very best types that are true to character, and propagate them as previously recommended in the case of the Polyanthus. A soil that suits the latter is well adapted for the Primrose also.

Double Primroses.—Then there is a very interesting section of Double-flowering Primroses. It is very difficult to say whence and how these originated. In his dictionary, published in 1731, Philip Miller mentions two double forms only, viz., the double yellow and a double pale red, and he states they were accidentally produced from seeds. Now we possess more than a dozen varieties. There are two, if not three, forms of the yellow; the white, blush, lilac, rose; two or three different shades of red, including the purple, the beautiful rich double crimson—the gem of the whole batch—and two new Continental varieties of comparatively recent introduction, viz., *platypetala plena*, or Arthur Dumollin, deep violet, and *Croussii*, clear deep lilac. We have no information as to how these originated. In country gardens one sometimes sees large patches of the double lilac and double white varieties, they being the two commonest, but the other colours are seldom met with. They appear to be more delicate in constitution than the stronger single varieties. They require a deep, moist, sandy loam, and will do planted out in the damper districts of the Midlands, the North of England, Scotland, and Ireland. In the more southern parts of England, hot dry weather materially affects them; they are attacked by red spider, lose their leaves, and gradually die.

We have adopted the practice of growing a collection in pots during the autumn, winter, and spring, and, when they have flowered, planting them out on a north border in summer, after being divided. We pot in autumn in small pots, using good yellow loam, leaf-mould, and sand, and pressing the soil firmly about the roots, and then place them in a cold frame. The plants are potted deeply, so as to encourage root-growth from near the lowermost leaves. When they fill the small pots with roots they should have a shift, but never be over-potted.

In summer, after they are planted out, we place cocoa-fibre about the plants as a covering to the soil, which serves to keep the soil cool and moist, and when the weather is very hot and dry we water overhead with soapsuds from the house, which assists to keep red spider in check. When planted out in an exposed position during summer, we have found a top-dressing or mulching with yellow clay a great advantage, as it keeps the roots moist and cool when the sun and rain have pulverised it. In addition it serves the purpose of covering up the roots that might otherwise be exposed to the action of the sun.

Types of Polyanthus.—There are several curious types of the Polyanthus that are found in old-fashioned gardens, and bear the names of Jackanapes, Jack - in - the - Green, Galligaskins, Pantaloons, &c. These are characterised by large green calyxes, and by curiously-marked flowers. They are to some extent floral curiosities, but they are very interesting to those that take an interest in them. Then there is what is known as the Blue Polyanthus, a somewhat delicate grower, with pale slaty-blue flowers. It is gradually losing value, because fine-coloured varieties of the Fancy Polyanthus, with deep purple and blue tints, are being raised and brought into cultivation, and these are of much more vigorous growth.

Cultivation.—To cultivate the Polyanthus and Primrose with success in or about London, or any rapidly-extending and populous city, seems to be a task of greater difficulty than the cultivation of any other flower, and for this reason collections are very seldom seen near such centres. The situation is unfavourable to them. They are natives of pure atmospheres, and as such they cannot endure the smoky air of large towns. Some attribute this to the presence of smoke, others to the continual motions of the atmosphere, which in most places would be injurious to these delicate flowers. At those seasons of the year when the weather is most trying to vegetation, a chilling atmosphere sets in towards a large town from the surrounding country, inasmuch as the artificial heat of the town causes the air over it to ascend, upon the same principle that air ascends in a chimney over a fire. Now it invariably happens that when cold air, though completely charged with moisture, approaches a warmer place it becomes a drying or withering air, and this is the reason why delicate flowers, and also the blossoms of the more early and tender fruit-trees, are much more subject to injury in the vicinity of towns than in the open country. In the vicinity of London, for instance, the general movement of atmosphere is from the north or north-east during the part of the spring which is so perilous to the growers of choice flowers and fruits; and, for the reason above mentioned, the metropolis not only has its full share of this blighting wind, but retards it, and thus greatly increases its mischievous effects. It is for the same reasons becoming increasingly difficult to cultivate the Sweet Violet round London.

Raising Seedlings of Polyanthuses and Primroses.—Any one fond of these, and desiring to have some fine young vigorous plants every year, should raise a batch of seedlings each season. As a rule they both seed pretty freely, except when the spring season is wet and frosty, or hot and dry. Seed should be gathered only from the best varieties, and when the seed-vessels turn brown and begin to open at the top the seed is ripe, and every day such pods as so open should be gathered, or the seeds will be lost. When gathered the pods should be spread on paper, perfectly dried, and the seeds separated from them. We prefer to sow in August, or as soon as the seeds are ready; they germinate more quickly, and nearly six months is gained in comparison with sowing in February following. One plan is to sow the seeds in earthenware pans or shallow wooden boxes, draining them with broken crocks, then placing some rough soil over them, and filling up with a fine light soil in which leaf-mould and sand predominate. This is pressed down until the surface is smooth and level; the seeds are then scattered thinly over the surface, and very slightly covered with sand; the pans are placed in a cold frame, precautions being taken that worms cannot work through into them, and a piece of glass is placed over each. They are kept shaded from the sun, and looked to occasionally to see that the surface is kept moist. In a month or six weeks the plants will make their appearance. During the winter the soil needs to be kept moist enough to insure life, and in early spring the tiny plants will make growth, and as soon as large enough to handle, should be picked off into store-pots, and finally planted out in a bed to flower; by the following spring they will have grown into extra strong plants, and will flower finely and freely.

SELECTION OF GOLD-LACED POLYANTHUS.

Black-Grounds.

Cheshire Favourite.	John Bright (Barlow).
Earl of Beaconsfield.	Lancashire Hero.
Exile (Cronshaw).	Lord Lincoln (Hufton).
Formosa (Burnand).	Prince Regent (Cox).

Red-Grounds.

George IV. (Buck).	Sir Sidney Smith.
Lancer (Bullock).	Sunrise (Barlow).
President (Hilton).	William IV. (Sanderson).

FANCY OR GIANT POLYANTHUS.

Buttercup.	Grenadier.
Criterion.	Harbinger.
Gold Cup	Lustrous.
Golden Bedder.	Sovereign.
Grandis.	Sultana.

SEMI-DUPLEX OR HOSE-IN-HOSE POLYANTHUS.

Cloth of Gold.	Lord Wolseley.
Crimson Beauty.	Scarlet Gem.
Faust.	Prince of Orange.

SELECTION OF FINE SINGLE PRIMROSES.

Altaica.	Purple Queen.
Auriculæflora.	Queen of Violets.
Amaranth.	Rosy Gem.
Gem of Roses.	Violet Gem.
Lilacina.	Virginia.
Ophelia.	Zenobia.

SELECTION OF DOUBLE PRIMROSES.

Blush.	Lilac.
Cloth of Gold.	Platypetala plena.
Crimson, or Madame de Pompadour.	Purple.
Crimson Purple.	Rose.
Croussii.	Scotch Red.
Giant Yellow.	Sulphur.
	White.

AQUATIC PLANTS.

By R. IRWIN LYNCH.

TROPICAL AND TEMPERATE AQUARIA.

It is well known that many aquatic plants are extremely beautiful, and they invariably prove in the highest degree attractive. Those of the tropics excel in magnificence, and they are not, as a rule, difficult of cultivation. The queen of all, the Victoria Regia, requires a tank from twenty-seven to thirty-six feet in diameter, about four feet deep in the centre, and from eighteen inches to two feet deep at the sides. A temperature of 85° must be maintained, and one foot of four-inch piping to twelve cubic feet of water is found to secure this. For Nymphæas, another tank should be provided, with a temperature of 70° to 75°. The Victoria may be regarded as a luxury, but these are much less costly, as the best may be grown in a smaller tank with less heat. Whether for the Victoria, or for Nymphæas and a general collection, there is no better arrangement than that of the Water-lily House at Kew. There is a large central round basin—generally the best shape—with a margin but little raised above the level of the floor, so that the plants are seen to the best advantage, and from this principal basin there is communication, beneath the circular path, with corner tanks, for the culture of Nelumbiums, and plants that grow in shallow water or mud. This house is square, and as these corner tanks serve a valuable purpose, there is probably no better shape. Nymphæas are always grown in pots or tubs, and it is important to observe that space may be economised by keeping the crowns near the surface of the water, as the leaves spread less than they would do when rising from a depth. The depth adopted at Oxford, where for many years they have been a speciality, is about six inches. In designing a house, provision should be made for planting out the Nelumbiums, and of course the Victoria must be planted out as hereafter described, but all other kinds may be sufficiently developed in pots or tubs. With the Victoria, a few Nymphæas and some other plants may be cultivated, but the Victoria must on no account be crowded by them. Some kinds, such as Vallisneria, Eichornia (Pontederia), Limnocharis and Pistia, may properly occupy the outside spaces in order to fully occupy and dress the tank. Aquatic plants almost invariably require the fullest amount of light, and they should not be overshadowed by the foliage of Palms or other specimens.

The requirements just referred to are somewhat extensive, and not alwsys possible, but many kinds may be grown in tubs and even large pots, which cost little. Paraffin casks cnt in two, each part forming a tub, answer well. Before being used, the inside should he charred slightly with a burning wisp of straw, in order to burn out the oil. These tubs have been used successfully in the Cambridge Botanic Garden for *Nymphæa flava*, *N. cyanea*, *N. scutifolia*, *N. pygmæa*, *N. Devoniensis*, *Nelumbium luteum*, and *Sagittaria montevidensis*, though, as the water is not heated, there are others that will not succeed. *Nymphæa gigantea*, apparently for want of more heat, refuses to start, but the difficulty might be obviated perhaps by standing the tubs on flues or pipes, where that is possihle. Some kinds, as for instance the Ouvirandra, do much the best in vessels of moderate size, as they are then more completely under control. For several kinds, large inverted bell-glasses answer admirably, and they will stand easily on blocks of wood hollowed out. *Aponogeton distachyon* makes a charming acquisition for the green-house, if a strong tuber is planted in a bell-glass with a little soil in the bottom.

A natural arrangement for the culture of tropical aquatics has not yet been attempted, though, no doubt, success is possihle. In a tank of irregular outline, formed with stone as for rock-work, various bays and lagoons might be arranged for particular kinds; indeed, with some thought, every one might be provided with a special position suiting its requirements. It is easy to imagine a very fine effect, not only from the aquatics, but also by the introduction of a variety of plants that would grow well in a moist atmosphere, for many of which rock-work would be provided. Nepenthes, and various Aroids, as Monstera and Philodendron, may be mentioned by way of suggestion. All those plants which are grown in pots or tubs, partly in water, should be planted out, and there are many subjects that would be especially ornamental. Such are *Thalia dealbata*, *Arundo mauritanica*, *Papyrus*, and *Acrostichum aureum*, the last of which grows in the West Indies much as the Osmunda does in Britain. For these, slopes clothed with Selaginella would perhaps be best, and about on the rock-work we should plant Begonias, Pellionias, and a variety of small-growing, choice kinds.

There are several desirable aquatics that have been lost, or yet remain to be introduced. Seeds, generally, may be sent dry, but the precaution of sending them also in small phials of water should be adopted when they are probably important. *Barclaya* is the only genus of *Nymphæaceæ* that has never been cultivated in this country. There are two species native of Malayan waters, which, if not highly ornamental, are of sufficient interest to be sought for. We do not now grow such interesting kinds as *Cabomba aquatica* and *Desmanthus natans*, the charming *Heteranthera limosa* is seldom seen, while we have also lost *Ouvirandra Bernieriana.*

The following is a selection of the best kinds in cultivation.

Azolla caroliniana.—An extremely charming and diminutive floating plant, which suggests a setting of tiny jewels in imitation of a bit of some small Selaginella. It rapidly increases by division, and spreads over a large space; it is emerald-green in colour, or tinted brown if exposed to sunshine. In summer it flourishes out of doors, and at Pinner a large pond was covered by it; but it has been killed at Cambridge, and is, therefore, not always hardy. Like other floating aquatics, it seems to do best if soil is placed in the bottom of the vessel in which it grows. It is often cultivated as *A. pinnata*, but it is probably not that species; the fructification has not been observed in Britain or on the Continent, and if found, it should be brought to notice. It is figured in the *Gardeners' Chronicle* (vol. xv., N.S., pp. 466, 467). This or another species found in the State of New York should be hardy in spite of the above experience. *Marsiliaceæ.*

Brasenia peltata.—A rare plant in cultivation, and not very easily grown. In the Cambridge Botanic Garden it does best in an intermediate house. A twenty-four-sized pot is made to hold water by stopping the hole at the bottom with clay; loamy soil is filled in to about three inches from the rim, and the space above is kept filled with water. The plant is fixed in the soil, and the leaves float on the surface. This is the only species, and it is found in North America, the West Indies, and Australia. It is also known as *Hydropeltis purpurea*. The leaves are roundish, peltate, and the flowers are small and reddish. It flowers but rarely. *Nymphæaceæ.*

Ceratopteris thalictroides.—A beautiful Fern of elegant form and splendid deep green colour. It is of annual duration, and though the fronds are proliferous, so that small plants might be established for preservation through the winter, it is much the best to raise from the spores every spring. They are produced in great abundance, and quickly germinate. They may be sown in any soil, and the pot should stand to within half an inch of the top in water at a temperature of from 70° to 85°. Very soon the pot may be sunk a little below the water, and as soon as the plants can be handled, they should be removed in little clumps to six or eight-inch pots, three or five in each. One shift into a large pot may be given afterwards, and it may be sunk by degrees several inches below the surface of the water, in the tropical aquarium. Native of the tropical and sub-tropical regions of Asia, Africa, America, and Australasia.

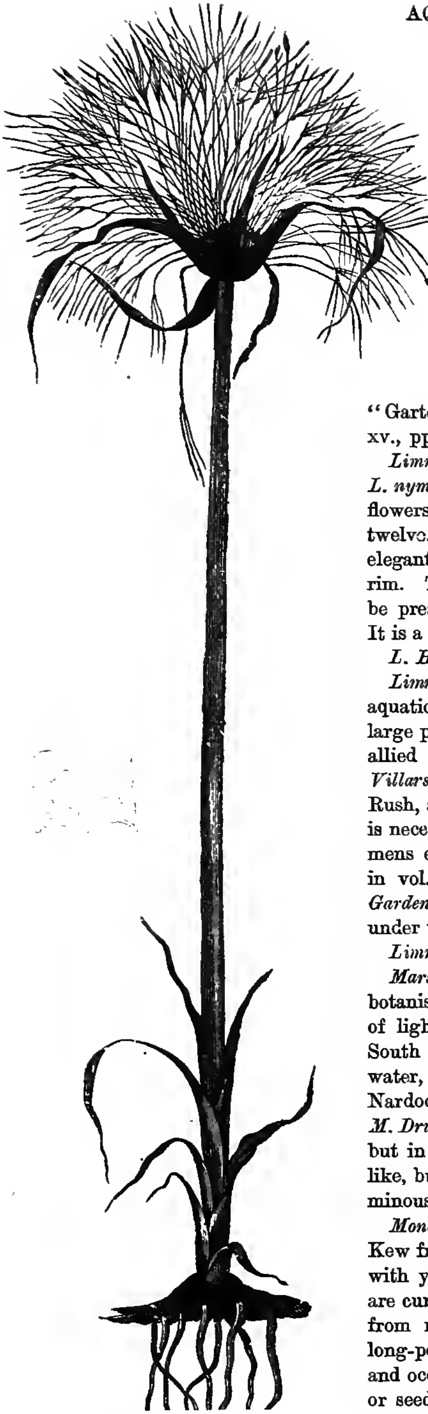
Cyperus papyrus (*Papyrus antiquorum*), the Paper Reed.—The magnificent plume-like heads on stems eight or ten feet high are remarkably handsome, and many together have a fine effect. It is this plant which yielded the substance used for writing upon by the ancient Egyptians. The root-stock is creeping, and for the most vigorous growth it should be planted but little above the water, though it will submit to some dryness, and fine plants may be grown in ordinary pots or beds, if water is given copiously during the season of growth. It may be increased by division, but useful small plants are obtained numerously from a root-stock, if it is taken up and laid on wet soil. Native of Sicily, Syria, and tropical Africa. An excellent account is given in the *Gardeners' Chronicle*, with an illustration (vol. iii., N.S., pp. 78—81). *Cyperaceæ.*

Eichornia azurea.—Among its cultivated congeners this is the showiest. It has the habit of our British Bog-bean, and from the long and stout leafy stems the flowers are produced in spikes forming pyramids of delicately mauve-coloured blossoms, each with a dark centre. The petals are exquisitely fringed, and the upper petal has a bright yellow spot. The leaves are of roundish outline, supported on slightly swollen stalks, and reach a diameter of seven inches. The stems root at the joints, and the plant is propagated by separating moderately short pieces. Young plants are most convenient for keeping through the winter. At Oxford this kind has flowered well out of doors in summer, but it does not always flower in this situation, though it grows freely. In *The Garden*, vol. xvii., p. 220, a coloured plate of it is given as *Pontederia azurea*. It is figured in the *Botanical Magazine*, tab. 6487. Native of tropical America. *Pontederiaceæ.*

Herpestes reflexa (Hort.) = *Myriophyllum proserpinacoides.*

Eichornia crassipes.—This is a well-known inmate of gardens, supposed formerly to be the species last mentioned. It is very different in habit, and will grow entirely without soil, floating on the surface of the water by means of its immensely swollen leaf-stalks. The leaves of each specimen are tufted, and from these short-stemmed individuals long runners are sent out, producing new plants in every direction, and for some time they are connected by living stems. It is of greatest interest as a floating plant, but in this condition it does not flower. It does sometimes flower when growing on mud, but the petioles are then lengthened, and they lose the characteristic swelling which enables the plants to swim. An individual growing or placed in a jar is illustrated in *The Garden*, vol. xvii., p. 220. It is known also as *E. speciosa* and as *Pontederia crassipes*. Tropical America.

Euryale ferox.—Though far from being comparable with the Victoria in splendour, it is of somewhat the same character, and is worth growing, as it occupies much less space. The flowers are comparatively small and uninteresting, but the leaves have a decided individuality; they are nearly three feet in diameter, purple below, where many strong spines are situated, and above, dark green in colour, with purple veins, the entire surface curiously puckered into rounded elevations. The cultivation is precisely that of the Victoria, except that the plant need only be grown in a pot, and may be sown a few weeks later. It is a native of Bengal and other parts of


CYPERUS PAPYRUS

India, and is cultivated for its root-stock and seeds. *Nymphæaceæ.*

Hydropeltis purpurea = *Brasenia peltata.*

Limnobium (*Trianea*) *bogotense.*—A floating plant with the habit of *Eichornia crassipes*, but it is very much smaller, and the leaves are not erect, but float on the water, the leaf-blades in this case being spongy and buoyant. They are nearly round, an inch long, and three-quarters of an inch broad, arranged in pretty rosettes. The flowers appear in summer, but they are unisexual and quite inconspicuous. This plant is known also as *Hydromystria stolonifera*; it belongs to the *Hydrocharideæ*, and is closely allied to our British Frogbit. It is a native of the northern part of South America. An illustration will be found in Regel's "Gartenflora," plate 980, and also in the *Gardeners' Chronicle*, vol. xv., pp. 466, 467.

Limnocharis flava.—This is very distinct from the better-known *L. nymphæoides.* It has broadly-ovate leaves with long stalks, and the flowers are produced on tall, erect stems, which bear from two to twelve. The flowers are pretty, though not large, and the plant is elegant in appearance. It is easily grown in a pot submerged to the rim. Though perennial it is apt to die, and the seeds should always be preserved. There is a figure in the *Botanical Magazine*, tab. 2525. It is a native of tropical America. Better known as *L. Plumieri.*

L. Humboldtii = *L. nymphæoides.*

Limnocharis nymphæoides.—One of the best of floating stove aquatics. It forms a sheet of pretty, round, light green leaves, and large pale yellow flowers are produced in profusion. Though not an allied plant, it has much the general appearance of our native *Villarsia* or *Limnanthemum nymphæoides.* It is allied to the Flowering Rush, and belongs to the same tribe of the *Alismaceæ.* Some warmth is necessary for its preservation during winter, and moderate specimens established for the purpose are most convenient. It is figured in vol. lx. of the *Botanical Magazine*, and there is a cut in *The Garden*, vol. xii., p. 255. Native of South America. Usually grown under the name *L. Humboldtii.*

Limnocharis Plumieri = *L. flava.*

Marsilea.—The plants of this genus are of greater interest to the botanist than to the horticulturist. They are all easily grown in pans of light soil standing in saucers of water. *M. quadrifolia*, a native of South Europe, is grown at Cambridge submerged in large glasses of water, and so treated the fruits are freely produced. *M. macropus* is the Nardoo of Australia. There are several other kinds in cultivation, and *M. Drummondi* is one of the prettiest. These plants are allied to Ferns, but in appearance are remarkably different; the leaves are Clover-like, but four-leaved, and the fructification resembles a small leguminous pod. They are found in all quarters of the globe. *Marsileaceæ.*

Monochoria cyanea.—This is a beautiful kind recently introduced to Kew from Australia, where it is native. The flowers are deep blue, with yellow stamens, in loose spikes of about ten. The flower-stalks are curiously sheathed by those of the leaf, so that the spike emerges from near the base of the leaf-blade. The leaves are ovate and long-pointed, supported on long stalks. It has a creeping rhizome, and occupies but small space. Increase may be effected by division or seeds, and the pot in which it is grown may be just submerged. The genus is closely allied to *Eichornia.* Two other species deserving of culture, also with blue flowers and similar in character, are *M. hastata* (*M. hastæfolia*) and *M. vaginalis*. Both are natives of tropical Asia. A variety of the last, *M. Korsakowii*, figured by Dr. Regel in the "Gartenflora," is a native of China and Japan, and is perhaps hardy.

Myriophyllum proserpinacoides.—This is a most lovely foliage plant, and of the easiest culture. In summer it does well out of doors, and survives our milder winters. The flowers are quite inconspicuous. Its leaves are produced in whorls of four, they are oblong in outline, and are divided, feather-like, into many narrow segments. The habit of the plant is creeping, and the shoots are extremely graceful. Cuttings root with the greatest facility. It has been known as *Herpestes reflexa*, but that name was ventured upon before the plant had flowered. It belongs to the *Haloragaceæ*, and is a native of Chili, though it was introduced from Brazil, where also perhaps it is native.

Nelumbium luteum (Golden Swamp Lily).—Of the fine plants which most tax the skill of the cultivator this is one of the finest, and no water-plant better deserves the skill that can be brought to bear upon it. It is difficult to cultivate except under just the right conditions, and when it does flower the blossoms are smaller than they are in the wild state. Those who know *N. speciosum* can conceive what this is like, as it differs most conspicuously in the colour of the flower, which is similar to that of a Maréchal Niel Rose. The wild flowers are ten to twelve inches in diameter, and have been compared to a semi-double Pæony; they have a delicious perfume, and when half open are like balls of gold. They are poised on tall stems, among leaves of striking character, in the form of immense discs, one to two feet in diameter, supported on erect stalks attached to the centre below. It may be grown successfully under glass, but although the winters of its habitat are colder than ours, we fail to grow it out of doors from the fact that we have not its hot American summer. At Cape Cod it was grown from seeds, and flowered in three years, in a shallow mill-pond, where the ice freezes to one foot in thickness. To grow it in our country, a house lower in temperature than the tropical aquarium is necessary, especially so perhaps as regards the water, which should not exceed 70°, or 75° at the highest. In the Cambridge Botanic Garden it has grown and flowered in a tub fourteen inches deep and two feet three inches wide at the top, standing on a shelf close to the light in the Cactus House. Seven flowers were produced in succession in 1884. The soil in this tub is eight inches deep, and consists of two parts fibry turf, one part rotten cow-dung, and one part rough sand. The sand should be rubbed up or thoroughly mixed with the dung, in order to finely divide the latter, for complete incorporation with the loam. Three tubers were planted early in April, and in July the result was about three dozen leaves and five flowers in different stages at the same time. In the Jardin des Plantes I have seen it growing about three feet high above water in a kind of well, which in winter is covered with glass. It is only in the South of England that its culture is worth attempting out of doors, and then probably a rough glass structure would greatly assist growth in summer. The tubers will not survive frost; but in water of proper depth they would be safe from it. Mr. F. Miles had this plant in his pond through the winter of 1881–82 without injury. Seeds germinate readily, but it is not easy to make the young plants form tubers, by which alone they can survive the winter. The hard testa of the seed must be cut through before sowing, or they will remain unaffected for a length of time. Of course, naturally, the seeds fall into water or mud, and probably never get so exceedingly hard and dry. It is figured in the *Botanical Magazine*, and an illustration will be found in *The Garden*, vol. xx., p. 501. It is wild in many parts of North America, chiefly in the South and Western States, and is sometimes called the Wampapin Lily. An interesting account will be found in the *Gardeners' Chronicle*, vol. xvii., N.S., p. 2. *N. jamaicense*, which grows freely in the cooler parts of Jamaica, is a form of this species. The genus forms a section of the *Nymphæaceæ*.

Nelumbium speciosum (the Sacred Lotus).—The splendour of this Old World species has made it remarkable from ancient times to the present, and fortunately there is no difficulty in its successful cultivation. At Kew it is finely grown in the small corner tanks of the Water-lily House, and it has also been well grown in large pots. To these tanks, which are not heated, water is admitted from the central basin during the season of growth, and it is allowed to run off for the resting season, but the mud is never dry. It is covered with water in the summer to the depth of only a few inches. The leaves reach a diameter of more than twenty-eight inches, and the stalks attain a height of four and a half feet, or more. Stems bearing the obconical seed-vessel have been measured seven feet high. Sound and complete tubers are easily transplanted, but there is some difficulty in establishing plants from seed. If the hard coat of the seed is cut through or chipped a little, they germinate very readily; but it is generally found at the end of the season that no tubers have formed, without which the plants cannot survive the winter. The soil recommended for *N. luteum*, with rather less manure, is used also for this. The winter temperature should not go below 45°. There are several good varieties.

N. aspericaule may be regarded as an improvement of the type; the variety *album* is a white-flowered Indian form. The flowers of *N. caspicum* are pure white, tipped with rose.

N. Leichardtii is a desirable form, native of Queensland, which has not yet been introduced, though attempts have been made by means of seeds.

As a species, *N. speciosum* is found throughout India, China, Japan, in North Australia and Queensland, the Malay and Philippine Islands, Persia, and the Caspian Sea. It is now extinct on the Nile, to which, probably, it was introduced. An illustration is given in the "Guide to the Royal Gardens of Kew;" there is a cut in *The Garden*, vol. xix., p 213, and it is figured in the *Botanical Magazine*, as well as in several other botanical works. In the "Treasury of Botany" will be found an interesting account of the plant with regard to its associations.

Nipa fruticans. — Though quite as ornamental as many other Palms that are cultivated, it is rather more of botanical interest than horticultural value. The leaves are pinnatisect, and of handsome outline, but the colour is yellowish-green and unhealthy looking. It is now placed near *Phytelephas*, the Ivory-nut Palm, but it has also some features of the *Pandanaceæ*, in which order it has been placed. The nuts of a similar plant abound in the tertiary formations at the mouth of the Thames, but this is a native of the salt marshes and coasts of the Indian seas. Importation is effected by means of germinating seeds or young plants in a Ward's case. The seeds soon lose vitality if kept dry.

Nymphæa.—Nearly all the kinds of this lovely group are easy to grow, and there need be no garden having a warm house without some of the best. Such a house as the Water-lily House at Kew, with its large circular basin, may be instanced as offering all the convenience necessary, and failing a proper tank some may be grown in tubs half filled with soil. In any case light is an essential, and the plants should never be much shaded by Palms or other ornamental specimens. The best soil is good loam, enriched with cow-manure, and the mixture is better if stacked some time before use. Light soil should not be used. In a proper aquarium the plants are grown usually in large pots, which may be sunk rather deeply if there is plenty of room. If there is not much room, the tops of the pots should be kept about six inches below the surface of the water, and then the leaves do not spread so widely. It is often convenient to drain off the water of the tank and gradually dry off the tubers for the winter; but this is not the best treatment. The better plan is to keep them in water all through the year. If it is more convenient to dry off the tubers, as much care as possible should be exercised to make it a gradual process, but with all care some loss may be expected. The tubers may remain in the soil they grew in till March, when it is the proper time to re-pot them in pots as large as will be necessary for the season, because they cannot well be again re-potted. The temperature of the water generally should be about 70° to 75°. Seeds may be imported dry, or in bottles of water, and tubers at rest in damp moss will survive a long journey.

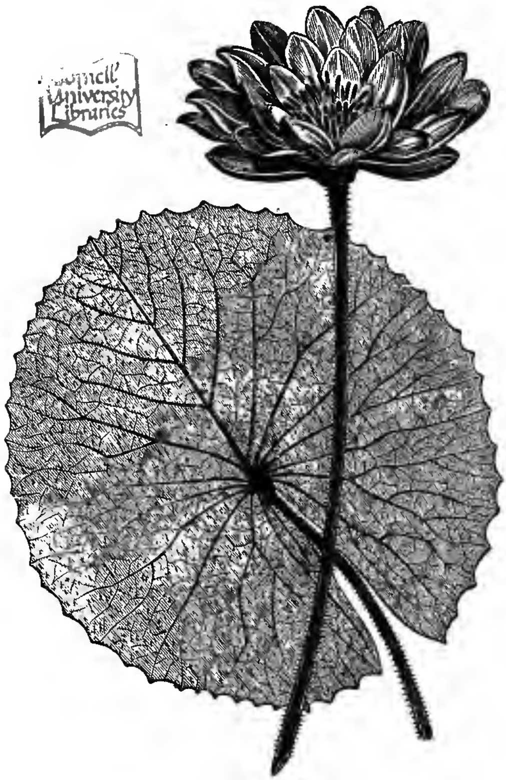
NELUMBIUM SPECIOSUM.

N. ampla.—A beautiful free-flowering kind, with white flowers, which open in the morning and close at mid-day. They are sweetly scented. The leaves are nearly round, and are deeply notched, green above, and deep red below. Native of Jamaica and St. Domingo.

N. flava.—This is a new introduction, and the only kind which can truly be termed yellow. It is nearly, if not quite, hardy, but no good result has been obtained out of doors. In habit, it is unlike that of the other species; it seems not to be tuberous, and it forms long creeping stems, so that it will not submit to the drying-off system. It requires to be kept growing in a cool house during winter, and in spring it may be potted with the other kinds. Out of doors it should be planted in deep water to be safe from frost. A plate will be found in *The Garden*, vol. xxiii., p. 334. Native of North America.

N. gigantea.—Of the blue-flowered Nymphæas this is the finest, though, under cultivation in this country, its flowers have not reached the large dimensions described of its native growth. It is described as very variable, with flowers white, rose, and purple, as well as blue, varying in diameter from six inches to one foot. It requires a tropical temperature, and should be grown in rich soil. The crowns, it is said, should be two feet deep in the water. The flowers remain open all day, and it is the only blue-flowered kind of which that can be said; the petals are of porcelain-blue, and opening wide, display the bright yellow stamens. The leaves are of large size, and the edge turns up, forming a rim like that of the Victoria. A picture by Miss North is in the North Gallery at Kew; it was figured in the *Botanical Magazine* some years ago, and a plate will be found in *The Garden*, vol. xxiii., p. 334. Native of Australia, where it is the only species.

N. Lotus (the Sacred Egyptian Water Lily).—This is a tropical species of many forms, in colour varying from pure white to deep scarlet, and in foliage also varying considerably. *N. Devoniensis*, a hybrid, with scarlet, sweet-scented flowers, is one of the finest of all Water-lilies, and was raised at Chatsworth from the variety *rubra*, and the type. *N. Sturtevanti* is a new American variety raised from the last. *N. Ortgiesiana*, a fine free-blooming kind, was raised from the varieties *rubra* and *dentata*. It resembles *N. Devoniensis*, but the petals are striped with deeper scarlet. *N. Boucheana* was raised from the parents which produced *N. Devoniensis*, but it is lighter in colour. The variety *rubra* was introduced from the East Indies, and the fine white-flowered variety, *dentata*, from Sierra Leone. These include, perhaps, all the best varieties, but there are others. They mostly require tropical treatment. *N. Ortgiesiana*, I found flowering out of doors, a few years ago, at Bonn. The species is found in the South of Europe, the Nile regions, Indian Archipelago, and Madagascar.

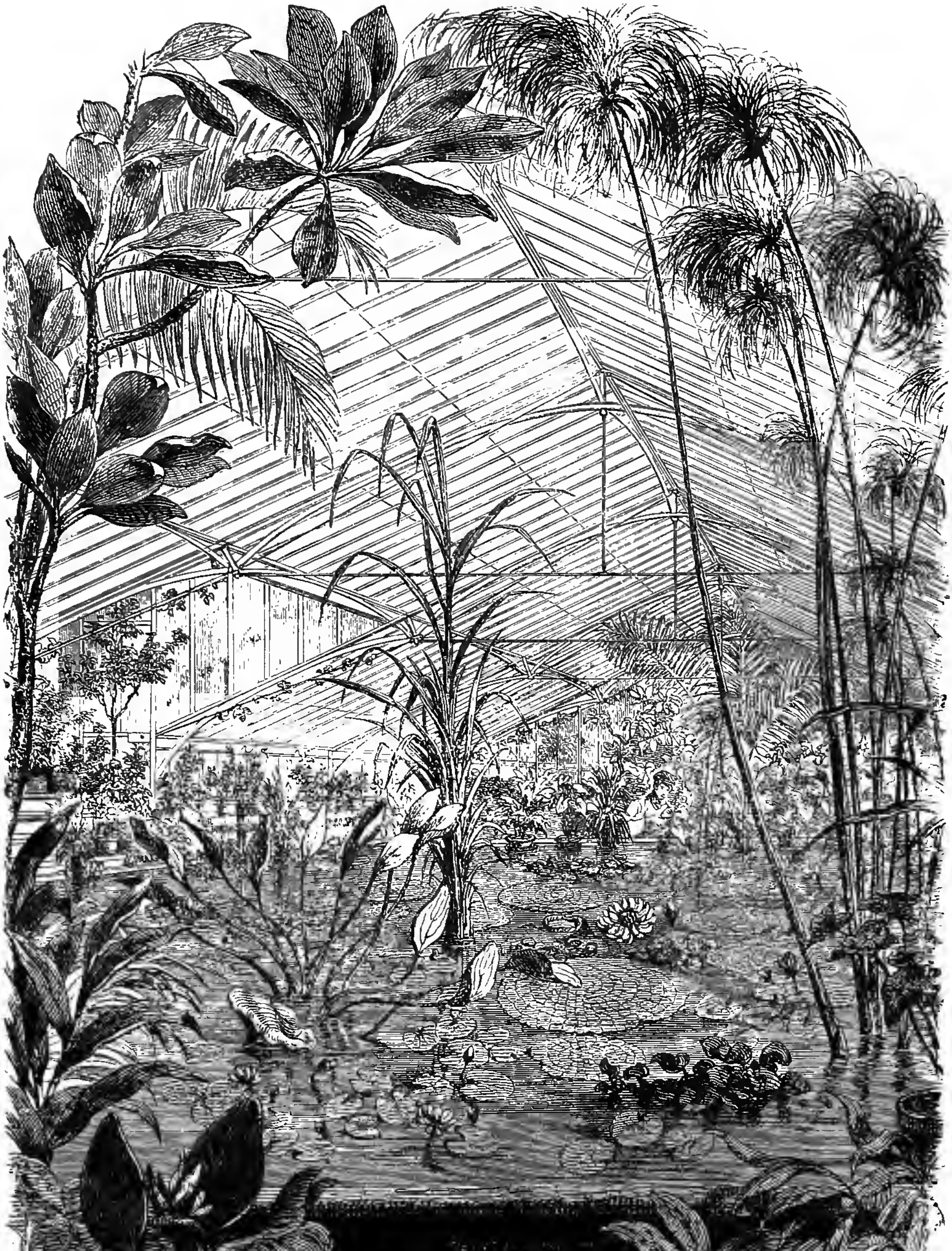


NYMPHÆA LOTUS.

N. pygmæa.—A very small species, but extremely pretty, with small, dark leaves, and numerous white flowers. It is a native of China and Siberia, and was found by Sir Joseph Hooker, in the Khasia Hills. It requires only protection from frost, but it might be found quite hardy from its colder localities. Another kind, *N. nitida minor*, is sometimes believed to be cultivated for it. *N. nitida* is a variety of the North American *N. odorata*.

N. Rudgeana.—The flowers are yellowish-white, and it is the only species besides *N. flava* with an approach to yellow colour. They open late in the evening, and are sweetly scented. It is generally grown as *N. blanda*. *N. amazonica* is a form of this. Native of Jamaica, Guiana, and Brazil.

N. stellata.—There are several distinct varieties of this species, which may be said to include all blue



Victoria Regia and other Aquatics at the Jardin des Plantes, Paris.

Nymphæas, except *N. gigantea*. The type is a fine plant, with sweet-scented flowers, the petals azure-blue, passing into darker colour near the tips. Of the varieties, *N. cærulea* is the common Cape Water-lily, and one of the best. Its flowers are deep blue and fragant, the filaments of the stamens are yellow, and the anthers dull blue. The leaves are shining green above, and are blotched with purple below. *N. cyanea* is a variety less fragrant than most Water-lilies. *N. Daubeneyana* is a very free-blooming variety of garden origin; it grows rapidly, and has the peculiarity of producing young plants from the leaves at the base of the blade. The flowers are pale blue and sweet-scented. *N. versicolor* has flowers of blue, white, purple, or flesh-coloured. Others belonging to this species are *N. capensis*, *N. scutifolia*, *N. micrantha*, *N. madagascarensis*, and *N. zanzibarensis*. The latter is one of the finest of all Water-lilies in cultivation; it has purple-blue flowers which remain open during daylight, a longer time than those of other forms of *stellata*. Its flowers are sweetly scented, and they are said to be nine inches across. This group is found from India to South Africa.

N. thermalis.—A fine species, with close resemblance to *N. lotus*, from which species it may be distinguished by the absence of hairs beneath the leaves. The flowers are large, white, and sweet-scented; they open in the afternoon, and remain open all night. Native of Hungary.

Ottelia ovalifolia.—A new introduction at Kew, received by seeds from Australia. The general appearance of the plant, and the leaves and flowers, have resemblance with *Limnocharis nymphæoides;* the leaves are six inches long by two inches broad, with petioles nine inches to a foot in length, and the flowers are described as pure white, with reticulate nervation, blotched with deep crimson at the base of each inner segment, which measures one and a half inches long, by two inches broad. It is a handsome plant, well deserving of culture. There is another species with this (*O. tenera*), endemic in Australia. The genus belongs to the *Hydrocharidaceæ*, and is allied to the Frog-bit.

Ouvirandra fenestralis (the Water-yam, Lattice, or Lace Leaf).—A singularly beautiful plant, the leaves of which, it may be said, are formed only of veins, tissue between them being so reduced as to leave holes. The leaves radiate from the crown, and float just below the water; they are oblong in form, rounded at each end, and vary from nine to fifteen inches in length, and from two to six inches in breadth. The lattice is formed of several veins parallel with the midrib, and connected by numerous cross-veins like the steps of a ladder. The length of the petiole is regulated by the depth of water. The inflorescence is forked, as in its near ally, Aponogeton, and the flowers are small and scarcely coloured. This and *O. Bernieriana* were introduced from Madagascar by the Rev. W. Ellis, and he gives in his "Three Visits to Madagascar," an interesting account of the first, with a good plate. Success in growing this plant may be expected if, with careful attention, two essential points are attended to. These are, dense shade and pure water. It does well in rather a wide range of temperature, and success has been attained in peat and in loam. It is best grown in a tub or pan (about two feet wide and one foot deep), so that the purity of the water may be easily secured. The tub may be placed on the north side of a house where the sun's rays can never reach it – it has done splendidly at Kew under a bench on the north side of a partition in the stove—but I have never seen this plant flower well except when near the glass, shade at the same time being provided for. Dense shade almost prevents the growth of confervæ, which is so injurious. The best and most natural soil is loam, with an addition of sand, and a little leaf-mould; pot-culture is best, and the crown of the plant should be a little above the rim, and two or three inches below the water. Every day rain-water should be poured in from the rose of a pot, and if the water is drawn off at any time, exposure of the plant must be avoided. Seedlings come up freely when the plant flowers well, and it is safer not to divide the old plants, though this may be done successfully. *O. Bernieriana* appears to be lost to cultivation. It differs from *O. fenestralis* in having the meshes nearly or quite filled up and smaller, the leaves being longer, narrower, and brighter green in colour. It is less ornamental. The flowers are rose-coloured. Both these are figured in the *Botanical Magazine*. The so-called *O. Hildebrandtii*, which we have not seen, introduced to Berlin six years ago, is an Aponogeton. (See *Gardeners' Chronicle*, vol. xi., N.S., pp. 110, 149.) *Naiadaceæ*.

Papyrus antiquorum = *Cyperus papyrus*.

Pistia Stratiotes (the Water-lettuce).—A favourite floating weed which extends rapidly by means of runners; it is sometimes found difficult to preserve during winter, but the reason is usually want of sufficient light and heat. It sends down masses of feathery roots, which do not require soil, but if they reach it the plants grow much larger, though they become less attractive. The plants form rosettes of wedge-shaped, pea-green, hairy leaves. Common in the tropics. *Aroideæ*.

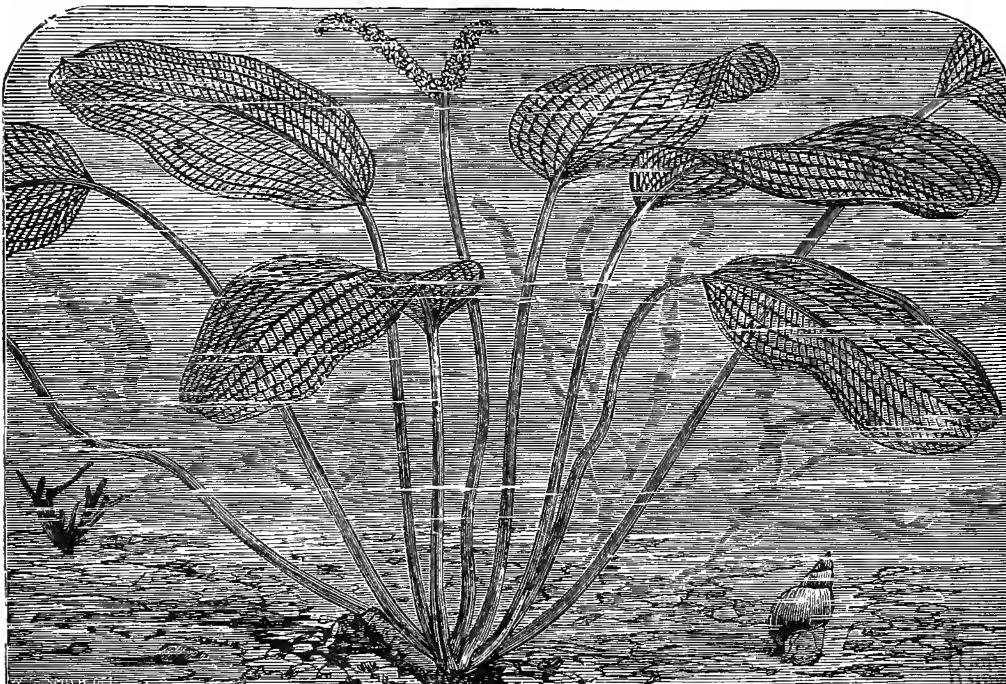
Pontederia azurea = *Eichornia*.

Pontederia crassipes = *Eichornia*.

Sagittaria montevidensis.—A free-flowering and beautiful plant of recent introduction. The leaves are as large as those of the Arum Lily, and it produces spikes of large white flowers with a maroon blotch at the base of each petal. They have been compared to some species of *Calochortus*. It has developed very finely, producing a profusion of flowers, in one of the mud beds in which the Nelumbiums are grown at Kew. It is raised easily from seeds. Native of South America. *Alismaceæ.*

Salvinia natans.—This is an extremely pretty and interesting small aquatic, which floats on the water, and can be grown in any small vessel with mud in the bottom. The leaves are oval, bright green, thickly set on the upper surface with warts and bristles. There are numerous pill-like fruits on the dissected leaves below the rhizome; there are no true roots, but these leaves resemble them, and serve the same purpose. The plant is annual, and the mud over which it grows must be preserved, as it contains the spores which produce a new crop the next season. It is figured in the *Gardeners' Chronicle*, vol. xv., N.S., p. 466. Native of the South of Europe. *Marsileaceæ.*

Trapa natans (the Water-caltrops).—An interesting annual with pretty rosettes of toothed leaves, broadly-ovate in shape, and provided with a swollen stalk. The flowers are inconspicuous. It produces curiously horned fruits, which are supposed to resemble the Caltrops of ancient warfare. They are the Jesuit's Nuts of Venice, and are called "Chataigne d'Eau" by the French. This and other species are used for food, the nuts being ground into flour. In cultivation, good seeds are not produced, and they require to be imported in damp moss. It may be grown in a tub with soil in the bottom, and in warm water out of doors it grows well. The species above mentioned is European. Others, as the two-horned *T. bicornis*, the "Ling" of the Chinese, might be introduced. Illustrated in *The Garden*, vol. xxiv., p. 557. *Onagrarieæ.*



THE LATTICE PLANT (*Ouvirandra fenestralis*).

Trianea = *Limnobium.*

Vallisneria spiralis.—This is specially suited for small aquaria. It has long narrow grass-like leaves, and is interesting by the curious manner of its fertilisation, and by its conveniently showing intercellular circulation under the microscope. It must be submerged, and it grows with great facility, but the male plant appears more delicate than the female, as it is sometimes lost. It is bright green in colour, but in strong light turns nearly red. The female flowers have long stalks, and reach the surface of the water, and are curiously pollenated by the breaking away of the male flowers from the base of the plant; they then float to the surface and are wafted to the females. It is a native of Southern Europe, and is found in the Lakes of Ticino in Switzerland. Another species is found in Australia. *Hydrocharideæ.*

Victoria Regia (the Royal Water-lily).—This is well known as the most magnificent of aquatics, and as forming one of the great attractions at Kew and Regent's Park every summer. Its immense foliage and lovely gigantic flowers entitle it to all admiration. The leaves are usually about six feet in diameter—sometimes six feet eight inches—with a bold turned-up margin, and the flowers measure about one foot, or even fifteen inches in diameter. They first open late in the afternoon, and are then pure white, afterwards turning to a dark rose-colour In order to secure seeds, the fruits when ripening must be enclosed with canvas, and they require to be kept in uncorked bottles of water. The best time for sowing is about the 1st of January; if sown earlier the plants suffer during the dark days of winter, and success is attained only by growing the plants without check from the first; if they are sown later than the above date, time is lost. The young plants must be shifted without injury to the roots till they reach 24-sized pots, which will be about the third week in April, when they are ready for planting out. A mound of soil is made in the centre of the tank, reaching to about eight inches from the highest level of the water, when the plant is developed. Success equal to any I know has been attained with about five cart-loads of soil, composed of loam ten parts, horse and cow manure one part, and peat and sand one part, but in the place of the peat I should use leaf-mould. Richer soil than this, however, is often used. At first the water should be a little more than one inch above the crown of the young plant, and as it grows the level of the water is raised. It is convenient to raise young plants every year, but the Victoria is not an annual, and it has been made to flourish in Paris for three years. The water should be kept at a temperature of 85°, and a fresh supply must be let in every day. Air must be given freely, but with caution, in order to avoid chill. This plant varies in some particulars, and it would be interesting to get seeds from various localities, as it is possible that distinct forms might be obtained. The seeds are roasted and eaten. Native of the Amazon basin, and of the rivers of Guiana and La Plata. *Nymphæaceæ.*

MANURING IN THEORY AND PRACTICE.

By John J. Willis.

PREVIOUS to the middle of last century, chemistry as a science can hardly be said to have had existence, so we may fairly conclude that, prior to that date, horticulture as an art, whatever assistance it may have received from other sources, was prosecuted independently of any aid from chemical science. During the last fifty or sixty years, however, chemistry has applied much of its force to the investigation of the constituent elements of the organised bodies of plants, and to an examination of the processes which go on in them during their life. Of what do these bodies consist? Whence do they acquire their component parts and their sustenance? What changes must the latter undergo in the living organisms of the plants in order to yield them nourishment and produce growth? Whence are we to draw our supply of those agents which, according to our present ideas, are destined to become the principal lever of horticulture?

These are some of the main inquiries which, by the aid of modern chemical research, we shall endeavour to answer, and from observations and experiments made in the field and in the laboratory, to deduce principles which may be more or less applicable to the requirements of the practical gardener.

Such principles, we trust, will explain useful practices and confirm their propriety. They will also help to account for contradictory results, and will point out the circumstances under which this or that practice may most prudently and most economically be adopted. Armed with the knowledge of such principles, the gardener will go among his plants as the physician goes to the bedside of his patient—prepared to understand symptoms and appearances more clearly than he has done before, and to adopt his practice to circumstances which have never before fallen under his observation.

There is a saying, somewhat common among those who affect to despise or contemn chemistry as a help to the horticulturist, to the effect that "a chemist would make a very poor gardener." Very possibly this is true, but as well might it be said that an anatomist would make but a poor physician; or that any man possessing one only of the several qualifications necessary for any occupation in life would be but poorly fitted for fulfilling the duties of that occupation. If a man is purely and simply a scientific chemist, the chances are that he would most likely make a very unprofitable business of gardening; and yet Lavoisier, who had certainly no very minute knowledge of the art of husbandry, by following a scientific system dictated by his knowledge of chemistry, is said to have in nine years more than doubled the produce of his fields.

If, however, as is likely enough, a man with a good knowledge of chemistry proved to be an unsuccessful gardener, his failure would be due to the fact of his being unpossessed of a practical knowledge of horticulture, and not because he made himself acquainted with the principles of chemical science; indeed, we have in the above-named case of Lavoisier, and of many others we might mention, good reasons for supposing that a man who had acquired a knowledge of the art would be a more successful gardener than a person knowing as little of practical horticulture, and ignorant altogether of chemical science.

If, then, the results of investigations should tend to explain and enforce good old practices, rather than to put forth those which are new and untried, the utility or even the necessity of the application of science to the improvement of horticulture will not be less evident.

Of What do Plants Consist?—From what we now know of the component parts, and of the sources of the constituents of plants, it is obvious that a knowledge of the composition of the atmosphere, of water, and of the soil, is essential to any right conception of the main features of vegetable economy; and it is of interest to observe that in the year 1610 a student of chemistry, named Van Helmont, asserted what he believed he had proved by reliable experiment, namely, that vegetable life derived its means of support entirely from water. But although water is indispensable to vegetation, from the fact that it supplies a medium for dissolving all those nutritive substances which cannot of themselves become fluid, and because, moreover, its fluid constitution is the means of the formation of the solid vegetable structure (for it is from the juices made liquid by the water that all the solid constituents of plants are built up), yet it was not until the distinguished Henry Cavendish made his discovery of the composition of water that the true use and function of that element in the vegetable world was understood. It is to the collective labours of Black, Scheele, Priestley, Lavoisier, Cavendish, and Watt, we owe the knowledge that common air consists chiefly of nitrogen and oxygen, with a little carbonic acid; that carbonic acid is composed of carbon and oxygen; and that water is composed of hydrogen and oxygen; whilst Priestley and Ingenhousz, Sennebier and Woodhouse, investigated the mutual relations of these several bodies and vegetable growth.

Chemical analysis shows that fourteen elements enter into the composition of plants, which may be divided into *combustible* (volatile) and *incombustible* (fixed) constituents. When a vegetable substance is burnt—as, for example, tobacco—the greater part of it is dissipated, becomes *volatile;* but there remains a white ash. This ash is the *incombustible* or *fixed mineral* portion of the plant burnt, and is found on analysis to contain chiefly the following constituents—potassium, magnesium, calcium, iron, phosphorus, sodium, silicon, sulphur, chlorine, and frequently manganese. The first five elements, although they may form but a comparatively small proportion of the whole plant, are nevertheless indispensable to its very existence.

How greatly these incombustible or "mineral" constituents may vary, not only in different plants, but in one and the same plant when different organs of that plant are taken, may be learnt from the following table:—

Percentage of Ash in 100 of Dry Substance, in Different Plants.

Description of Plant.	In Seeds.	In Stem or Leaves.	In Roots or Tubers.
Cabbage	...	10·8	...
Cabbage Stalks	...	6·5	...
Jerusalem Artichoke	...	28·3	5·4
Beans	3·6	8·0	...
Peas	2·7	6·2	...
Potatoes	...	14·9	4·3
White Turnips	4·0	15·5	6·0
Carrots	10·0	11·0	8·0
Parsnips	...	15·8	6·2
Kidney Beans	4·1	5·2	...

Ashes of Trees in 100 of Dry Substance.

Description of Tree.	In Wood.	In Leaves.	In Bark.
Walnut	2·99	7·01	6·40
Oak	2·50	5·40	6·00
Willow	0·45	0·82	...
Beech	1·40	0·42	6·62
Pine	0·30	0·20	1·79
Elm	0·19	0·12	...
Filbert	0·50	6·55	6·20
Cherry	0·28	...	10·37
Fir	0·14	2·31	1·79

In looking at the preceding table, we cannot fail to be struck with one or two points, which are illustrated very remarkably:—

(*a*) That the quantity of mineral matter contained in the same weight of the different plants we cultivate is most unlike.

(*b*) The different quantity of ash yielded by different portions of the same plant is equally significant. Thus, 100 lbs. of the stems and leaves of the Artichoke give 28 lbs. of ash, while an equal weight of the dried tubers will give less than 5½ lbs. of ash when burnt. Mineral ingredients are abundant in succulent foliage, but are found in small proportions in seeds, wood, and bark; and the nearer we approach to the elaboration of the final products of the plant—the seed—the more constant is the quantity and composition of ash in one and the same species.

(*c*) The timber of freely-growing trees yields but a small proportion of ash, while the leaves, and especially the autumnal leaves, contain a considerable amount—sometimes as much as 20 per cent. of the dry matter or water-free substance.

The leaves which fall in autumn have been found, on analysis, to have lost nearly all their starch, albuminoids, phosphoric acid, and potash, these having been transferred to the stem. By the action of the sun in spring-time, the new buds swell, the sap rises, the starch and other matters deposited in the wood during the previous autumn are re-dissolved, and are utilised by the plant for the production of new growth during the summer.

Ash ingredients necessary to plant-life.—A knowledge of the composition of the ashes of plants is most essential in a practical point of view, as indicating the mineral constituents which particular plants abstract from the soil in order to build up their structure, and as a guide in judiciously selecting the manure most suited to their wants, for it is utterly impossible to attempt producing a plant at all without some ash-ingredients are present in the soil.

The following table shows the percentage chemical composition of the ashes derived from various plants, or separated portions of plants, when burnt:—

Composition of 100 Parts of the Ashes of Plants.

	White Turnips.		Carrots.		Potatoes.			Mangel Wurzel.		Jerusalem Artichokes.		
	Root.	Leaves.	Root.	Leaves.	Tubers.	Stems.	Leaves.	Bulbs.	Leaves.	Tubers.	Stems.	Leaves.
Potash	47·6	28·1	41·46	17·11	61·60	39·53	22·22	46·26	25·00	60·77	38·40	6·84
Soda	8·7	6·0	17·60	8·47	1·00	14·00	5·37	18·20	23·03	——	5·37	5·54
Magnesia	2·6	2·1	5·36	0·89	5·00	4·10	7·78	4·36	9·45	1·30	1·91	1·95
Lime	12·0	34·8	8·86	24·05	2·40	14·85	27·69	5·58	9·36	3·34	20·31	40·15
Ferric Oxide	0·4	0·8	0·32	3·43	0·85	1·34	4·50	0·75	1·02	0·45	0·88	1·14
Phosphoric Acid	10·6	6·7	12·68	6·21	17·67	6·68	13·60	8·10	5.35	16·99	2·97	6·61
Sulphuric Acid	12·3	11·3	6·93	5·08	8·25	6·56	6·37	3·28	7·02	3·77	3·23	2·21
Silica	0·7	1·5	2·00	11·61	1·00	2·56	6·47	4·00	3·25	1·50	1.53	11·25
Chlorine	5·1	8·7	4 79	23·15	2·23	10·38	6·00	9·47	16·52	11·88	25·40	24·31
Total	100·0	100·0	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

A simple inspection of the above results leads to various interesting conclusions. Were the ashes of every plant or portion of a plant the same in quantity and composition, a knowledge of the gross produce in any given case would suffice to indicate the amount of mineral exhaustion that had taken place in the soil. This, however, is anything but the actual state of things. The separate portions of plants differ in their mineral composition fully as much as one entire plant does from another.

Thus we find that, while potash salts predominate most in the under-ground portion of the plants enumerated, lime exists in the largest quantity in the stem and leaf, the above-ground growth. Therefore we find it is to a considerable degree the character or fertility of the soil which determines the vigour of the plant grown, and the relative development of its parts. The proportion of lime varies within very wide limits, being in some plants as low as 1 and in others reaching over 40 per cent. of the ash. From some experiments recently made in Germany on the beneficial effect of lime to plant-growth, it appears that most seeds will germinate without this ingredient being present in the soil; but, although the young pla nts spring up and form their first leaves, they soon become yellow, wither, and die.

How Plants Feed.—Plants obtain the elements of which they are composed partly from the soil and partly from the atmosphere. From the soil they obtain, by means of their roots, all the incombustible constituents which are found in its ash, and nearly the whole of their nitrogen and water. From the atmosphere they obtain, through the action of their leaves, nearly the whole of their volatile matter—the carbon, with small quantities of nitrogen and water.

It was at one time believed that a complete restoration to the soil of the mineral constituents taken out of it by plants would enable them to assimilate or gather in their necessary supplies of nitrogen from the air; but this has been proved by Sir J. B. Lawes and Dr. J. H. Gilbert, in their experiments at Rothamsted, Hertfordshire, to be entirely fallacious.

The following table gives a summary of some of the Rothamsted experiments, which will assist us in understanding this part of the subject:—

AVERAGE PRODUCE PER ACRE OF ROOT-CROPS, GROWN YEAR AFTER YEAR ON THE SAME LAND.

Description of Crop.	How Treated.*	Weight of Bulb.		Weight of Leaf.		Increase by the Manure. Bulb.		Increase by the Manure. Leaf.	
		Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.
Norfolk White Turnips (4 years, 1845—1848)	Without Manure	1	4	0	17	...		...	
	Mineral Manure only	8	1	2	15	6	17	1	18
Swedish Turnips (4 years, 1849—1852).	Without Manure	2	6	0	6	...		...	
	Mineral Manure only	7	17	0	10	5	11	0	4
Swedish Turnips (15 years, 1856—1870)	Without Manure	0	11	0	3	...		...	
	Mineral Manure only	2	6	0	8	1	15	0	5
Mangel Wurzel 4 years, 1881—1884)	Without Manure	4	17	0	18	...		...	
	Mineral Manure only	5	16	1	0	0	19	0	2

AVERAGE PRODUCE PER ACRE OF CEREAL CROPS GROWN YEAR AFTER YEAR ON THE SAME LAND.

Description of Crop.	How Treated.*	Grain in Bushels.	Straw in Cwts.	Increase by the Manure. Grain in Bushels.	Increase by the Manure. Straw in Cwts.
Barley (34 years, 1852—1885)	Without Manure	$17\frac{1}{2}$	$9\frac{7}{8}$	...	...
	Mineral Manure only	$23\frac{1}{2}$	12	6	$2\frac{1}{8}$
Oats (5 years, 1869—1873)	Without Manure	$19\frac{7}{8}$	$10\frac{3}{8}$	...	...
	Mineral Manure only	$24\frac{1}{2}$	$13\frac{3}{8}$	$4\frac{5}{8}$	3
Wheat (34 years, 1852—1885)	Without Manure	$13\frac{1}{8}$	$11\frac{1}{4}$	...	...
	Mineral Manure only	$15\frac{1}{4}$	$12\frac{7}{8}$	$2\frac{1}{8}$	$0\frac{5}{8}$

These results show that while a certain amount of increase in growth is obtained by the annual application of a manure composed exclusively of mineral constituents, it is entirely inadequate to force a full average crop of either roots or grain, and that in the case of the root-crops, which were all grown upon the same land, the accumulation of minerals in the soil by the yearly dressing did not assist the succeeding crops in obtaining a larger supply of nitrogenous constituents, either from the soil or from the atmosphere, for in each succeeding stage of the experiment the increase obtained over and above that yielded without manure was less than in the preceding period.

* Mineral manure always composed of sulphate of potash, soda, magnesia, and superphosphate of lime.

In the foregoing experiments phosphoric acid was applied in the form of superphosphate of lime, and Ville says that "phosphates fill two distinct functions in plant-growth—they aid themselves in the nutrition of the plant, and determine the beneficial action of the other mineral ingredients. Their function is therefore more important than that of the other mineral constituents, since to their own peculiar action is added a secondary derived effect, that of determining the assimilation of all the other mineral ingredients."

As all crops taken from the land remove a greater or less amount of plant-food, it is clear that, if healthy plant-growth is to be maintained, soils must be provided with available mineral constituents from external sources; for as each species of plant requires a certain amount of mineral matter for its development, it follows that unless a soil is capable of furnishing this supply the plants will either not flourish, or will refuse to grow at all.

We now come to the *combustible* or volatile constituents of plants. These are made up of five chemical elements, and comprise carbon, oxygen, hydrogen, nitrogen, and sulphur. Without these five important elements no plant is ever produced; they are, however, distributed in very different proportions. Thus, plants dried at a temperature of 212° Fahrenheit yield of—

Carbon, nearly one-half by weight.
Oxygen, rather more than one-third.
Hydrogen, little more than 5 per cent.
Nitrogen, from $\frac{1}{2}$ to 4 per cent.
Sulphur, from 1 to 5 per cent.

This is further illustrated by the following table:—

Elements.	Clover Hay.	Potatoes.	Peas.	Wheat. Grain.	Wheat. Straw
Carbon	47·4	44·0	46·5	46·1	48·9
Oxygen	37·8	44·7	40·0	43·4	38·4
Hydrogen	5·0	5·8	6·2	5·8	5·3
Nitrogen	2·1	1·5	4·2	2·3	0·4
Ash, including Sulphur and Phosphorus	7·7	4·0	3·1	2·4	7·0
Total	100·0	100·0	100·0	100·0	100·0

Warington, in his "Chemistry of the Farm," states that "the carbon, hydrogen, and oxygen form the cellulose, lignose, pectin, starch, sugar, fat, and vegetable acids which plants contain. The same elements, united with nitrogen, form the amides and alkaloids; and further, united with sulphur, the still more important albuminoids, which are essential constituents of all plants."

Sources of Plant-food.—Leaving out of consideration such exceptional cases as those brought to light in Darwin's beautiful investigation on insectivorous plants, and also the sources of the organic substance of fungi, and, perhaps, of some forced horticultural productions, it may be stated that the source of the carbon of vegetation generally is the carbonic acid existing, in very small proportion, but in large actual amount, in the atmosphere.

The assimilation of carbon by plants is effected by a very simple process. Carbonic dioxide, formed by the union of carbon and oxygen, is absorbed by the leaves of plants, in the substance of which it is decomposed, the carbon being absorbed by the plant, whilst the oxygen is set free. This succession of effects is carried on without interruption, but with variable intensity, up to the time of flowering. As soon as the flower is in bloom, and the young seed begins to develop, the growth of the plant gradually lessens, and soon stops completely, and the flower, instead of absorbing carbonic acid into its substance and drawing in light and heat, like the foliage, absorbs oxygen, sets free carbonic acid, and radiates heat.

To convey a more definite idea of what is accomplished by vegetation in the assimilation of carbon from the atmosphere, may be quoted the results of some direct experiments made by Sir J. B. Lawes and Dr. J. H. Gilbert at Rothamsted.

In a field, which has now grown wheat for forty years in succession, there are some plots in which not an ounce of carbon has been returned to the land during the whole period. Yet, with purely mineral manure, an average of about 1,000 lbs. of carbon is annually removed, and where a given amount of nitrogenous manure is employed with the mineral manure, an average of about 1,500 lbs. per acre per annum more is obtained; in all, an average of about 2,500 lbs. of carbon annually assimilated over an acre of land without any return of carbonaceous manure to it.

The source of the hydrogen in plants is water; the water, being sucked up from the soil by the roots of the growing plants, is in part decomposed within their cells, and the resultant elements combine in some peculiar way with the carbon absorbed by the leaves to form sugar, starch, cellulose, and the other proximate constituents.

With regard to the sources of the element nitrogen, the explanations are by no means so simple. The quantity of this element overlying every acre of the earth's surface amounts to over 32,000 tons; yet it is probable that the majority of the plants cultivated in the garden or on the farm are incapable of directly assimilating from this immense store of the free element the nitrogen they require to build up their structure during growth. This subject is now occupying the attention of many eminent agricultural chemists.

Experience in both the field and the laboratory has proved that cultivated plants obtain a portion of their nitrogen in the form of ammonia, nitric acid, and other nitrogenous compounds, from the soil through the medium of their roots. The product of the putrefaction of one generation of plants and animals thus affords a supply of available food for its successors.

Nitrogen, in combination with hydrogen, forms ammonia, and the substance with which most horticulturists are acquainted as ammonium salts is obtained from an extinct vegetation which probably existed ages ago.

GLASS STRUCTURES AND APPLIANCES.

GREEN-HOUSES AND CONSERVATORIES.

THE chief distinction between a pit and a green-house may be defined thus: the latter has a door in the end or side for admission into the interior, and a path a part or the whole of the way round it, and the former has not. The difference between green-houses and conservatories have also been thus described:—In the green-house the plants are mostly grown in pots and are portable, in conservatories they are planted out and permanent. Neither of these definitions is anything like exhaustive or complete. For we have sunk houses in plenty as like pits as two peas are like each other, and deep pits with paths, doors, &c., in plenty; green-houses also abound in which not a few of the plants, and all the climbers, are planted out, as well as conservatories in which all the plants are portable.

Purpose rather than pots or planting-out has been adopted by some as the ground of difference between these two styles of houses. Green-houses have been looked upon as places for growth and the safe storage of plants, rather than their display for pleasure or ornament; and no doubt very many of them are so grievously overcrowded, that plant-stores would more fitly describe them than either green-houses or conservatories. But then not a few of the green-houses, and those among the smallest, are often the most brilliantly furnished and tastefully arranged. Size is a more uncertain basis of distinction than purpose, and to assert that the small glass-houses were green-houses and the big ones conservatories, would cause a revolution along the leads and balconies, where tiny green-houses abound, and generally glow into the full and blushing importance of suburban or town conservatories.

Form and design have also been adopted as distinctions. Plain lean-to houses have been called green-houses; span, curvilinear, ridge-and-furrow, domed, or other ornamental-shaped roofs, conservatories. But it is easy to show that such distinctions have no more solid foundation than the others, and cannot be upheld.

Finally, temperature has been assumed to establish and maintain the difference between green-houses and conservatories, and generally it may be admitted that there may be a difference of from five to ten or more degrees between the two classes of houses in large places: the green-houses when filled with such plants as Heaths being kept about 40° in winter, while the conservatory, filled with a mixture of flowering plants, ranges from 45° to 50°. But then where the green-house is furnished with flowering plants, these differences of temperature disappear or may be reversed. Generally, however, conservatories are more ornamental than the majority of green-houses, while not a few of the best of both, for purposes of culture or of ornamental display, are as plain and unpretentious as bald brick or stone walls and simple glass roofs can make them.

Great changes of taste have occurred in reference to ornamental structures for plants. While these were designed by or under the sole control of architects, they were mostly ponderous to a fault, and occasionally beautiful and even magnificent. Now these latter qualities are expected to be found in the plants rather than in the houses that enclose them. Possibly this reaction, like many more, has run to excess, not a few modern green-houses and conservatories being more like mere skeleton screens, than substantial plant-structures fit to battle for years against the vicissitudes and severities of our fickle climate.

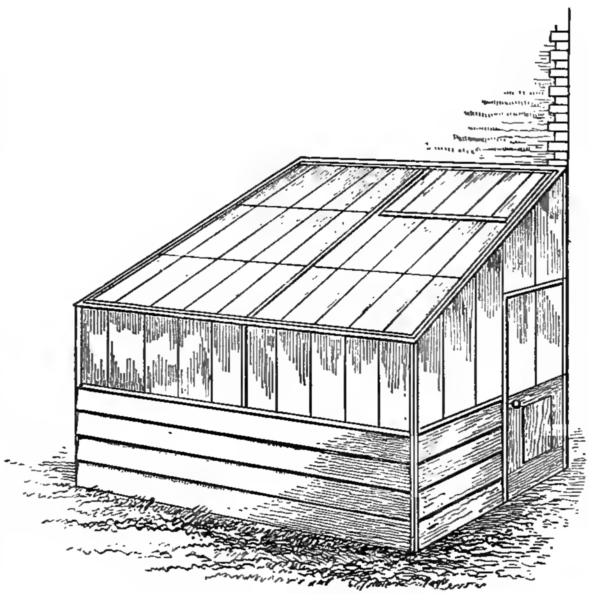


Fig. 20.—The Mechanic's Green-house.

Neither is a due regard to ornamental effect a matter to be neglected in the erection of green-houses and conservatories. Especially should this have careful consideration when such are attached to or are erected in close proximity to dwelling houses. Great structural beauty and due congruity with surrounding objects are quite compatible with the highest cultural merits in glass-houses, and not a few town and villa residences, and even great country mansions, are much marred and spoilt by the meanness and meagreness of the green-houses and conservatories abutting against them. A little more art in design, somewhat greater solidity of base, more congruity and harmony with the style and size of the house, a happier choice of a site, would often convert the disfiguring conservatory into a telling ornament in itself, as well as a perpetual source of pleasure and delight through the plants which it securely shelters and nurtures into the highest beauty and perfection.

But while all this is true, and deserves the careful consideration of every one about to erect a green-house or conservatory, it must also be added that not a few of either (for there is really no essential distinction between them) of the best-furnished houses, are mere glass cases barely rising above the dignity or the size of common three-light pits, either placed in their usual positions on the ground, or set up endways against the walls of a house.

Small Green-houses.—Such structures naturally develop into what may be properly called the Mechanic's Green-house (Fig. 20). Very often actually made from a few lights, eked out and patched up houses may also be seen in the mechanics' gardens of Nottingham and other large towns, in which wonderful feats of successful culture are achieved under difficulties that may well seem insuperable to ordinary zeal and energy. But their owners have mostly something like a mania for gardening, and not a few of them have been known to rob their beds of

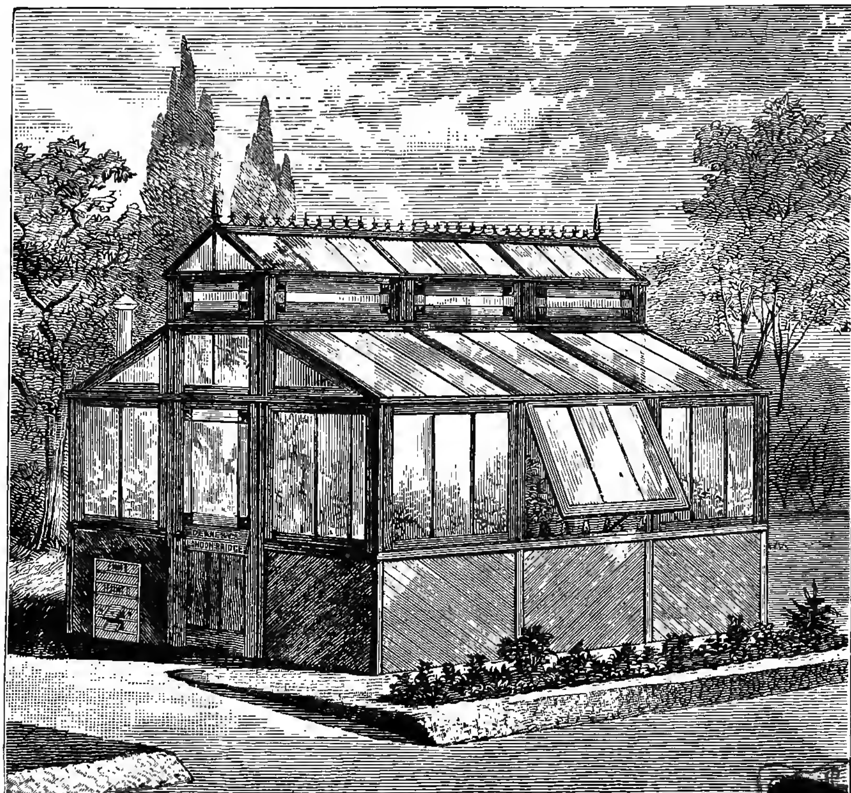


Fig. 21.—A Ready-made Standard Pattern Detached Conservatory.

with a little extra wood and glass, such a structure is within the reach of any one who has the least practice in using tools, a few shillings to purchase materials, and the leisure and skill at command to put them together. Even if the skill to construct it be wanting, the total cost is a mere trifle for the pleasure afforded.

Such small plain houses will probably soon be as common against cottages as the balcony conservatories are now against the better kinds of suburban or town residences. Immense numbers of tiny detached plant-blankets rather than their pot-plants should suffer from sudden frosts. These tiny houses are mostly built by the tenants, and are consequently of all shapes and sizes; and the numbers of plants that are safely stored and successfully cultivated in them is incredible to those that have not seen them. Their money value ranges from one pound to five, few of them, perhaps, being worth more than the latter sum; but their worth as industrial relaxations, and educational and cultural forces, is beyond all calculation. No duke or prince could be more proud of his conservatory, that may cover an acre or more of ground, than the Nottingham artisan is of his green-house, a yard wide, two yards long, and a yard and a half high. True, he may have to stoop to enter such a structure; but he has stooped to conquer nature to good purpose, and his prodigies of successful culture are to him and his family and friends perpetual sources of the highest and purest pleasure.

Almost all the forms of small green-house lend themselves readily to development. The lean-to form of Fig. 20, somewhat extended, becomes what may be called the average amateur green-house, as seen almost everywhere, and which needs no further description. It may only be well to observe that these lean-to houses are sometimes constructed without lights in the front wall, which should then be made somewhat lower; as, although such shaded sides have their uses, they must not be carried too far. As a rule, this construction is probably adopted in order to confine the glazed work as much as possible to plain "lights," or sashes, resting at once on the lowered front wall. This reduces the cost of building by nearly one-half; and if the roof is glazed, on stout sash-bars or light rafters, and roof-lights or sashes also dispensed with, as is often done, the labour and cost of erection will be still further lessened, while the house may be made even more strong, and will prove quite as durable and efficient.

The regular or hip-spanned house is equally capable of enlargement, and lends itself more readily (considering the cost) to some amount of ornamentation. Being generally detached and quite independent of any other building, such are made in various standard patterns by most of the horticultural engineers. Many of these can be obtained cheaper than they could possibly be erected specially; and of course they are all constructed to be set up on sills as "tenant's fixtures." *This latter is a point that must always be attended to unless there is a special agreement with the landlord*, who can otherwise claim every sort of glass-house or other structure which may be erected upon his land. Fig. 21 represents an excellent design by Messrs. Deans and Co. of these ready-made conservatories; and it may give a useful idea of their cost to state that this pattern can be delivered free to any place in England, size ten feet by eight feet, by ten and a half feet high to the lantern, including the staging and heating apparatus, for £25. Any greater length of such standard patterns can usually be had for somewhat less than a proportionate increase, no additional ends being required.

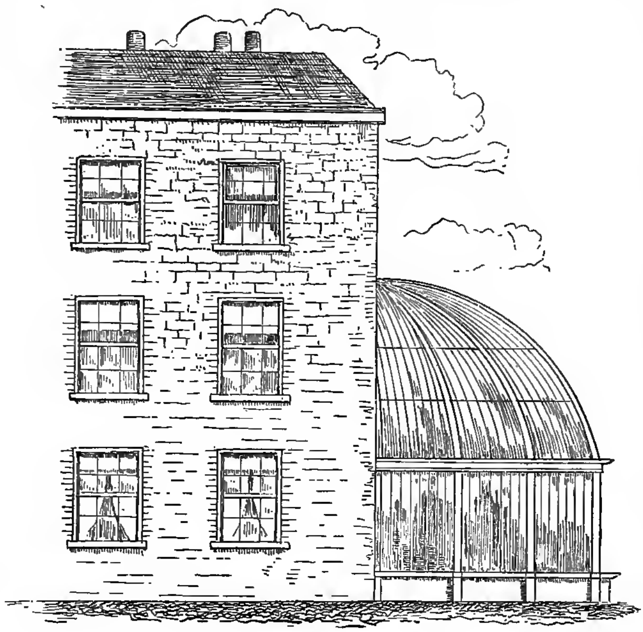


Fig. 22.—Small Ornamental Attached Conservatory.

Attached Conservatories. — Small conservatories built against cottages or houses are, however, far more easily managed than those quite detached, especially if the latter are placed in the garden at a considerable distance, as is the case with so many of those around Nottingham and many other large towns. The "attached" conservatory also admits of a considerable amount of ornamentation at little additional cost, especially with the aid of some sort of domed or curved roof (see Fig. 22). Where the curved or domed roof is so steep as to necessitate the bending of the glass, this form of roof is expensive. But by following easy gradients as in Fig. 22, straight glass may be used, and most of the advantages of bent glass are obtained without extra cost.

Domed conservatories, such as the attractive design by Messrs. Weeks and Co., shown in Fig. 23, are, however, most effective when placed at some little distance from the dwelling-house, but still, as is shown in the engraving, brought within reach of the drawing-room in all weathers by means of a glazed corridor. The cost of such a design as this, though of course more than that of the preceding, will, owing to the principle of construction, be found moderate for the substantial and chaste appearance produced.

Glazed Corridors or Passages.—Conservatories, of whatever form or size, are, in fact, robbed of full half their charms when they are detached from the dwelling-house, their usefulness decreasing as their distance from the dwelling-house increases. Even in the case of large conservatories or green-houses, such as Fig. 24, which structural, cultural, or other reasons may require to be removed to a considerable distance, glass verandahs or glazed passages, from four to six or more feet wide, according to their length, are invaluable as connecting links between the dwelling-house and the conservatories. Such structures, skilfully clothed with climbers, and furnished with a single row of well-grown plants on one or both sides, not unfrequently become more beautiful than the far more pretentious plant-house to which they lead. By some such contrivance the conservatory proper—that is, the house mainly devoted to the artistic display of plants in bloom—should be brought within easy and comfortable reach of the drawing or sitting-room in all weathers. Such charming resorts, pleasing at all times, are doubly enjoyable when the weather without is so wet and inclement as to render out-of-door exercise unpleasant or impossible.

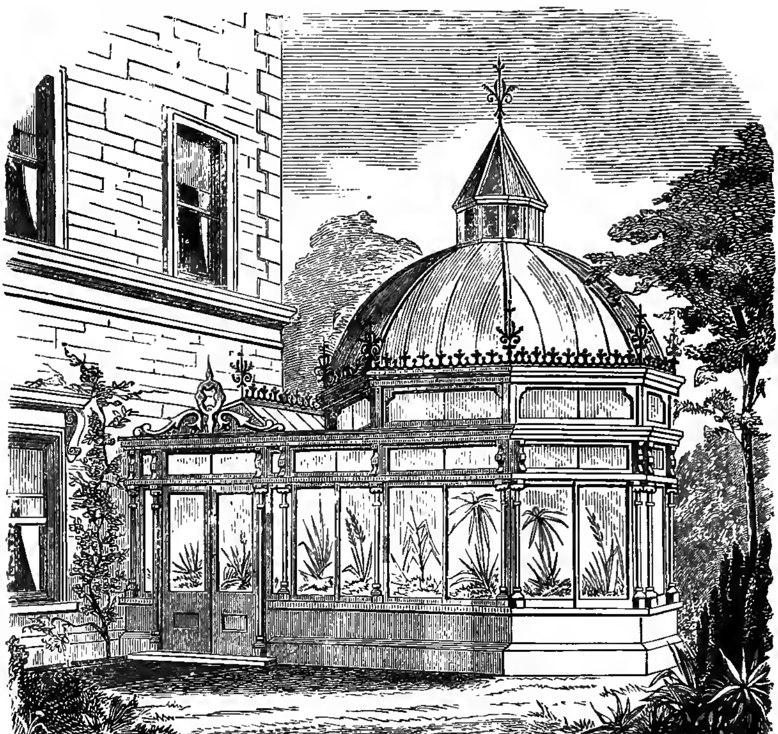


Fig. 23.—A Semi-attached Domed Conservatory.

Large Conservatories.—As these are nearly always built to skilled designs or under skilled superintendence, it would be useless to enter into any detail about them. But one general remark should be made. Whereas in most of the smaller conservatories and green-houses, convenience and capacity of storage are the chief considerations, in larger houses some dignity and grandeur of appearance are imperatively called for by good taste; and a certain amount of direct ornament may add to this, without

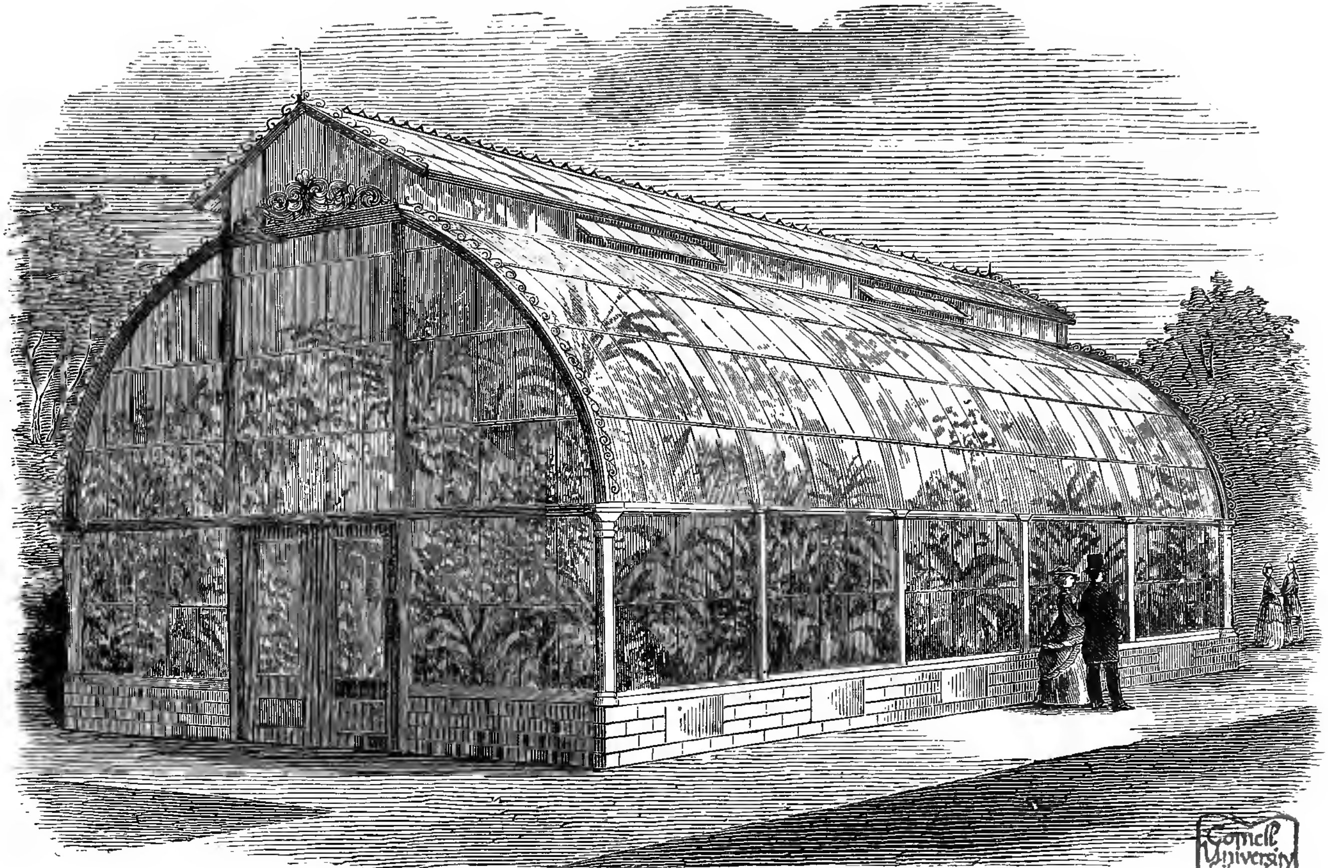


Fig 24.—A Circular Span-roof Conservatory glazed with Flat Glass.

in the least necessarily lessening their efficiency or area for the storage or display of plants.

Still, in the main, the design of the conservatory should be its own chief ornament. In detached buildings there is vast scope for variety of design; but general opinion and practice seem pretty unanimous that some form of circular or span roof is at once the most elegant, strong, and best for cultural purposes. Many such are built of bent glass; but this is by no means necessary, and whether it is employed or not should be governed by the amount of exposure or risk; for such glass is expensive. Very nearly, if not quite, the same effect can be produced by various methods of glazing with flat glass, as can be seen by the representation in Fig. 24 of an excellent design by Messrs. W. E. Rendle and Co. The glazing of green-houses and conservatories will, however, receive separate treatment in a later article of this series.

House-top Conservatories.—Glass, through being so long and so heavily taxed, is still by many of the working classes considered a luxury beyond their reach. On the contrary, it is now among the cheapest of all roofing materials, taking into account its durability; being virtually indestructible, unless in the case of accidents. Small areas, or in fact areas of almost any extent, may be enclosed with glass at less cost than with any other substance. When this fact is generally acted upon by architects, and stout glass is used to enclose portions or the whole of the roofs of houses, a powerful stimulus will be given to horticultural pursuits, and a partial or complete revolution effected in the house-building of the day. Instead of almost universal sloping roofs, and the devotion of the attics to dirt, lumber, the spiders, and the bats or sparrows, flat roofs, partially or wholly covered with glass, would convert the house-tops into covered gardens, or furnish roomy or commanding sites for house-top conservatories. Considering how scarce and dear ground is in or near to crowded towns, and how difficult it often is to find room for the smallest glass-house on balconies or against the house, the acquisition of the whole or part of the area of the house-top for relaxation and gardening, would be an immense advantage to the health and happiness of the inmates.

From the almost universal prevalency of sloping opaque roof, of course such structures have hitherto been rare. But they exist in sufficient numbers to prove the practicability of growing plants, flowers, and oven fruit, to perfection in crowded cities. The examples of good gardening on the leads, balconies, and even areas of the streets of London and other large towns, are most encouraging proofs of how much may be achieved under present difficulties of the most trying character.

Fig. 25 represents a house-top conservatory erected some years ago by Messrs. Barr and Sugden over their business premises in King Street, Covent Garden, but which would be just as suitable for a private house. How ornamental as well as useful such structures may be made, can be seen at a glance, and also how entirely independent of any local advantages in the way of ground-space or situation.

But the chief merit of house-top conservatories is, in fact, that they utilise so much space hitherto almost worse than wasted, and convert it into the most useful sanitary and horticultural purposes. Areas of immense extent may thus be won for the most delightful pursuits and the most healthful and pleasant recreation. Almost any man may thus not only be enabled to sit under his own Vine and Fig-tree, but to enjoy this seemingly impossible luxury on his own house-top, none daring to make him afraid. House-top conservatories can readily be warmed from the kitchen boilers or other fires of the dwelling-house. Glass-houses such as that here shown, or even on a less pretentious scale, would do much to add to the beauty of detached houses, terraces, squares, or streets, instead of proving the disfiguring blots and eyesores against good taste or congruity, which have long been characteristic of so many of our conservatories attached to dwellings.

Storage, Staging. — It is astonishing what enormous numbers of plants can be kept and grown in small houses by a series of shelving and other skilful expedients. Occasionally in tall houses, shelf upon shelf rise one above the other from floor to roof-apex, and by the skilful use of saucers under the pots, and careful watering, the plants take but little harm. But the most common and profitable method of storage is that of stages, proceding in regular gradations from near the floor of the house in front, to within a foot or so of its top, like the steps of a stair with exceptionally fleet risers and narrow steps. (See Fig. 26.) On this primitive and still common stage, the plants can be placed very closely together and yet not over-hang in any way.

In larger houses the centre stage (see Fig. 27) and side shelves are the most provident of space. In span-roofed houses, the centre stage has mostly one broad shelf in the centre, and two or more on either side, at lower or different levels. In lean-to conservatories, the centre stage is as it were cut in two, and is only half the size. More frequently, however, the greater height of the back wall allows of one or more shelves being added to the stage.

The stages, until a comparatively recent date, were mostly made of wood. This answered well while it lasted, which, however, was not long, owing to its being so constantly subjected to being wetted and dried. It is this alteration of condition that proves so fatal to the durability of timber. Kept either dry or wet, good red deal, which was mostly used for plant-stages in green-houses, lasts a long time in good condition. But no care in use nor in painting could keep plant-stages from the trials of a daily, almost an hourly change in their conditions. Hence their rapid decay, and consequent expense and risk of accidents.

These have led to the general selection of iron bearers, with slate, stone, or concrete shelving and staging, in lieu of wood. Beautiful castings of chastely designed patterns, from six inches to two feet or even a yard wide, may now be had for the purpose of plant-staging. The frames of the stages are also formed of cast or wrought iron resting upon stone. Such shelving may be said to be practically indestructible, and is as porous as it is durable.

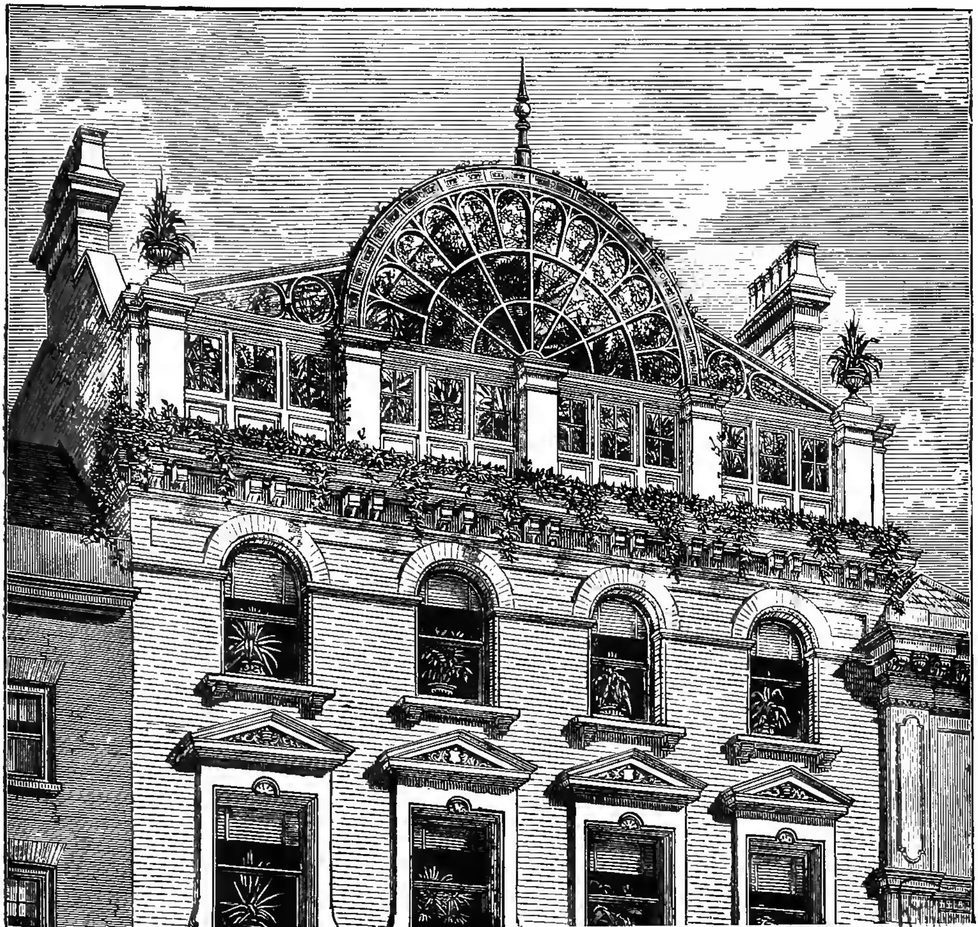


Fig. 25.—A House-top Conservatory near the Strand.

Slate, stone, and concrete slabs have also been used on the iron framework or bearings of stages. These, however, are said by cultivators to be cold, and they are certainly not popular.

Plants do not thrive so well on slate, stone, or concrete stages as on those of iron or wood. Nor is the reason far to seek. Unless pretty freely perforated with holes the water cannot obtain free egress from the pots. Hence the beginning of stagnation at the bases, followed quickly by sour soil, yellowish leaves, and an enfeebled state of health among the plants.

The remedy, at once simple and practical, for this objection to slate, stone, and concrete for plant-stages has been found in the easy expedient of covering the area or level surfaces of such substances with a layer, a few inches thick, of such porous material as smashed charcoal, oyster or other shells, spar, flints, or other substances, coarse gravel or taffa. The best and cleanest of such porous substances is spar broken fine enough to make the pots stand level on it. This not only allows of the free and spontaneous egress of water from the base of the pots, but looks exceedingly well in contrast with the verdure of the leaves and the beauty of the flowers, and also forms an impregnable barrier to the approach and attack of slugs and other pests from between the plants.

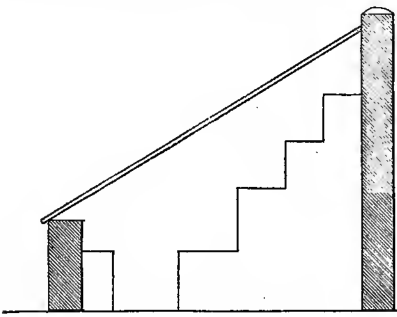


Fig. 26.—Staging in Lean-to House.

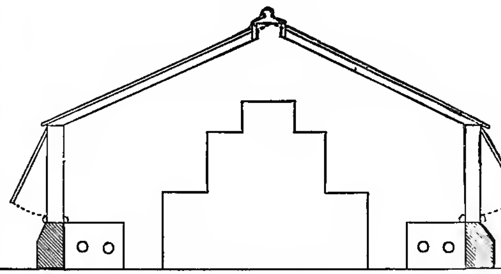


Fig. 27.—Staging in Span-roof House.

Portable Staging.—Without greatly diminishing the storing or cultural area of conservatories, very much may be done to break up the monotony and stiffness of the larger formal stages and lines of walks by using a few portable iron or other stages. These should be of handy sizes so as to be moved with ease, and of such height as to suit the size and area of the conservatory. They may be had of ironmongers and horticultural sundrymen, of all sizes and designs. Their great merit consists in their portability and the facilities they afford for grouping plants in the most favourable mode and place to insure cultural success and artistic effects. With one or more such stages posted and furnished with taste, a new element of freshness and beauty would be introduced into most conservatories, and the endless sameness and monotony which broods like a nightmare over so many of them would be abolished.

Such portable stages permit of taller and larger plants being grown in smaller houses, and, indeed, in those of all sizes. Considerable space might be kept clear between the stages, and in the largest of these one or more tall Camellia, Azalea, Rhododendron, Orange-tree, Tree Fern, Palm, or other such plants could be placed, adding, by their contrast, a distinct beauty to the effect of the masses of shorter plants grouped on the portable stages.

Open Floors.—Another good and effective way of furnishing conservatories is to dispense with stages or shelves altogether, and arrange the plants wholly on the floors of the houses. In such cases the whole floor should be paved over with tile, stone, or ornamental iron grating of chaste pattern, and sufficiently strong to bear the weight of the plants, and the heavy and constant traffic that their proper culture and full enjoyment necessitate.

In most of these cases the front shelves are retained. But in others the shelves are removed and the front of the conservatory is clothed with Tea Roses or choice climbers, as well as the roof; and where most of the finer specimen plants are planted out, it is better and more satisfactory to dispense with all the shelving as well as the staging. In such cases the centre bed and side borders need not be paved nor covered over, but may be converted into borders and beds of suitable compost, that is, mostly a half-and-half of peat and loam, freely mixed with sand for choice green-house plants and climbers. But for portable plants in pots, tubs or boxes, the better plan is to have the whole floor equally well prepared for a promenade or for grouping the plants. This preparation of base affords full opportunity for frequent changes in the arranging of the groups of plants, and the form and area of the walking and enjoying spaces between them.

No plant in pot or tub should ever be placed on the soil of border, or stone or tile floor, without being raised on tiles, pebbles, or some other contrivances, to permit of the free egress of water and to prevent the ingress of worms. More plants are crippled and finally killed for lack of these precautions than by any other means. The mere drainage within pots or tubs, however ample, is almost useless unless the water has free egress from it, which it cannot have when flat-bottomed pots are placed on the firm level surface of the soil, or the more impervious one of a stone or tile floor.

Roofs of Conservatories.—These, it will be already seen, vary as much in form as in size, and that is saying a great deal. So long as they are waterproof, and admit a full amount of light and a sufficiency of air, the matter of form is of less moment than is generally supposed. Most of the almost endless diversity of forms may be brought under three general heads—that of lean-to, span, and curvilinear-roofed houses. The lean-to is the most generally used, as it may be set up against the wall of the dwelling-house, offices, or garden, which is mostly found ready to hand. By raising a front wall up two feet or a yard high, parallel with this, and placing a glass sash about the same height on the brick-work, and joining all together with a wall-plate, the front of such houses is formed. A few rafters spanning the distance from front to back form the framework of the ordinary lean-to conservatory. Of course the distance between the two walls, which may range from four feet to twelve or even more, determines the width of the house, while the disparity of height between the front and back walls measures out its atmospheric area and regulates its angle of inclination. Provided the latter is sufficient to shoot off the water freely, its exact incidence is of less importance than has been generally assumed in most of the text-books.

Most of these dwell at length on the great importance of carefully adjusting the angle of elevation to the latitude of the place, and the consequent directness or obliqueness with which the sun's rays will shine on the roof at any given hour of the day. But all this is somewhat complicated, and is more apt to bewilder or perplex than prove of use in guiding aright the mechanic, or amateur or practical gardener, in search of the most useful angle for his tiny green-house or more imposing conservatory.

Best Angle for the Roof of Conservatories.—This will be found to lie between the ten degrees enclosed within the compass of 35° and 45°, 40° being a good mean for most parts of Britain. The angle is meant as measured from a horizontal line at the height of the top of the front wall. The steeper the angle, the greater in general the amount of light which the roof will absorb or transmit; the flatter, the less. Hence conservatories with a southern aspect may have a flatter roof than those facing the west, east, or north. It is a popular error, however, born and fostered of the days of dear and semi-opaque glass, that conservatory plants will not thrive unless the house faces south, or nearly so. Modern glass of good quality is so transparent as hardly to obstruct any of the sun's rays; and this, with improved methods of construction, enables the cultivator to command a tolerable amount of success in houses of any aspect, unless those due north; and even in these very fine Ferns, Mosses, and other foliage plants may be grown in great perfection.

There are many methods for determining the angle of elevation, but the following table, given by Thompson in the "Gardener's Assistant," and by other authorities, will save all trouble.

Width of House in Feet.	Height of Back Wall above Front Wall, in Feet.													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5	21° 48′	30° 58′	38° 39′	45° 0′	50° 12′	54° 27′	58° 0′	60° 57′	63° 26′	65° 34′	67° 3′	68° 58′	71° 21′	71° 34′
6	18 26	26 33	33 41	39 48	45 0	49 24	53 8	56 18	59 2	61 24	63 27	65 13	66 48	68 12
7	15 56	23 12	29 44	35 32	40 36	45 0	48 49	52 7	55 0	57 32	59 45	61 42	63 26	65 0
8	14 2	20 33	26 33	32 0	36 52	41 11	45 0	48 22	51 20	53 58	56 19	58 24	60 16	61 56
9	12 31	18 26	23 57	29 3	33 5	37 52	41 38	45 0	48 0	50 43	53 8	55 18	57 16	59 2
10	11 19	16 42	21 48	26 36	30 58	35 0	38 39	41 59	45 0	47 44	50 12	52 26	54 27	56 19
11	10 18	15 15	20 0	24 26	28 36	32 28	36 2	39 17	42 16	45 0	46 50	49 46	51 51	53 45
12	9 27	14 2	18 4	22 57	26 33	30 15	33 41	36 52	39 48	43 10	45 0	47 57	49 24	51 20
13	8 44	13 0	17 6	21 2	24 47	28 18	31 36	34 42	37 34	40 14	42 3	45 0	47 7	49 5
14	8 8	12 5	15 56	19 39	23 12	26 34	29 44	32 44	35 39	38 9	40 36	42 53	45 0	47 0
15	7 35	11 17	14 55	18 26	21 48	25 1	28 4	30 58	33 41	36 15	38 40	40 55	43 0	45 0
16	7 7	10 37	14 2	17 21	20 33	23 38	26 33	29 21	32 0	34 0	36 52	39 5	41 11	43 9
17	6 42	10 0	13 14	16 24	19 26	22 21	25 12	27 54	30 28	32 54	35 13	37 24	39 28	41 25
18	6 20	9 27	12 31	15 31	18 26	21 15	23 57	26 34	29 3	31 26	33 5	35 50	37 52	39 48
19	6 0	8 58	11 53	14 44	17 31	20 14	22 50	25 27	27 46	30 4	32 16	34 23	36 23	38 17
20	5 42	8 31	11 19	14 2	16 42	19 17	21 48	24 14	26 36	28 49	30 58	33 0	35 0	36 51

From this it will be seen at a glance that the angle of elevation is a mere matter of width of house, and disparity of height between front and back walls, or in the case of curvilinear or span-roofed houses, between the bases and crown of the arch or apex of span, and their width.

The roofs of conservatories should be kept at a sufficiently low angle for the maintenance of equable temperature, as if the pitch of the roof be too steep it is certain that all the upper portion of the house will be heated to excess during hot weather, and the flowers be quickly exhausted and withered up. This is easily managed in the usual type of green-house roof, but in the case of curved roofs it requires more consideration.

It is found in practice that the pure quadrant form is almost too flat at top and too steep at bottom. The result of this might be the admission of water near the top, and the loss of light and heat at the base of the house. To remove these practical structural defects, and supposing the roof as originally planned to be a full quadrant containing 90°, or equal parts, 35° might be cut off from the base, and 15° from the summit of the quadrant, thus leaving 40° of the best part to form the roof of the house. Supposing the quadrant to be made with a radius of 25 feet, this reduction of its area at both ends would form a house 14 feet wide, and $10\frac{1}{2}$ feet above the. brick-work forming its base. Such a house would be admirably adapted for growing green-house or any other plants, as well as for the cultivation of fruit, as almost every ray of light and heat would be utilised to the uttermost.

Ridge-and-furrow Roofs.—The ridge-and-furrow method of covering roofs is probably of all others the newest, and is as yet but rarely practised. Comparatively little was heard of it in theory or seen in practice until the late Sir Joseph Paxton covered the first Crystal Palace in Hyde Park in this manner, and more lately repeated it on a yet wider scale at the Crystal Palace, Sydenham. It can hardly be said to supersede any other method of glazing, but to be added to them, and to render them yet more simple and efficient. This method breaks up the smooth monotony and the level planes of glass roofs into any number of ridges and furrows, and the ridges can be so placed as to absorb a maximum amount of the sun's warmth and light, not only in the early morning, but also in the afternoon and evening, thus utilising the sun's quickening and strengthening force to the uttermost. As the ridges and furrows are mostly of a uniform size all over the roof, it follows that rafters, and sash or glazing bars, and glass—or the two latter where rafters are dispensed with—may be of uniform size and substance throughout, and may be transferred without inconvenience or confusion: an immense practical advantage in large undertakings. This form of roof also affords rare facilities for strengthening it by ties, ornamental or otherwise, whilst every portion of it is of uniform strength and durability. The ridges if carefully glazed must be waterproof, while the breaking up of the watersheds into innumerable streams reduces the risk of flooding in the furrows or gutters or other portions to its lowest limits.

Best Form of House for Efficiency and Economy.—These two do not always run abreast in the matter of conservatories. The cheapest, however, in the end, where prolonged use is in view, will mostly be those that have most brick or stone, timber, or other opaque substances in their construction. Hence to a great extent the popularity of lean-to houses. The brick wall for the back is generally already in existence, and that is warm, as popularly expressed; that is, it absorbs more caloric and retains it longer than glass. On the same ground, houses with iron rafters or bars are said to be colder than wooden ones. They are really not so if well constructed and carefully glazed, unless in the respect that the iron rafters and bars are smaller in bulk, and much more rapid conductors of heat than wood. To this extent metallic houses cool sooner and under the same conditions to a greater extent than wooden ones: wood being such a slow conductor of caloric that those parts of the conservatory formed of it are virtually impermeable to its passage.

Hence more natural or artificial heat is necessary to raise the temperature to any given point and to maintain it at any given figures, say 45° to 50°, in iron-roofed houses as they are popularly called, than in wooden ones, in curvilinear and span-roofed houses than in lean-to's. But for this extra trouble and cost the cultivator is abundantly rewarded by the larger and purer supplies of natural heat and light enjoyed in houses of the latter class.

Houses admit light in the ratio of their transparency, much more than by virtue of their angle of inclination, and no one can read our LIFE-HISTORY OF PLANTS without seeing that light is to a very large extent the Alpha and Omega of successful cultivation and of plentiful production.

Another claim for the economy of lean-to houses does not stand the test of practical experience. It has been generally assumed that roofs of this form take less glass than the span-roofed house of equal atmospheric area, of regular or unequal span (that is, with the two sides alike in length, or the cool side a half or quarter or any given proportion of the southern or more favourable side). This is not so. With the same angle of elevation, it is found that no more glass is needed to enclose the same area with a span-roof than was required in a lean-to roof. As, however, the two angles must necessarily meet much sooner when starting towards each other than if one only travelled towards a wall at the back of the house perpendicular to its base, it follows that the highest portion of the span-roof, that is its apex, would only be about half the highest point of the lean-to roof at the summit of the back wall. This lowering of the roof and bringing it closer to the plants, and placing the latter all over the house almost at the same distance from the light, is one of the greatest merits of span and curvilinear-roofed houses. So marked, indeed, has been the improvement in the cultivation of green-house, stove, and other plants, since the general introduction of span and other equally light roofs, that the lean-to's are gradually disappearing, to the decided gain of horticulture.

Nevertheless, for certain purposes—such, for example, as the cultivation of Ferns, Mosses, and several foliage plants, especially among the latter being the variegated Begonias of the Rex section—lean-to houses, with somewhat ponderous roofs, often produce better results with less trouble than the more light modern houses. While such Ferns as Trichomenes and Hymenophyllums, Todeas, or other filmy Ferns, can only be grown in houses shaded from every direct ray of sunshine, and with even the entry of strong light partially subdued. Not a few Ferns, however, enjoy the light, and can bear a fair amount of direct sunshine, not only without injury, but with positive benefit.

COMMON GARDEN FLOWERS.

Hardy Primulas.—Of these there is a large and very interesting group, some of them hybrids of the Common Auricula, a large number of them natives of the Alps of Switzerland, while some are from Japan and the East Indies. There are a few that can scarcely be denominated hardy, but they are well worthy of green-house culture. The cultivated Auriculas and the cultivated Polyanthuses are dealt with in a separate series of articles.

We allude to the Common Primrose in passing only for the purpose of saying that it is very common in woods, hedges, and pastures, and that even in an uncultivated state it varies in producing flowers: white, rose, blush, and brownish; and these are alike single and double. The Common Primrose is *Primula vulgaris*, or *P. acaulis*, and Primula is the Latin for very early, and refers to the flowering of the species during the opening season of the year. The name Primrose, as Parkinson observed, was given "because it shows by its flowering the new spring to be coming on, it being, as it were, the first ambassador thereof." It is truly an English flower, and in no other country will it grow so abundantly. Equally abundant is the Common Cowslip, *Primula veris*. It is common in England, chiefly in a clayey or chalky soil; it is rare in Scotland, but found near Edinburgh and in Fifeshire. Cowslip is the name the flower has borne from the earliest Anglo-Saxon times, and probably referred to the sweetness of its perfume. It has been called the Palsywort, and for the same reason that the French name is "Herbe de la Paralysie," the flowers being considered efficacious against nervous disorders. Cowslip-wine is a well-known country compound, and Pope refers to its supposed quality when he prescribes in poetry,

> ——— "for want of rest
> Lettuce and Cowslip-wine—probatum est."

The Oxlip is *P. elatior*, and is the foundation of our fine Fancy or Giant Polyanthuses. The flowers resemble those of the Cowslip in form, but are larger and paler in colour; while the flowers grow in more numerous clusters also. It is comparatively a rare plant, frequenting bushy places, and often difficult to reach when found in the woods, on account of the thorny brushwood among which it grows. Slight local variation is observable in various places.

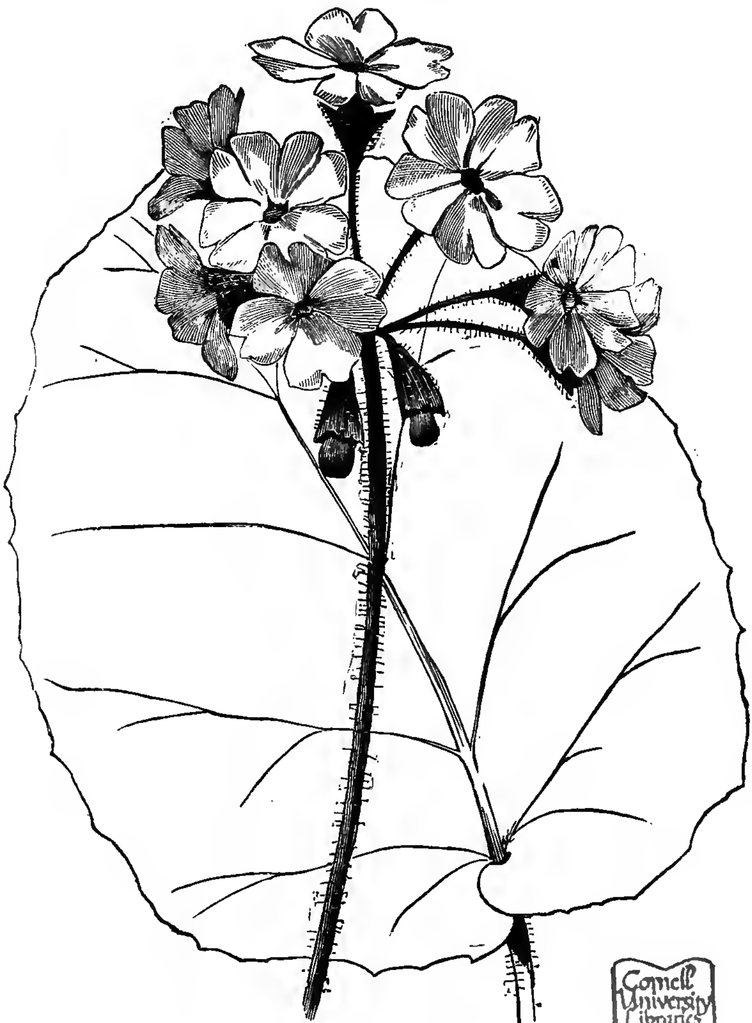
The common form of *Primula Auricula*, or it may be improved varieties of it, is often found in this country. It lives in a wild state on the high mountain ranges of Switzerland, France, Austria, and the Caucasian chain, and has probably a much wider distribution. Possessing a vigorous constitution, and sporting into a goodly number of varieties when raised from seeds, it attracted early attention from lovers of flowers; its more striking variations were perpetuated and classified, and their modern representatives are treated of under the head of FLORISTS' FLOWERS. There is a variety of the Alpine Auricula known as *P. Auricula marginata*. This produces larger heads of fragrant yellow flowers of a deep golden tint. The foliage is thicky covered with a white farinous powder, and margined with a narrow white band. The presence of this powder on the leaves of some cultivated Auriculas, and the entire absence of it on others, is difficult to account for. There is an entire absence of it on the leaves of the green-edged section; but in the cases of the grey edges, the white edges, and the selfs, while it is thickly scattered over the leaves in some varieties, it is not to be found on others.

P. amœna is the Caucasian Primrose, a handsome early kind, with the appearance of the Oxlip; flowers in early spring; purple in colour; small; borne in many-flowered umbels on stiff stems. It should be planted on a warm border, in deep loam and leaf-mould.

P. Balbisi is a somewhat rare species of dwarf growth, and it produces showy golden-yellow flowers.

P. Bellunensis is in the way of *P. viscosa*, but with golden-yellow instead of rose-coloured flowers. It is a very distinct deciduous species.

P. calycina is a somewhat scarce dwarf Alpine species, with large purplish-pink flowers.



A Japanese Primula.

P. capitata is one of the Himalayan Primroses, and appears to be allied to *P. denticulata*. It produces large globular heads of dark maroon-purple blossoms, with distinct yellow eyes, and is a very handsome plant, flowering throughout the summer months. It is somewhat delicate in constitution, and should be grown in pots with the protection of a cold frame, being liable to injury from wet.

P. cashmeriana is, as its name implies, one of the Himalayan group, and produces large capitate trusses of light purple flowers, with yellow centres.

P. ciliata appears to be closely allied to *P. intermedia*, the latter a supposed hybrid between *P. viscosa* and *P. Auricula*. Some hold them to be different, but they are very close together. It is represented by a dwarf, tufted, free-growing type, throwing up trusses of bright reddish-purple flowers like those of an Alpine Auricula.

P. ciliata purpurea and *P. ciliata coccinea* are both very fine varieties; one has bright purple, the other bright red flowers; they are charming subjects for cultivation in pots. There are a few varieties of *P. intermedia*, such as Minstrel, Heroine, Portia, and others that have been raised from seed, and vary in colour, but all charming subjects for pot-culture.

P. Clusiana is a charming dwarf species, with large rich bluish - purple flowers.

P. cortusoides is the Cortusa - like Primrose, a native of Siberia, entirely distinct in appearance from any of the species commonly grown, the leaves being comparatively large and soft, not nestling firmly on the ground like many of the European species, but elevated on stalks two to four inches in length; the deep rosy clusters of flowers being produced on stalks from six to ten inches in height. In consequence of its taller and freer habit, the plant is liable to be much injured and disfigured if placed on an exposed spot or open border; therefore it should have a sheltered position where, while it will not be exposed to cutting winds, it at the same time will not be shaded to its injury. There are a white, a lilac, and one or two other varieties.

PRIMULA INVOLUCRATA.

But this section, charming as the forms are, is quite eclipsed in stately beauty and great variety by the larger group of *P. cortusoides amœna*, but now more properly known as *P. Sieboldi*. The type was at first considered to be a variety of *P. cortusoides*, but is now regarded as quite distinct, being much larger in all its parts, and having noble trusses of beautiful deep rose-coloured flowers. It came to us from Japan, having with two or three other varieties been introduced therefrom; but, like *P. cortusoides*, it is believed to be a native of Siberia. It is worthy of mention that this fine Japanese Primrose was in cultivation in this country for several years before seedlings were obtained from it. But several raisers, both at home and on the Continent, succeeded in raising seedlings, and now there is in cultivation a large group of varieties, all of a most valuable character, placing them in the front of all the hardy Primulas for beauty and effectiveness. They are all of easy culture, thriving in almost any kind of garden soil that is not too wet in winter. But as it flowers early it is liable to be cut off by spring frosts, and therefore we recommend that it be grown in pots in a cold frame, and flowered there, or in a cool green-house. It is a plant that will bear gentle forcing, and for decorative purposes in spring there are scarcely any other plants that can compete with *P. Sieboldi* and its varieties. The creeping roots spread themselves about in the soil, and as the points of these put forth growths, a small clump is soon made into a large one, and by dividing them in autumn, a variety can be largely increased. When grown in pots they should be well drained, and a rich, light, free soil used. After the plants have done flowering the pots should be plunged in cocoa-fibre or cinder-ashes, during the summer, but not allowed to suffer for want of water. They can be divided if necessary about October, and in re-potting the divided pieces they should be placed in small pots, and be buried just beneath the soil, which should be pressed firmly about them.

The following is a selection of the best varieties:—

Alba grandiflora, pure white.	Mauve Beauty, white and mauve.
Beauty, bright red.	Peach-blossom, pink.
Charmer, soft pale mauve.	Purpurea, bright mauve-purple.
Cordelia, pale lavender.	Ruby, deep red.
Exquisite, pale lilac.	Rosalba, rosy-pink.
Fascination, deep lavender.	Violacea laciniata, deep violet.
Gaiety, deep violet-blue.	Vivid, bright magenta.
Hermia, rosy-lilac.	Vincæflora, rich lilac.
Laciniata, deep purplish-red.	
Lilacina, veined lilac.	

P. farinosa is the Bird's-eye Mealy Primrose, a small plant with little blossoms of a beautiful lilac colour, arranged in full clusters like a garden Verbena; the leaves and the stem are covered with a white powder or meal. "No sweeter flower holds up its head to kiss the breeze that rustles over the elevated bogs and mountain pastures of Northern England, and it should be doubly interesting to the British cultivator because it is a true native, found in Lancashire, North Yorkshire, Durham, Northumberland, Westmoreland, and Cumberland, and in some parts of Scotland. It is, however, a local plant. To find it in early summer morning, as one ascends the Helvellyn range for the first time, is to a lover of wild-flowers a great pleasure, and one that will be long remembered" (Robinson's *Alpine Flowers*). It is easy to cultivate in pots, the chief want, whether in pots or in the open, being abundance of water in summer, and where this does not fall naturally it should be supplied artificially. If planted out in the open ground it should be in deep moist soil, and it would be well to cover it with cocoa-fibre or leaf-mould in hot and drying weather.

There is a stemless variety of the preceding known as *P. farinosa acaulis*, a very diminutive form, requiring considerable care in its culture.

P. glutinosa is a beautiful and distinct species, very dwarf and pleasing, and producing brilliant bluish-purple flowers in early spring. It is found on the Tyrolese mountains. It should be grown in pots in a cold frame, or plunged out of doors in a bed of sand.

P. integrifolia is a diminutive Primrose, very common on the higher parts of the Pyrenees, and to be met with in abundance in elevated pastures in North Italy. It produces rose-coloured flowers in early summer. *P. glaucescens* is said to be a deeper-coloured variety of this, and it does well in thoroughly drained peaty loam.

P. involucrata, also known as *P. Munroi*, is a native of the Himalayas, growing on very high elevations on the mountains of Northern India, in the vicinity of water, and bears creamy-white flowers with a yellowish eye. It is a deciduous species, dying down in summer and leaving at the surface of the soil a number of small pea-like tubers. As soon as the leaves have faded, these should have a covering of soil placed over them to prevent them from being washed away by rain. It does well in pots, which, in the growing and blooming season, should stand in saucers of water.

P. japonica is a fine species introduced from Japan, flowering in early summer, throwing up stout flower-stems, carrying many flowers arranged in whorls, but, unfortunately, it is difficult to get many whorls in flower at one time. It is a strong-growing subject, doing well in pots and in the open ground; it makes a conspicuous object on rockwork. There are a few varieties of it, and all can be raised from seed, which they produce freely.

P. latifolia, the Broad-leaved Primrose, comes from the Pyrenees and from various mountain chains of Southern Europe; when well grown it produces from two to twenty violet flowers in a head, borne on a stem. It does well planted out or potted in deep rich loam and peat, and is a remarkably fine species when well grown. It is of a deciduous character.

P. longiflora is related to the Bird's-eye Primrose, but distinct from it, and considerably larger than even the best varieties of that species; the flowers are large, rosy-purple, with long tubes, and musk-scented. It should be planted in a free moist loam.

P. lutéola is a free-growing species, with long lanceolate smooth leaves, bearing bright yellow flowers, and does well in heavy loam on shaded spots. It is a charming subject for pot-culture.

P. marginata is a distinct and attractive species, and is readily distinguished by the silvery margin of its greyish, toothed, smooth leaves, caused by a dense bed of white dust which lies exactly on the edge of the leaf, and by its sweet, soft, violet-rose flowers, appearing in April and May. It is a native of the Alps of Tauria and Dauphiny. It is very free-growing and does well in pots, throwing up many young growths when well established. There are two varieties of this—one named *cærulea*, the other *grandiflora*, both distinct and well worthy of cultivation.

P. minima is the Fairy Primrose, for its size a singularly ornamental kind, with very small leaves, prostrate, and rather deeply notched at the ends; but the flowers make up for the very diminutive leaves, being not unfrequently nearly an inch across, and quite covering the minute rosette from which they spring. It is a native of the Alps of Austria, flowering in early summer, the stem rarely bearing more than one, but occasionally two flowers, rose-coloured, or sometimes white. It does best in the rock-garden, planted in rich moist loam, or in pots in sandy peat and loam.

P. nivea, or *nivalis* of gardens, is the Snowy Primrose, and resembles *P. ciliata* in its dense clusters, but the flowers are rather smaller, and pure white. It is quite distinct in aspect from any other species in cultivation; happily, it is very easy of culture, and may be grown in pots or in the open ground. It flowers in April and May, is a native of the Alps, and is by some supposed to be a variety of *P. viscosa.* This is a charming subject when grown in pots, but should be frequently divided, for it has a tendency, in common with other species, to get somewhat naked about the base of the shoots, and, as these protrude rootlets, the whole plant is likely to go off if not taken up and divided into as many pieces as possible. Every shoot will form a plant, inasmuch as each is usually furnished with little rootlets, which take hold of fresh soil immediately. Many people keep plants of Primulas like this for years in the centre of the same pot, whereas by dividing them, and placing them down to the leaves in fresh soil, much finer specimens may be obtained.

P. Parryi is a very fine and distinct species, bearing charming rosy-crimson flowers, but scarce, and not easy to cultivate.

P. pedemontana is a dwarf species in the way of *P. ciliata*, bearing deep lilac-coloured flowers, and it is a native of the Alps. It is a charming subject for growing in pots.

P. pulcherrima and *P. purpurea* are both very fine forms of *P. denticulata*, or very closely allied to it.

P. rasea is a perfect little gem, and bears heads of brilliant rosy-carmine flowers in early spring; each blossom is nearly an inch across; the leaves are smooth, and of a bright deep green. It does well planted out in rich loam and peat in moist shaded positions, and it does equally well in pots, in good soil. It is one of the prettiest for general cultivation. It is a native of the East Indies. As it seeds freely it is easy to raise seedlings, and some of the varieties so obtained are finer than others.

P. rosea grandiflora is one of these selected seedlings; the flower is larger, and of a deep crimson hue.

P. scotica is the Scotch Bird's-eye Primrose, and is one of the choicest little gems in the British flora. Its rich purple flowers, with large yellowish eye, open in the end of April. It is rather difficult to obtain, unless one has an opportunity of getting it from its native localities in Scotland, in the counties of Sutherland and Caithness, as well as in the Orkney Isles, growing in damp pastures. It must have perfect drainage, and be planted in a soil composed of friable loam, mixed with sandy peat or a little cocoa-fibre, and made perfectly firm.

P. sikkimensis is the Himalayan Cowslip; flowers large, and borne in loose, terminal, drooping clusters, clear light yellow in colour, borne on naked stalks twelve to eighteen inches high. It is a handsome plant when well grown, but being of rather tender character, should be cultivated in pots in a green-house.

P. spectabilis is a pretty rosy-flowered species of dwarf growth, highly effective, and does well in pots in a cold frame.

P. verticiliata is a half-hardy species requiring green-house culture, a species with a free habit of growth, and handsome incaled foliage, producing large whorls of pale yellow, half tubular-shaped flowers. It should be grown in pots.

P. viscosa is the Viscid Primrose, from the Alps and Pyrenees. It is the lovely little Primrose that travellers who visit the Alps in early summer see opening its clear rosy-purple flowers at various altitudes. It is well adapted for rockwork, on which it may be grown in any position, in light peaty soil, or spongy loam, with about one-half of its bulk of fine sand, provided its roots are kept moist during the dry season.

P. Wulfeniana is allied to *P. calycina*, and is an excellent companion to it.

Lastly we have to treat of two new species of comparatively recent introduction, which, though simple in character, are yet exquisitely charming. One is *P. floribunda*, a dwarf, half-hardy evergreen form, presenting the general aspect of *P. verticiliata*, but smaller. It forms tufts of spreading coarsely-toothed leaves, and numerous erect scapes four to six inches high, bearing whorls of clear chrome-yellow flowers, a quarter to half an inch in diameter. It blooms with marvellous freedom, and for a great portion of the year, and it seeds pretty freely; so it is not difficult to obtain seedlings. Quite tiny plants bloom, when the tufts of leaves are barely two inches in diameter. It should have pot-culture in a green-house. This gem is a native of the Western Himalayas from Kumaon to Cashmere.

The other is *P. obconica*, or *poculiformis*, an evergreen species from China, of free robust habit; the leaves large, roundish, and light vivid green; flowers an inch or more across, of a delicate lilac, and under glass almost white colour, borne in clusters on stiff, erect stems. It is a very persistent bloomer, flowering almost all the year round, and when grown in pots makes an excellent green-house plant; it is half-hardy, and impatient of cold and undue moisture.

Slugs are very injurious to Primulas and other plants when grown on rockwork, and such places; and if they find their way into a cold frame, they will prey upon the hearts of the plants, doing great injury in a small space of time. They should be diligently sought for and ruthlessly destroyed.

HOT-HOUSE OR STOVE PLANTS.

BY WILLIAM HUGH GOWER.

INTRODUCTION.

IT will be quite superfluous to enter into details here respecting the construction and fitting of the structure to accommodate the plants to be treated upon under this heading, as these matters will be fully discussed in the articles upon GLASS STRUCTURES AND APPLIANCES now appearing in this work. As we before remarked, however, when referring to green-house plants, the modern span-roof house is the best adapted for the cultivation of good and handsome specimens, although many tropical plants will thrive in a "lean-to" house which would utterly ruin many of the hard-wooded kinds from cooler regions.

The hot-water system of heating plant-stoves is now all but generally adopted, and most plants seem to flourish under the treatment, although since its adoption, and the consequent abolition of the old smoke-flue, sundry old-fashioned plants from hot dry regions seem to have slipped out of cultivation, as if they missed something necessary to their existence which is not supplied under the present conditions. A hot-house or stove for the accommodation of a general collection of tropical plants should be kept as near as possible at a temperature of from 65° to 80° during the summer months, and from 60° to 70° in winter; there should be a division, or a separate house, in which the temperature would range perhaps 10° lower; this is intended for the accommodation of plants from considerable elevations, and will also serve as a resting-place for many of the tropical species when growth is past and they are required to lie dormant for a time.

Stove plants revel in a high temperature and a moist atmosphere, but they require in addition a free circulation of air, and therefore the best manner of ventilation is by admitting the cold air just below the level of the hot-water pipes, in order that it may be warmed before coming in contact with the plants. A certain amount of shading is also necessary during the summer months, for although many of the plants enjoy full exposure to the sun's rays in the open, they cannot withstand them under glass with impunity; but such matters will be treated in other parts of this work.

Tanks for water should be constructed inside the house, and so placed that the water may be kept nearly of the same temperature as the atmosphere, for nothing is more injurious than cold water falling upon the young roots, or tender shoots, of tropical plants.

Tropical plants are much infested with insect pests, and perhaps the most formidable is the mealy-bug. This is a small insect powdered white all over. The female is wingless and devotes the whole of her life to the destruction of plants and the increase of her species, both of which she effects with surprising rapidity. There are numerous specifics recommended for their destruction, all of which are no doubt good, but some require to be used with great caution. The brown-scale is another pest which often keeps company on the same plant with the mealy-bug, and is exterminated by washing, or in the same manner as its friend and acquaintance. Green-fly, yellow-fly, and thrips can be exterminated by fumigation, but if any one plant is continually infested with thrips, it may be taken for granted the temperature is too high, and it should be removed to a cooler place. The red-spider, though very minute, is a dreadful pest, and its appearance is due alone to aridity in the atmosphere, for if the air is well charged with moisture no red-spider will put in an appearance; sulphur mixed with water, and the plants affected syringed with it a few times, will soon eradicate it, but the discoloured leaves will still remain (until they die) as a monument of their visit, and the cultivator's want of care. The very best way to keep plants from falling a prey to these pests is to keep their surroundings sweet and clean, the atmosphere well charged with moisture, and the temperature as regular as possible; this will conduce to vigorous health, and with this the chances of these attacks of pests and disease are reduced to the minimum.

Acalypha.—This is a very large genus, belonging to the Spurgewort family (*Euphorbiaceæ*). Very few species have any beauty to recommend them to the notice of the cultivator. Those here enumerated are remarkable for their handsome foliage. They should be potted in peat, loam, and sand.

A. macrophylla.—The colours of the large leaves in this plant are very diversified, shades of coppery-green, red, and yellow being curiously blended. It is a very showy species. South Sea Islands.

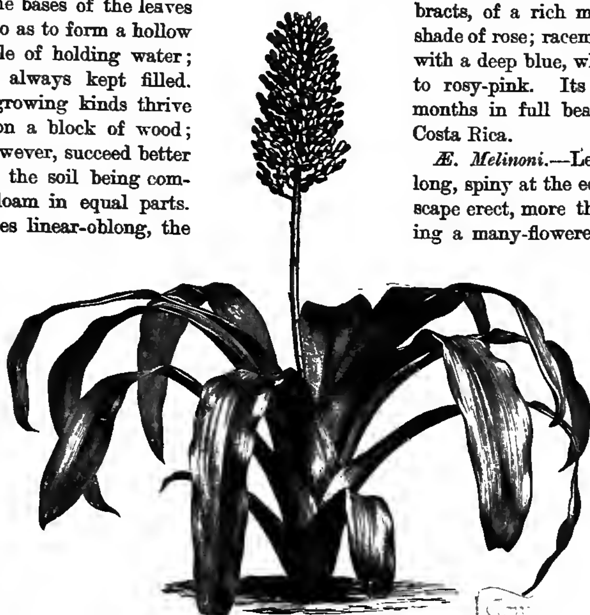
A. marginata.—Scarcely so robust as the preceding; the ovate-acuminate leaves are hirsute, rosy-carmine and green; the centre bronzy-green. South Sea Islands.

A. obovata.—Leaves obovate, when young light green with yellowish-white border, changing with age to intense deep green, the edges rosy-pink and the centre bronzy-green. South Sea Islands.

A. Wilkesiana.—This plant was originally named *A. tricolor*. It attains a height of ten or twelve feet, but is more handsome when smaller; its leaves are large, and ovate-acuminate in shape; ground-colour bronzy-green, mottled with irregular-shaped patches of red and crimson. New Caledonia.

Æchmea.—A genus of plants belonging to the Pine-apple family (*Bromeliaceæ*), and deriving their name from *aichme*, "a point," in reference to the stiff points of the calyx. They are all natives of tropical America, and are oftentimes found growing as epiphytes in the company of Orchids, Ferns, and other plants, on the stems and branches of the forest trees. Their leaves are arranged in a rosulate manner, the bases of the leaves closely imbricating, so as to form a hollow in the centre, capable of holding water; and this should be always kept filled. Many of the small-growing kinds thrive best when grown upon a block of wood; the larger kinds, however, succeed better treated as pot-plants, the soil being composed of peat and loam in equal parts.

Æ. cœlestis.—Leaves linear-oblong, the edges armed with closely-set short spines, deep green, but faintly barred transversely with a paler hue; the peduncle stout, bearing a large, dense raceme; bracts rosy-purple; calyx pale brown; petals a lovely pale blue. Summer months. Brazil.



ÆCHMEA MINIATA DISCOLOR.

Æ. discolor.—Leaves broad and recurved, green above, purple below; the panicle branched, destitute of bracts: calyx coral-red, tipped with black; petals twisted, and dull purple. Summer months. Brazil.

Æ. distiacantha.—Leaves linear-oblong acute, glaucous-green, the edges distantly armed with reddish spines; panicle furnished with numerous large and showy bright red bracts, which greatly add to the display; calyx rose-colour; the petals of a deep bluish-purple hue. Summer months. San Paulo, Brazil.

Æ. fulgens.—Leaves somewhat narrow, spiny at the edges; the flower-spike rather short, slightly branched, ornamented with bright scarlet bracts; flowers scarlet, tipped with blue. Late summer and autumn months. Cayenne.

Æ. glomerata.—Leaves quite smooth, upwards of two feet long, and nearly six inches broad; linear-oblong, distantly armed on the edges with short and stout black spines; dull green; scape erect, eight to twelve inches high, bearing its flowers in alternate glomerate panicles, in which the large bracts are bright red, the petals deep blue. Spring months. Bahia.

Æ. Mariæ Reginæ.—Very robust; leaves some eighteen inches long, armed with spines at the edges, dark green; spike erect, the lower portion bearing numerous, very large boat-shaped bracts, of a rich magenta, flushed with a shade of rose; raceme dense, flowers tipped with a deep blue, which changes with age to rosy-pink. Its beautiful bracts last months in full beauty. Spring months. Costa Rica.

Æ. Melinoni.—Leaves one to two feet long, spiny at the edges, and dark green; scape erect, more than a foot high, bearing a many-flowered panicle, the middle branches being the largest; flowers rich scarlet, tipped with pink. Summer months. Brazil.

Æ. Veitchii.—This species forms a pretty rosette-like plant; the leaves strap-shaped, upwards of a foot long, and about two inches wide, finely toothed at the edges, pale green, with some spots of a darker hue; flowers produced in a dense, oblong, bractiate head, some six inches or more long, flowers and bracts bright scarlet. Summer months. New Grenada.

Æschynanthus.—These are beautiful flowering plants, belonging to the order *Gesneraceæ*. The majority of the species thrive best potted in a mixture of peat and Sphagnum moss, and they should be placed in hanging baskets and suspended from the roof. Naturally, *Æschynanthus* are epiphytal, their pendent stems and clusters of showy flowers hanging down amongst the branches of the forest trees having a gorgeous effect. They enjoy strong heat, and an abundance of water both to the roots and in the atmosphere.

Æ. cordifolius.—Leaves heart-shaped, thick and fleshy, smooth, dark green above, paler on the under side. Flowers tubular, produced in large axillary clusters; tube orange inside, red without; limb spreading, striped with black. Summer months. Borneo.

Æ. fulgens.—Leaves large, oblong-lanceolate, tapering to a point, coriaceous in texture, bright green. Flowers in terminal umbels; upper half of tube crimson, lower half orange; limb orange-yellow, striped with black. Summer months. East Indies.

Æ. grandiflorus. — Leaves lanceolate, coriaceous and deep green. Flowers in terminal umbels, large, rich crimson and orange. Summer months.

Æ. javanicus.—Flowers long and tubular; the calyx is edged with red, and the tubes bright red; the throat rayed with yellow. Summer months. Java.

Æ. Lobbianus.—Leaves short, elliptic, dark green; calyx large, purple; tubes brilliant scarlet. Summer months. Java.

Æ. longiflorus.—Flowers large, the tubes curving upwards, becoming stouter towards the limb; deep crimson. Summer months. Java.

Æ. speciosus.—This plant is not pendulous, but somewhat erect in habit. Flowers in terminal umbels of ten to twenty; tubes long, rich orange-yellow, running into reddish-scarlet towards the top; the limb streaked with yellow and black. Summer months. Java.

Æ. tricolor.—Stems drooping; leaves ovate; the flowers with shorter tubes than most of the species, deep red, the limb and throat orange, the upper lobes of the lip streaked with black. Summer months. Borneo.

Agalmyla.—A small genus of *Gesneraceæ* nearly allied to *Æschynanthus;* the name comes from *agalma,* "an ornament," and signifies its ornamental appearance in its native forests; treatment the same as already recommended for *Æschynanthus.*

A. staminea.—Naturally this plant is epiphytal; it has large fleshy oblong-lanceolate leaves, some six inches in length, and dark green; flowers axillary, in clusters of about twelve to fifteen, tubes two inches long, bright scarlet; stamens much exserted. Summer months. Java.

Allamanda.—A genus of *Apocynaceæ,* named in honour of Dr. Frederick Allamand, of Leyden, who was a professor of natural history in that university, and who afterwards travelled in Guiana, and discovered the first species (*A. cathartica*).

Allamandas are all bold-growing and very free-flowering; all, with one exception, climbers; and all, with one exception, yellow-flowered. They form splendid objects trained over a balloon-shaped trellis, or upon the rafters or pillars of the stove, their rich golden flowers keeping up a display for several months. The soil best adapted to their wants is a mixture of equal parts loam, leaf-mould, peat, and sand. They enjoy strong heat and moisture when growing, both overhead and to the roots. To the latter occasional applications of liquid manure will be of the greatest assistance. After the flowering season water must in a great measure be withheld, and early in spring, before new growth commences, cut the shoots back to within a few eyes of the old wood.

A. Aubletii.—A long trailing plant, producing its oblong-lanceolate acuminate leaves in whorls; these are some six inches long, and bright green. Panicles large and many-flowered; corolla funnel-shaped; the limb campanulate, with large spreading lobes, rich golden-yellow. Summer months. Guiana.

A. cathartica.—Leaves in whorls, obovate, smooth, and deep green. Flowers smaller than the preceding, deep yellow. In its native country an infusion of its leaves is taken as a cure for colic. Summer months. Guiana.

A. grandiflora.—Although this species was the largest-flowered at the time of its introduction, later discoveries have eclipsed it; still it is a very fine and showy plant, its rich clear golden-yellow flowers being distinct from any other; the habit of growth is less robust, and the leaves have a somewhat glaucous hue. Summer months. Brazil.

A. Hendersonii.—This plant is also called in some gardens *A. Wardleana.* It is a very desirable form, being of close compact habit, and with a little attention to pinching the young growths it can be trained in bush form, but is far more effective when allowed to make long growths. Flowers very large, deep orange-yellow, with a much darker throat. Summer months. New Grenada.

A. neriifolia.—This species is a bush, and not a trailer, with broad-oblong leaves and terminal panicles of yellow flowers, streaked with orange. The flowers are shorter and smaller than other species in the family. Summer months. Brazil.

A. nobilis.—Flowers nearly seven inches across the spreading limb, of the very brightest yellow, and delicately fragrant. The flowers are produced in great profusion. Summer months. Brazil.

A. Schottii.—A very fine species with large flowers, measuring six inches or more across, rich bright yellow in colour, with a spot of white at the base of the lobes of the limb. One of the very finest species. Summer months. Brazil.

Alloplectus.—This family consists of a few soft-wooded plants with handsome flowers, belonging to the Gesnerads, and is remarkable for the large coloured calyx in which the flowers are seated. The name comes from *allas,* "diverse," and *plekein,* "to plait," in reference to the plaiting of the calyx. The soil should be peat, leaf-mould, and sand.

A. capitatus.—Stems red, bearing ovate dark green leaves; flowers numerous in the axils; calyx large, deep crimson; corolla small, yellow. Spring months. Brazil.

A. chrysanthus.—Leaves deep green above, purple beneath; calyx deep red; the tubular corolla rich golden-yellow. Summer months. Columbia.

A. concolor.—The calyx and corolla are both yellow in this species, the latter curiously curved. Spring months. Brazil.

A. dichrous. — Leaves ovate-oblong and entire; flowers axillary; calyx large, reddish-purple, whilst the long tubular corolla is yellow, and clothed with long hairs. Summer months. Brazil.

A. Schlimii.—Leaves green above, deep velvety-purple shaded with violet beneath; calyx bright red; the tube of the corolla yellow on the under side, purplish-violet above. Summer and autumn. New Grenada.

Alocasia.—A large genus of Arads, nearly allied to *Caladium;* it contains many plants with strikingly beautiful leaves, for which they are so much sought after, and cultivated in our plant-houses. The older species were called "Colocasias," but that name seems to have dropped out to a great extent, and the present becomes the accepted term. In their native countries the roots of some kinds are cooked and used as an article of food, which, being filled with starch, is very nutritious. The leaves are also boiled and eaten in the way of Spinach.

Alocasias enjoy plenty of heat and an abundant supply of water during the growing season, but as they lie nearly dormant during the winter season, much less will be required. The soil that Alocasias thrive best in is a mixture of peat, loam, leaf-mould, and well-decomposed manure, and a small portion of sand.

A. gigantea.—This species attains a height of nearly or quite four feet; the leaves are sagittate, with the upper lobes much spread, upper surface rich deep green, of a metallic hue on the under side. Indian Islands.

A. intermedia.—This is a garden hybrid, and, like nearly all hybrids, a very free-growing plant; the leaves are sagittate, and some three feet long, metallic green above, the principal veins rayed with white, purplish slate-colour beneath; an extremely ornamental plant.

A. Jenningsii.—A free-growing plant, attaining a height of about three feet; leaves about ten inches long, rather less across, ground-colour a glaucous-green, with about six large oblong blotches of black on each side of the midrib. An elegant species from the East Indies.

A. Johnstoni.—This is a remarkable plant, and not a true Alocasia; the leaf-stalks are mottled and furnished with rings of spines at intervals; blade of leaf sagittate, with very long lobes; the whole length of the leaf is about two feet, bright olive-green, mottled and veined with red. Solomon Islands. Correct name, *Cyrtosperma Johnstoni.*

A. Lowii.—Although one of the first of the genus to find favour in the eyes of cultivators, it still retains the high position it obtained on its introduction about a quarter of a century ago; leaves twelve to eighteen inches long, sagittate, with two large ear-like lobes, upper side dark green, primary veins ivory-white, with a narrow white marginal border, under side deep purple. Borneo.

A. macrorhiza, var. *variegata.* — A bold, strong-growing variety, differing only in colour from the species; leaves very large, cordate-acuminate, with large lobes at the upper part; ground-colour brilliant green, splashed and mottled with pure white and grey, petiole of leaf streaked with pure white. Ceylon.

A. metallica.—This species is totally distinct from any other known plant; the petioles are usually one to two feet high, the blade of the leaf some eighteen inches long, and twelve inches across, somewhat ovate in shape, with a shallow sinus at top, surface bullate, shining, of a uniform rich bronzy metallic hue, under side deep shining purple. Borneo.

A. neo-Guineensis.—A superb species, with very short foot-stalks, which renders it dwarf and compact; blade of leaf broadly-ovate cordate, the surface deep green, smooth and shining, irregularly spotted and blotched with creamy-white. New Guinea.

A. Sanderiana.—The leaves of this very beautiful species are sagittate and deeply lobed; ground-colour deep metallic green with a narrow border of white; the midrib and primary veins grey, broadly bordered with pure white. Indian Archipelago.

A. Thibautiana.—A fine, bold species, with large cordate-sagittate leaves of deep olive-green, overspread with a film of greyish-green, the midrib and primary veins white.

A. Veitchii.—This very beautiful plant produces leaves about eighteen inches in length, sagittate in shape, with very long upper lobes; ground-colour intense deep green, with a white marginal border; the midrib and principal veins light green, bordered on each side with grey, and the spaces between slightly netted with white hair-like lines; the under side is of a uniform deep purple. Borneo.

A. zebrina.—A strong, bold-growing plant, with large and broad sagittate leaves some two feet long, and bright green; the petioles attain a height of about four feet; these are light green, encircled with zigzag bands of blackish-green. Philippine Islands.

Alpinia.—This family of plants is nearly related to the Gingerworts (*Zingiboraceæ*); it contains many handsome species, but it is long since they were fashionable. The name commemorates the celebrated Italian physician and botanist, Prosper Alpini, who resided in Egypt upwards of three hundred years ago.

A. nutans, some years back, was a general favourite. The whole plant is very aromatic, and its drooping spike of white flowers have a very pearl-like appearance. *A. Galanga* produces the aromatic root of commerce known as "Galanga," which is used in cases of indigestion; whilst the fruits of *A. alba* are known as "China Cardamoms." These plants enjoy rich loamy soil, and an absence of heat and moisture.

A. vittata.—This species is about the only member of the genus now to be found in our hot-houses, saving in strictly botanic gardens, and this has found favour on account of its variegated foliage; it has stout underground creeping rhizomes, which produce reed-like stems bearing numerous narrow yellowish-green leaves, which are variously striped with deep green and creamy-white. South Sea Islands.

ALOCASIA THIBAUTIANA.

Amasonia.—This contains but a few species, all of which, however, are more or less beautiful; they belong to the Verbenaceous order, and are easily cultivated in the stove if treated in the same manner as recommended for Eranthemums and other Acanthads.

A. punicea.—This is a plant of recent introduction, and the most beautiful of all the species hitherto discovered. Leaves somewhat oblong-lanceolate, coarsely serrated at the margins, nine to twelve inches long, and pale green; peduncle erect, rich crimson, bearing long narrow brilliant crimson-scarlet bracts, which last many weeks in full beauty. Flowers long and tubular; pale yellow, but they do not last in perfection so long as the bracts. Amasonias are all natives of tropical America, the majority being found in Brazil; this species is widely distributed. Autumn and winter. Tropical America. Correct name, *A. calycina.*

Amherstia.—A genus of *Leguminosæ*, named in honour of the Countess Amherst. It contains but one species, and "when in flower it is said to be one of the most superb objects imaginable, unrivalled in India or any other part of the world." There is something of mystery attached to this plant, inasmuch as it has never been found in a perfectly wild state, but was discovered in the gardens of a monastery near Martaban, and these were evidently under cultivation. The flowers of this plant, which the Burmese call "Thoka," are strewn in profusion as votive offerings before the images of Buddha. This plant requires very strong heat, shade, and a very moist atmosphere;

pot in good sandy loam, drain the pots well, and after the wood is ripened it must never be allowed to suffer from drought.

A. nobilis (the only species).—When mature it attains a height of forty feet. The leaves are large, equally pinnate, dull purple when young, changing with age to deep green; racemes ovate, pendulous, and very large; flowers rich brilliant vermilion, with three yellow spots on each. They are destitute of any fragrance. The plant was first flowered at Chatsworth, and was planted out in a small house in which Pitcher-plants and other heat and moisture-loving subjects were most successfully cultivated. Spring and early summer.

ANTHURIUM VEITCHII.

Ananassa.—From *Nanas*, its local name in South America. This is a genus of *Bromeliaceæ*, and it includes the plant which produces that most delicious of all fruits, the Pine-apple. The species quoted here do not produce large fruits, although they are edible, but they are introduced on account of the extreme beauty of their foliage. For soil use good rich loam, with a small portion of vegetable mould, drain the pots well, and supply with strong bottom heat; very good specimens are grown without bottom heat, but the colours are far richer when it is applied to them.

A. Porteana.—A plant with a rosulate habit of growth like the common Pine-apple; the leaves rather more erect, ground-colour deep olive-green, with a broad central band of creamy-white, the edges armed with fine teeth. Philippine Islands.

A. sativa variegata.—Leaves arranged in a rosulate manner, some two or three feet long, beautifully arched, and armed on the edges with recurved spines; the leaves are striped from base to apex with alternate bands of green and creamy-yellow, and (when grown in strong heat) suffused with rosy-crimson. South America.

Ancylogyne.—A genus of Acanthads possessing very few showy species; the species introduced here, however, being an exception, and well deserving of general cultivation for its extreme beauty. Pot in a mixture of loam, peat, and leaf-mould in equal parts, adding a little sharp sand. After flowering, this, and the majority of the *Acanthaceæ*, require cutting back hard in order to keep them bushy and well furnished with leaves to the base.

A. longiflora.—Sir Joseph Hooker in describing this plant says: "It is undoubtedly one of the finest tropical *Acanthaceæ* ever introduced into this country, and cannot fail to be a most important accession to our stoves." It is a somewhat shrubby plant, with quadrangular stems, and ovate-oblong acuminate, bright green leaves, some six to nine inches long; flowers produced in branching, drooping panicles; flowers tubular, about two inches long, deep rich purple. Winter and spring months. Guayaquil.

Anthurium.—A large genus, belonging to the *Arum* family, and deriving their generic name from *anthos*, "a flower," and *oure*, "a tail," in reference to the long cylindrical spadix upon which the flowers are situated. Many or most of the species are naturally epiphytal, but they conform readily to pot-culture. Anthuriums for the most part are grown for the sake of their beautiful leaves, but of late years several kinds have been introduced, with magnificent and gorgeous spathes, which are oftentimes confounded with flowers. These are mostly thick and leathery in texture, and consequently remain a long time in full beauty. These plants should be potted in rough peat and loam. They enjoy a warm atmosphere abundantly charged with moisture.

A. Andreanum.—This very fine plant is tufted in habit; petioles slender and erect, bearing a cordate-oblong acuminate bright green leaf, eighteen inches to two feet or more in length. The peduncle is longer than the petioles, supporting a most brilliantly coloured spathe and spadix. Spathe heart-shaped, upwards of six inches long, with a bullate surface of a uniform brilliant scarlet; spadix about two inches long, ivory-white at the base, passing into pale yellow at the point. Summer months. Columbia.

A. candidum.—A small-growing species; the leaves ovate-lanceolate and acuminate, dark green; peduncles slender, longer than the leaves; spathe ovate-acuminate, from three to four inches long, an inch wide, pure white. Columbia.

A. crystallinum.—The leaves of this plant are ovate-cordate, from one to two feet long, bronzy-green when young, changing with age to deep green, the midrib and principal veins bordered with bright silvery-white, which has the appearance of being frosted. Tropical America.

A. Dechardii.—In the description of this and similar species we are told its magnificent flowers are of such-and-such a colour. Now members of scientific bodies should certainly have sufficient scientific knowledge to know the difference between a flower and a coloured leaf. The present species is of moderate growth, and a very ornamental plant, leaves oblong-acuminate and deep green; peduncle rising above the leaves, bearing a large cordate-acuminate pure white spathe, which is slightly reflexed; spadix erect, and creamy-white. Summer months. New Grenada.

A. insigne.—This species has no ornamental spathe, but is a bold-growing ornamental-leaved kind. The leaves are trifoliate, the divisions running down almost to the base, middle lobe ovate-lanceolate and acuminate, a third longer than the side lobes, which are ovate-lanceolate and obtuse, the whole of a uniform rich deep green. Columbia.

A. magnificum.—Leaves very handsome, on strong examples some three feet long, cordate in shape, ground-colour rich olive-green, the midrib and primary veins white. Brazil.

A. ornatum. — This is another white-spathed species of great beauty. Leaves ovate-cordate and acuminate, thick and leathery in texture, and deep green; peduncle rising above the leaves, bearing a large linear-oblong spathe, some six inches long, slightly less than two inches broad, and pure white; spadix shorter than the spathe, dull purple, with small white dots. Spring months. Venezuela.

A. regale.—A fine majestic plant, with large cordate-acuminate leaves, some two feet or more long, of a deep metallic green, the primary veins white; when young the leaves are tinged with purplish-rose. New Grenada.

A. Scherzerianum.—This, popularly known as the "Flamingo Plant," is a compact-growing species, and one that makes a gorgeous display in the stove. It was discovered in Costa Rica by Herr Inspector Wendland, the third generation of Wendlands who have been royal gardeners at the palace of Herrenhausen in Hanover, and was first brought to England in 1861 by the writer of these lines. The leaves are oblong-lanceolate, thick and leathery in texture, about eighteen inches long, and two inches across, deep rich green above, paler below: peduncle standing erect, deep red, bearing a large ovate-oblong spathe, some three inches long and two inches broad, of a uniform rich deep scarlet; spadix curled, orange-scarlet. The spathes are very persistent, lasting in full beauty some three or four months.

In the variety *Williamsii* the spathe is pure white, and the twisted spadix is lemon-colour. The variety *Rothschildianum* has a white spathe, spotted with carmine. In the variety *Wardii* the spathes are much enlarged, being upwards of six inches long and four inches broad, of an intense deep crimson-scarlet; whilst the form called *maximum* produces large oblong-ovate and acuminate spathes, some nine inches long and four broad, of a rich crimson-scarlet. Summer months. Costa Rica.

A. Veitchii.—There is no doubt that this is one of the most extraordinary introductions of modern times; petioles upwards of two feet long, the blade of the leaf attaining a length of three feet or more, whilst its width is about eight or nine inches. The leaves are leathery in texture and transversely waved, which gives them a bullate appearance; ground-colour deep green, suffused with a bronzy hue. Columbia.

A. Waluiewi.—Leaves cordate-acuminate, twelve to eighteen inches long, and about eight inches broad; deep olive-green, with a rich metallic hue spread over the surface. Before they reach maturity they are suffused with a rich tinge of reddish-crimson. Venezuela.

A. Warocqueanum.—This is a remarkable and handsome species; leaves some twenty and even thirty inches long, and only seven or eight inches broad; the ground-colour of the blade is of a rich, bright, velvety-green, the midrib and primary veins being nearly white. New Grenada.

PROPAGATION.

By W. Watson.

INTRODUCTION.

THE art of multiplying plants by special methods, more or less artificial, as well as by those taught by nature, is one of the most important of the branches into which horticulture is now divided. Much has been done during the last twenty years to swell very largely the demand for plants of all kinds, both by the immense increase in the number of those who practise horticultural pursuits either for pleasure or profit, and by the tendency of scientific inquiry into the laws of vegetable physiology and morphology, to add an additional interest to plants. The effect of all this has been to render the art of horticulture much more important as an industry than it ever was before; and especially to raise the art of propagation and improvement of useful and beautiful plants to a place of higher interest, and of vastly augmented importance. Scientific inquiry has been devoted more especially to the laws which govern the principles of fertilisation and seed-bearing among plants; and a large amount of useful information, capable of being turned to good account by the practical cultivator, has been evolved from these inquiries. It is now possible for the hybridiser and cross-breeder of plants to perform his work according to known rules, which, if properly acted upon, are almost certain to bring about the desired result. Until the late Charles Darwin and other eminent naturalists unravelled the mystery of flower fertilisation, and laid bare the laws which govern this particular function of plants, hybridisation was a haphazard, empirical art, and the results of the operator were governed by chance. He was to a large extent working in the dark, and trusting to luck for success.

Propagation, apart from seed-raising, is still, and must perforce remain, an empirical art, for a knowledge of which we are compelled to look to the practical and skilful operator. We have, however, much information upon the most successful modes of multiplying plants by artificial means, and it is to the elucidation of these that we intend to devote a large proportion of the following chapters.

Although it may not be really necessary to the successful propagation of plants that the practitioner should possess a knowledge of the physiology of vegetable life, yet it must be evident that to know something of those functions that are called into action by his operations, and of the laws which govern to a large extent his work, would be of great assistance to him, and would add largely to the interest of his experiments. By it many failures would be avoided, because impossible things would not be expected, as is too often the case when the operator is ignorant in matters of this kind. The right road to success would often reveal itself to him who knew something of the laws that govern plants under various conditions as regards their growth and reproduction. Writing over forty years ago, Dr. Lindley said: "It is, I confess, surprising to me that the real nature of the vital actions of plants, and of the external forces by which they are regulated, should be so frequently misapprehended, even among writers upon horticulture; and that ideas relating to such matters should obtain among intelligent men in the present state of what I may call horticultural physiology."

To that portion of the present work which is devoted to the LIFE-HISTORY OF PLANTS, we therefore recommend the beginner's attention, as by it he will be taught where improvements in his methods of culture are possible, and be led to the discovery of much that will prove of value and interest to him in the pursuit of horticulture.

Notwithstanding the advance that has been made in a knowledge of vegetable physiology, and of the laws that affect the multiplication of plants by artificial methods, there is, as we have already hinted, much about which science can give us little helpful information. To classify all known plants into groups, for each of which a particular kind of treatment would prove successful in their propagation, is only possible by ignoring the natural affinities of plants, by which is meant their botanical relationships with each other, and allowing ourselves to be guided by the results of practical experiments upon the plants themselves. Even then, there would remain a large number of anomalous cases of plants which require special methods for their multiplication, and of others for the propagation of which it may be said we have practically no successful data. It is only by testing each new plant as it comes into our possession, that we can arrive at a knowledge of its reproductive capacity. The nature of by far the greater portion of the plants cultivated in this country is such as precludes the possibility of increasing them by the most natural methods, that is, from seeds; we are therefore compelled to resort to what we have called artificial means, of which cuttings, grafts, layers, buds, &c., are the most generally used. It is to these we refer when speaking of the difficulty experienced in the propagation of some plants; for of course all vegetables in a state of nature are capable of reproducing themselves by means of seeds, although under cultivation they often exhibit the same sterility as is known to exist in many animals when domesticated. Nothing strikes the beginner as being more anomalous, than those cases where a variety of a plant cannot be propagated in the same way as the type from which it sprang; or where a species of the same genus fails to reproduce itself under the same treatment as with another species proves successful. There is no known reason why some Aralias should strike freely, whilst others cannot be rooted from cuttings, although the species are closely related to each other; and this is but one instance among many of a similarly inexplicable character.

Another case of irregularity similar to the above is that of many plants failing to thrive under cultivation in this country, unless grafted upon another species or kind. There are thousands of plants which exhibit this peculiarity, apart altogether from those which are *improved* by being grafted upon another kind, an important subject to which we shall refer again. The selection of a suitable stock upon which a plant incapable of thriving upon its own roots would succeed, is often very difficult. In the cultivation of fruit, Coniferæ, and Roses, this is always of great importance.

Again, the strange incongruity observable in the reproduction from seeds of the characters of the parent plant is another subject upon which information is wanting. Stability of character is as uncertain among cultivated plants as the most ardent disciple of the doctrine of evolution need wish. For the purposes of the horticulturist, this character of breaking away from the type is often an advantage; but where the typical characters are what we desire to have reproduced in the offspring, seeds as a means of propagation are rendered comparatively valueless by their often failing to reproduce the parental characteristics wished for. These and similar cases of an anomalous nature are to be borne in mind when we are about to deal with the multiplication of new plants, or those with the variability of which under cultivation we are unacquainted. When failure is the result of the application of one method, another and another must be tried until the most suitable one is discovered.

The large influx of new plants of all kinds, both for purposes of ornament and economical uses, which has been consequent on the rapid development of horticulture in recent years, has given an impetus to the art of plant propagation never before known; and the effect of the inquiries into the laws which govern the process of fertilisation and hybridity, has been to stimulate the efforts of cultivators after improvement of race.

We may profitably devote a section to each of the methods practised in the reproduction and improvement of cultivated plants, giving the details of each as fully as possible, and showing how they may be applied with success to the most important and interesting of our garden products.

SEEDS.

Introductory.—All flowering plants may be considered capable, under favourable conditions, of reproducing themselves from seeds. It is usual to speak of seeds as the natural method of reproduction, and of all other methods as artificial or auxiliary. To be accurate, however, we should consider every one of the numerous means of reproduction in plants of which we have any knowledge to be natural, as the capacity to be thus increased is inherent, and requires only this or that condition for its being called into action. Cuttings, buds, division, offsets, and even grafts are known to be used by nature for the increase of various plants. These are, however, auxiliary methods, which have been turned to account by the cultivator, the most general or normal method being that of seeds or sexual increase.

"A seed is a living body, separating from its parent, and capable of growing into a new individual of the same species. It is a reproductive fragment, or vital point, containing within itself all the elements of life, which, however, can only be called into action by special circumstances" (Lindley). Every seed, from the tiny flour-like seeds of Begonias, Gloxinias, &c., to the large seed or nut of the Double Cocoa-nut, which is more than two feet in diameter, and weighs over twenty pounds, contains the beginning or germ of a plant, together with a certain quantity of food stored up within it, and intended to supply the seedling with nourishment till roots and leaves have been formed. In botanical works seeds are divided into two great divisions, according as they have this nourishment stored up (1) in the cotyledons or (2) in the seed itself. The first of these divisions is termed exalbuminous, the second albuminous. For all practical purposes it is sufficient to define these terms as meaning that the nutritive deposit for the seedling's use is contained either in the first leaf or leaves of the seedling itself, as in the Pea, Bean, Oak, Cucumber, and the like, or it remains in the seed after the plantlet has grown out, continuing to supply the latter with food till it is strong enough to provide for itself. The importance, therefore, of allowing the cotyledons and seeds to remain on the germinating plant till cast off by the plant itself, is thus plainly shown. Numerous experiments made on germinating seeds of Palms, Cycads, and other albuminous seeds, and on various seeds belonging to the exalbuminous division, such as Beans, Cucumbers, &c., proved how vitally important to young seedlings were their seeds or the cotyledons respectively during the early stage of development. By removing the seed of an Ivory-nut (*Phytelephas*) and of a Cocoa-nut after germination had taken place, but before perfect leaves and strong roots had been formed, death to the seedlings was the immediate result. In the same way it was found that by breaking away from seedling Beans and Cucumbers their thick fleshy cotyledons, the seedlings either died at once, or were rendered incapable of developing into healthy plants.

When a seed is placed under conditions favourable to germination, it begins to undergo certain chemical changes by the absorption of water and the effects of heat, is softened, and becomes swollen, the germ or embryo breaks through its shell, and a new plant is thus born. When once vitality is set in action in a seed, its growth and development cannot be arrested or prevented except by death. The root grows down into the earth, and that portion of the seedling destined to form the stem grows in the opposite direction. It is supposed that the force of gravitation governs the growth of plants, but, whatever the cause, all plants are governed by the same rule, sending their roots towards the earth, and their stems or leaves into the air. The amount of light, heat, and moisture, and the nature of the soil that are most suitable to the numerous and various forms of plant-life may be considered under separate heads. For other conditions which control germination the reader is referred to the chapters on the LIFE-HISTORY OF PLANTS.

Temperature.—The extremes of cold and heat which seeds are known to bear without any loss of vital energy, although not without interest to horticulturists, need not be gone into here; those conditions which are most favourable only being of direct interest to us at present. It is not always safe to turn to nature for information on how plants may be best managed under artificial conditions. If we could be sure that a certain natural method was the best that nature employs, then probably to follow her would be our wisest course. But nature, like gardeners, has often to have recourse to makeshift plans. Plants are found growing under conditions which do not more than supply the barest necessaries of existence. There are numerous instances on record of gardeners having been led astray through copying what appeared to be nature's plan for the management of certain plants. Orchids have been found growing on the ground in moist shaded forests, and it was, therefore, assumed that an imitation of those conditions would be most suited to the plants when cultivated in our houses. It was, however, afterwards discovered that the plants found on the ground had been blown down or otherwise removed from their more favoured position on the tops of the trees, where they were exposed to the fierce action of an equatorial sun. In like manner seeds are found germinating in all sorts of untoward situations. If we consider for a moment how various must be the conditions in which the seeds of plants are placed in a wild state, how they become widely disseminated through the agency of birds, water, wind, &c., it is easy to see how mistakes might be made if we were to be guided in our treatment of plants by our knowledge, often only very fragmentary, of how they sometimes exist in nature.

Nature is a safe guide when we really understand her. In the case of the Orchids above-mentioned she showed us the best treatment for the plants. It was the misjudgment of her imitators that led them to look upon the *first* conditions under which the plants were found as the most suitable. Mistakes of this kind are only made when the plants are new and their nature unknown. The majority of cultivated plants, for the reproduction of which seeds are relied upon, are well enough understood to prevent errors of treatment. It may be laid down as a general rule to be observed in the treatment of all seeds, that the temperature most suited to their germination and vigorous development should never be below the mean ground temperature in which the plant grows naturally, but if possible should exceed it by several degrees. Many seeds will germinate, though very slowly, in a lower temperature than is good for them. A high temperature will, on the contrary, force all seeds into quick activity. Thus Peas, Beans, and numerous other seeds of quick-growing herbaceous plants which grow out of doors with us, will in a temperature of 80° germinate in about one-sixth the time they take when sown in a more natural temperature. With proper care, a degree of heat much in excess of what would prove sufficient may be applied to seeds and plants, often to their advantage. The limits of high temperature for plants are not so strictly defined as the lower limits of temperature are. It is possible that plants do not object so much to extreme heat as to extreme cold, a possibility explained by physiological laws. For horticultural purposes a high temperature often proves of service in the raising of plants from seeds. By sowing seeds of hardy plants and trees in a stove temperature, much time is saved, without any injury to the seedlings resulting. A high temperature will induce old seeds to germinate, which in a lower or more natural temperature would not be excited into growth. "Trial" seeds of vegetables, Wheat, &c., when sown in a warm house to test their health have germinated satisfactorily, but seeds of the same sample when sown out of doors remained inactive. Their vital force had become weakened by some cause or other, and it was only under the exciting influences of a high temperature that this could be remedied, and the seeds made to germinate.

The application of unusual warmth sometimes fails to excite into germination seeds which require to lie dormant for some time, or which do not mature until some months after they have ripened. Thus Acorns, Chestnuts, and other seeds of hardy trees were sown last autumn in a warm house, but refused to germinate, although they remained healthy and apparently uninfluenced by the warmth. *Lilium* seeds, which out of doors often take from one to two years after sowing before they germinate, will, when sown in a warm house, be forced into growth in about three months. On the other hand, some kinds of seed will germinate much more quickly if sown just before they are ripe than if allowed to mature before being sown.

In all cases, however, a moderately high temperature will be found a useful factor in the raising of plants from seeds, and especially when applied to old seeds or those of questionable health. For seeds of tropical plants a temperature of 80° will be found suitable in every case; seeds from temperate climes will germinate freely in a temperature of 65°; those of hardy plants may be sown out of doors or in frames in the season at which they would naturally germinate. Where it is found convenient to employ a higher temperature for seeds than they naturally require, some care is necessary after germination has taken place, as, although the excessive heat is productive of good in so far as quick germination is desired, it would have an injurious effect on the health of the seedlings if they were allowed to remain in a high temperature too long. As soon, therefore, as they are strong enough, they should be gradually hardened off till brought into the temperature most suited to them.

Reference may here be made to the effects of climate on the characters of cultivated plants, and especially of those varieties which are the result of cultivation. Numerous facts are on record, tending to show that such plants often owe their most important characters to changes in the conditions of life, and amongst these climate is a great modifier. Varieties of Asters, Stocks, and Roses, as well as of numerous vegetables, which have originated with Continental growers, often lose the character for which they were distinguished after having existed for a time in English gardens. For hardy plants, therefore, it will be advisable to obtain seeds only from those countries whose climate corresponds with our own.

Moisture.—We sow seeds in soil, not because the chemical nature of the soil itself has any influence on the germinating process, but because of its being a suitable medium in which the conditions essential to germination—*i.e.*, warmth, moisture, and air—are brought to bear upon the seed; it also is there ready to receive the roots of the seedling as they develop, and to supply the plant with food as soon as it begins to shift for itself. Moisture and heat are two principal causes of germination; without them germination is impossible. The water supplies oxygen sufficient to enable the seed to get rid of the large amount of carbon which was necessary so long as the seed remained dormant, but which alone was detrimental to growth. Water also has a softening influence on the often hard shell in which the seed is enclosed, thus rendering the escape of the embryo from the seed much easier than if the outer coats remained hard. To afford the seeds the amount of moisture they require, we either bury them in moist soil or sand, or place

THE FIERY-RED MORMODES (MORMODES IGNEUM).

A hothouse Epiphyte from Central America, belonging to the natural order of Orchids. The flower in the middle of the plate, to which the name of *igneum* is given, is conspicuous for the great size of its parts and for its intense colouring. A stiff stalk, about a foot high, bears a dozen large fleshy flowers, of which the sepals and petals are alike chocolate-coloured, and the lip a rich fiery orange-brown. There is no streaking or spotting in any part of the surface. The sepals are flat, linear-lanceolate, very sharp, and spread flat out, even turning backward after a time; the petals, on the contrary, are erect, and somewhat broader. The lip, a tough fleshy body, when spread out has an elliptical outline, with a major axis transverse, and the edge extends into a triangular point on one side; in its natural condition it is rolled back, and folded so as to look as if angular though not really so.

The smaller figures vary somewhat from the larger. One has dingy red flowers, marked with lines of dots; and the other has dark lake flowers, speckled irregularly with red, but not dotted; their lips are thinner, smaller, and have a decidedly angular outline.

THE FIERY-RED MORMODES.
(MORMODES IGNEUM.)

them under atmospheric conditions such as would fulfil the same purpose. So soon as absorption takes place, germination will or ought to commence. Old seeds or immature ones will often fail to grow if kept very moist, but may be induced to push into activity by keeping them comparatively dry till germination has commenced, increasing the amount of moisture as growth continues. "When the vital energies of a seed are diminished, it does not lose its power of absorbing water, but is less capable of decomposing it. The consequence of this is that the free water introduced into the system collects in the cavities of the seed and produces putrefaction; the sign of which is the rotting of seeds in the ground."

At Kew, where all kinds of seeds are received in large quantities annually, it is the custom to treat old or sickly-looking seeds as follows:—The seeds are first thoroughly dried, so as to destroy any germs of decay or disease of any kind which may have attacked the seeds before their arrival. They are then spread out thinly upon slates, placed in a warm and moist atmosphere, and covered with a sheet of paper. If vitality has not been destroyed, this treatment generally brings about germination, on the first sign of which the seeds are placed in soil. Any healthy seed will germinate if immersed in water of the required temperature, but unless the plant be an aquatic the excess of water soon proves fatal. For all seeds of terrestrial plants, therefore, no more moisture should be allowed than is sufficient to keep the medium on which the seeds are sown in a moist condition. An excellent guide to follow is that of the plants to which the seeds belong, giving their seeds the same amount of moisture as would be enjoyed by the plants themselves.

In the case of very fine seeds which are sown on the top of the soil, it is wise either to stand the pots containing the seeds in shallow pans of water, so that the soil may be kept moist by capillary attraction, or to effect the same purpose by dipping the pots almost up to the rim in water, and holding them there for a few moments till the soil has become thoroughly moistened. The length of time seeds may be allowed to remain in water without injury depends on the nature of their outer coverings. Mr. Darwin made numerous experiments for the purpose of discovering how long the seeds of land plants might be immersed in sea-water without losing the power to germinate. He found in many instances the time was unusually long, some of the seeds thus tested germinating after an immersion of 137 days. In like manner many seeds may be kept in fresh water for a long time, if the temperature is not high enough to excite germination

It is quite a common practice with gardeners to steep hard-coated seeds in warm water for a few hours before sowing, the effect of which is the softening of the seed-coats and the excitement of the vital principle, so that germination is much quickened. Peas, Beans, Erythrinas, Acacias, in fact all those seeds belonging to *Leguminosæ* may be thus treated before sowing. The effects of soaking in warm water are sometimes of a startling character. At Kew, some time ago, a number of large seeds of various kinds were examined after having been sown in a warm house for over a year, and were found to be quite intact, but showed no signs of germination. They were then placed in water heated to 160°, and allowed to remain in soak for twenty-four hours, after which they were re-sown. In less than a fortnight after this most of the seeds had begun to germinate, and nearly every seed eventually grew and formed a strong plant. In the same establishment large numbers of Brazil-nuts, Sapucayo-nuts, and other large hard-coated seeds are annually sown, and it is found that by carefully removing the shells before sowing, germination takes place much more speedily than when they are allowed to remain. The same plan is often had recourse to in the treatment of seeds of Olives, *Coniferæ*, &c.

Aquatic plants, such as Nymphæas, Victoria, Euryale, the Buckbean, &c., naturally shed their seeds in water, where they remain dormant as long as the temperature of the water is low, germinating freely and developing into plants on the return of a higher temperature. Although it appears to be nature's plan to preserve these seeds in water, yet they may be kept for a long time in a perfectly dry condition without losing their vitality. Seeds of Nelumbium have been known to germinate after having been kept dry for over one hundred years.

These seeds may be kept equally well in water if the temperature is not allowed to approach that which induces germination. There are instances recorded of seeds which had commenced to grow having been dried again, and which, on being replaced in a moist situation, grew freely without suffering materially from the check. But these are exceptional cases, and by no means such as need be regarded as of horticultural importance. There can be no doubt that when once germination has begun, any check to its progress is as likely to prove fatal as it would be in the case of eggs after incubation had commenced. All seeds, therefore, should be kept dry and in a low temperature till required for sowing, and when once wetted, no check in the shape of drought or low temperature should be permitted, for even if such check do not prove fatal, it cannot but prove highly injurious to an organism of such extreme delicacy as a germinating seed or seedling.

Light.—It is generally believed that darkness assists germination, and that light retards it, but whether the presence or absence of light alone affects the germinative process either one way or the other has not yet been clearly shown. Various and numerous experiments have been made to test whether the action of light on germinating seeds is for their good, and the general conclusion thus arrived at appears to favour the view that it is not. If this were not so, it might be asked, why cover seeds with earth, or, if fine, place them in a darkened position? The answer to this question must be, that seeds are covered, not so much to exclude light as to keep them uniformly moist, and to prevent irregularities in temperature. For all seeds sown out of doors we know that a covering of soil, varying in depth with the size of the seeds, is necessary, and the same is understood to apply for seeds under glass, unless they be very small. Yet we know that moisture, and a certain degree of heat, along with atmospheric influences, are sufficient to cause any seed to germinate, whether placed in darkness or in bright light.

Frequent proofs of this occur in the propagating department at Kew, where, as is stated above, many kinds of seeds are sown annually. In addition to this, the discussion on the question of darkness for seeds, which took place in the horticultural papers some time ago, led to various experiments at Kew to test how far light affected the process of germination. Seeds were sown on the surface of soil, on cocoa-nut fibre, and in water in a bell-glass, and to prevent evaporation squares of glass were placed over the seeds in such a way as would admit sufficient air without excluding any light. The result of these experiments appeared to show that light did not prevent, nor appreciably interfere with, germination, the seeds starting into growth at about the same time as those which were covered with soil in the usual way. Before it can be satisfactorily proved that these conclusions were safe more experiments will be necessary, but so far as we have gone the evidence gathered favours the opinion that light alone does not interfere with the germination of seeds. Every gardener knows how freely the smallest seeds will vegetate if sown on the surface of soil, covered with a pane of glass and placed on a shelf near the light; seeds of such plants as Gloxinia, Gesnera, Primula, Calceolaria, Begonia, and Bertolonia are commonly sown in this way. Orchids, too, are raised from seeds scattered upon the surface of living Sphagnum moss, where darkness is out of the question. If fine seeds are not injured by light, may we not conclude that larger ones are equally unaffected by it? Experiments like the above prove that such is most probably the case.

As already stated, seeds are covered with soil to afford them the necessary moisture and warmth; it is also necessary, at least in the case of large seeds, to enable the root to take firm hold of the soil, by presenting an opposing force to the pressure of the root as it prolongs itself and pushes its point into the ground. For these reasons, irrespective of the question of light, a covering of soil is beneficial to all but the smallest seeds. Various scales have been given of the different depths at which seeds of different sizes should be sown, but the best we can suggest, and the one found least likely to mislead, is that the thickness of the covering of soil for seeds should not exceed their own diameter. For seeds sown out of doors it is perhaps better to sow a little deeper, for the sake of a proper degree of moisture, and to prevent their being eaten by birds, &c. Under glass this rule can never be far wrong. Deep sowing is often unfavourable to germination, rather because of the exclusion of a due amount of air, than through darkness or the absence of any other condition. Numerous instances of this are not unfrequently recorded; as, for instance, when land has been cleared of trees, or when the earth has been turned over to any depth, a new vegetation springs up, which is often composed of plants unknown in the near neighbourhood of the newly-cleared land, and must therefore have sprung from seeds buried in the earth at too great a depth to permit vegetation. Seeds thus buried retain their vitality for a very long period. At Kew it sometimes happens that seeds which on first sowing were buried too low down in the soil have remained dormant for a long while, but on bringing them nearer the surface they generally germinate soon.

Dr. Lindley mentions an instance of how seeds of Flax were affected by deep sowing: "The injuriousness of covering seed with too much earth arises less from the superincumbent pressure of the soil than from the exclusion of atmospheric air, which is quite indispensable to germination. The seed of the common Flax comes up at different periods, according as it is planted in one, two, or three inches depth of soil; if it be sown four inches below the surface it will not come up at all. Not that air does not penetrate to this depth in the soil, but the quantity of air will very much depend on the looser or denser character of the soil."

Soil.—For all seeds of any size and the vegetative power of which is strong and quick-acting, the soil most suitable is such as the plants would thrive best in when large. It is always best to use a finely-sifted soil, at least for delicate-rooted seedlings; for the smallest seed the mixture ought always to be sifted through a sieve with a quarter-inch mesh.

Various mixtures have been proposed as suitable for all seeds: Lindley suggests equal portions of peat, loam, and sand, others advise all sand, and others prefer sandy loam. If what has already been stated is accepted, it will be seen that the plan here advised is a safe one, viz., to use a mixture similar to what the plants would prefer, plus a larger quantity of sand. If it be borne in mind that the nature of the soil does not in any way affect the process of germination, providing it does not exclude essential conditions, it will be seen that the soil most likely to satisfy the wants of the young plant as soon as it begins to search for its own food is that which it thrives in when strong. Mr. Anderson Henry, who was a most successful raiser of delicate seeds, preferred a compost of equal portions of peat, loam, and sand with a little pulverised leaf-mould added. It is, however, difficult to lay down a hard-and-fast rule in this matter, owing to the varying nature of different soils in different localities—what is good for a certain plant in one place being unsuited for it in another. In this and in all other questions that concern the management of seeds a great deal must be left to the intelligence of the gardener, to whom, if the fundamental principles of germination are properly grasped, the special conditions essential to the welfare of seeds and seedlings will readily suggest themselves. By first of all inquiring into the nature of the plants from which the seeds have been obtained, and ascertaining the conditions under which they are known to thrive, the treatment necessary for their seeds may be soon arrived at.

Vitality of Seeds.—With very few exceptions all seeds retain their germinating power for at least a year under ordinary conditions; and, when placed in circumstances specially favourable, they remain fresh for a very lengthened period. Several remarkable instances of this have already been mentioned, but cases even more remarkable than these are recorded. In the ground, when buried deeply, the length of time seeds will retain life is indefinite—according to some authorities, even unlimited. The accounts of seeds which had been taken from ancient Egyptian tombs germinating on being placed under favourable conditions, and other similar cases of an astonishing nature, might be mentioned. These are, however, of little or no practical moment, beyond showing us how wonderfully tenacious of life is the tiny germ which lies enclosed in its often thin and delicate wrappers. How long a seed will remain good when placed under the conditions supplied in the seed-house, or when sown and treated for germination, is a question to which we may turn for more useful information. A seed, when properly matured and kept dry in an even and suitable temperature, will remain healthy for a more or less lengthened period, according to whether it is oily or starchy, or whether it belongs to the exalbuminous or the albuminous kinds. Oily seeds usually perish in a comparatively short time, so that it becomes necessary to sow them as soon as possible after they are ripe; such seeds are those of Tea, Coffee, Camellia, Theobroma, Acorns, Brazil-nuts, Walnuts, &c. Seeds of a starchy nature are generally much longer-lived. It is, however, impossible to draw a hard-and-fast line between long-lived and short-lived seeds, as there are so many conditions other than those we perceive, and often altogether beyond our control, which affect the vitality of seeds. Lindley says: "Seeds are probably possessed of different powers of life, some preserving their vital principle through centuries of time, while others have but an ephemeral existence under any circumstances. The reasons for this difference are unknown to us." In the case of many of our most popular and long-cultivated plants, however, we have data sufficient to enable us to perceive how long their seeds may be expected to remain capable of germinating. The following list was prepared by the well-known seed merchants, Vilmorin-Andrieux and Co., of Paris, and with it is incorporated a portion of a list printed in Burbidge's "Propagation and Improvement of Plants."

Average Duration of the Germinating Power of the Seeds of some Cultivated Plants.

	Years.		Years.
Acacia	many	Lentil	3
Alder	1	Lettuce	5
Amaranth	5	Maize	2
Angelica	1	Mallow	5
Anise	3	Marjoram	2
Artichoke	5	Melon	5
Aster, China	1	Mustard	5
Asparagus	4	Nasturtium	5
Balsam	many	Onion	2
Basil	6	Parsley	3
Beans, Broad	6	Parsnip	2
Beans, Kidney	3	Peas	4—5
Beetroot	5	Potato	4
Borage	3	Purslane	8
Burnet	2	Radish	5
Cabbage	5	Rampion	5
Capsicum	4	Rhubarb	3
Caraway	2	Rocket	2
Cardoon	7	Rosemary	4
Carrot	4	Salsify	3
Chervil	2	Savory	2
" Tuberous	1	Scorzonera	2
Chicory	8	Sea-kale	3
Corn Salad	5	Sorrel	2
Cress	5	Spinach	5
Cucumber	5	Strawberry	8
Egg Plant	7	Thyme	2—3
Endive	9	Tomato	5
Leek	2	Turnip	5

The above tables do not profess to give in every case the longest time possible for the seeds to remain good, but only the average time during which, under the conditions supplied in an ordinary seed-room, they might be expected to retain their power to vegetate. Cabbage-seeds have been known to germinate after being kept for ten years, and Kidney Beans after five years. As above stated, the conditions which affect the duration of life in seeds are too often beyond control, or altogether hidden from us.

It has been already pointed out that under certain conditions some seeds will remain dormant in the ground for a long time without losing their vitality; in like manner seeds will sometimes lie for years without commencing to grow, even when the conditions under which they are placed are what we consider favourable to germination. Lindley mentions various instances of this, all tending to show how necessary it is to have patience in the management of seeds, and more especially when the age of the seeds is unknown. Old seeds always germinate more slowly than young ones; the hardening of the testa or seed-coats through long exposure, no doubt, accounting to some extent for their tardiness in starting. By steeping in warm water or by removing the outer shell from seeds, germination, as shown above, is much forwarded. Fruits of Hawthorns, Hollies, Birch, and other hardy berry-bearing trees are generally subjected to a softening process before their seeds are sown. This process is what is termed the "rot-heap," and is managed as follows:—The fruits are gathered in the autumn as soon as ripe, and are thrown in heaps. A quantity of sand, ashes, or light soil is mixed up with them by frequently turning them; they are then buried in a pit, or placed in heaps and covered with turf, where they remain till the following spring. The whole is then prepared for sowing by first partly drying and then sifting. In this manner the seeds are separated, whilst the warmth and moisture in which they were stored through the winter has softened the hard shell of the seeds, and, no doubt, has excited the germinative process.

Seeds of plants belonging to the Ranunculus and Primrose families sometimes remain in the ground for several years without moving. Mr. Anderson Henry states that some seeds of *Ranunculus Lyalli*, the Shepherd's Lily, sown by him in 1878 did not germinate till 1881; and in the case of seeds of a second species of *Ranunculus*, germination took place four years and a half afterwards. The same extraordinary slowness has often been observed in seeds sown at Kew. How far this slowness to vegetate may be considered as natural to the plants, or whether it is due to some untoward influence to which the seeds had been subjected, is not clear. Seeds of *Ranunculus Lyalli* vegetated in about eleven months at Kew. I suspect that with most of those plants the seeds of which usually remain in the soil a long time before growing, it would be better to sow the seeds immediately on their becoming ripe. Mr. A. Henry found *Primula Japonica* and Gentians slow to germinate, but when the seeds of these plants are gathered and sown as soon as ripe, they generally germinate in a few weeks. It is said that Colchicum-seeds generally take over two years to start into growth. It is always best to select the largest and heaviest seeds in all cases where robustness of growth is the first aim; smaller seeds being slower to get away, and containing less vital force than larger ones of the same kind. It is also supposed that large seeds retain life for a longer time than smaller ones do.

In concluding these general remarks, we would point to the great importance of careful harvesting and drying, before storing the seeds; to the necessity for perfect dryness and a regular and medium temperature as long as the seeds are kept out of the ground; and, at least in the case of valuable seeds, to the wisdom of allowing the seeds to remain in the soil till all hope of their germinating is past.

THE ORCHARD-HOUSE.

By William Coleman.

Although half a century has hardly passed away since the late Mr. Rivers commenced the culture of all kinds of stone-fruit trees, Apples, Pears, and Figs, in pots under glass, his prediction that every moderate-sized garden in the United Kingdom would in a few years have its orchard-house has been almost verified. When at the outset the roughly and cheaply-built houses or glazed sheds were strongly recommended to the masses, the pomological pioneer did not presume to say they would upset existing arrangements for forcing each kind of fruit separately, by means of which the wealthy could be supplied with the best of everything in its season. Neither was he romancing when he said, the day was not distant when Peaches, Nectarines, and Apricots, at present far beyond the reach of the merchant's clerk, would be to him familiar things, and thousands of little suburban gardens would have their cheap orchard-houses, in which the tired tradesman would feel refreshed in the pleasant evenings of summer, by the mere act of pinching off the young and tender shoots of his Peach-trees, and inhaling the sweet perfume. His sons now live, not only to see all their father predicted grow into existence, but to bear testimony to the fact that those sceptics who prophesied that orchard-houses would never lower the price of fruit in the market, are now building and stocking substantial gigantic houses all over the country. Not to supersede, but to supplement their Peach, Plum, Fig, and Cherry houses; not to do away with their leviathan Royal Georges and other standard kinds of fruit-trees, but to enable them to keep abreast of the times, and to test the new kinds now so formidably numerous.

To the lover of horticulture, be he amateur or professional, the management and testing of a number of new kinds of fruit is a most interesting, nay, a fascinating occcupation. To the owner of a small garden the orchard-house affords more pleasure than any other structure, and to the merchant who now invests large sums of money in cheap but substantial glass structures, the return, whether it lowers the price of fruit or not, is certainly satisfactory. A few years ago a gentleman applied to me for a list of the best kinds of Peaches and Nectarines for orchard-house culture, and he is now producing over one thousand dozen of fruit in good seasons. Others are doing the same, with the natural result that Covent Garden quotations are now much lower than they were, be the cause what it may.

Reference to Dr. Hogg's "Fruit Manual" shows that we now have ninety-eight varieties of Peaches, thirty-five varieties of Nectarines, and seventy of Figs described and classified. The orchard-house now enables the professional grower to test a great number of these within reasonable limits before he transfers them to his extensive training-houses proper. Cherries the learned author divides into eight races, consisting of Red and Black Geans, Black and White Hearts, Black and Red Dukes, Black and Red Morellos, in all one hundred and fifteen varieties. The one hundred and fifty-six varieties of Plums he divides into Nectarines, Gages, Orleans, Apricots, Prunes, Pedrigons, Imperials, and Mirabelles. These he subdivides into free-stones and cling-stones. All are not suitable for growing under glass, but many of them are, and the only way in which the old friends with new names or sterling new kinds can be practically proved is, by growing and fruiting them in pots. To the amateur such formidable lists are bewildering; to the nurseryman they are probably injurious; but in order to enable the cultivator to make a judicious selection, lists of kinds suitable for special purposes will hereafter be given.

Of Pears nothing has as yet been said; but when grown on the Quince stock, and protected from spring frosts, all the best dessert kinds are worthy of a place under glass, where they form most beautiful pyramids and bushes, from which fruit of the first size and quality can be obtained.

Houses.—The original orchard-house in its simplest form was a plain glazed unheated structure, varying in size, ugliness, and aspect, to meet the requirements of the owner, and the space at disposal. This, thanks to our Popular Educators, has given way to more elegant and substantial, but none the less inexpensive houses, varying from ten to thirty feet in width, thirty to two hundred feet in length, and ten to fourteen feet in height. Where good walls covered with established trees exist, the lean-to, similar to a plain vinery, is best adapted to early culture, as the wall affords shelter from piercing winds. The trees on the walls, which absorb sun-heat, give the earliest fruit, while one or two rows of trees in pots placed on the front border give variety in succession. This house is easily built as a tenant's fixture, as shown in Fig. 1.

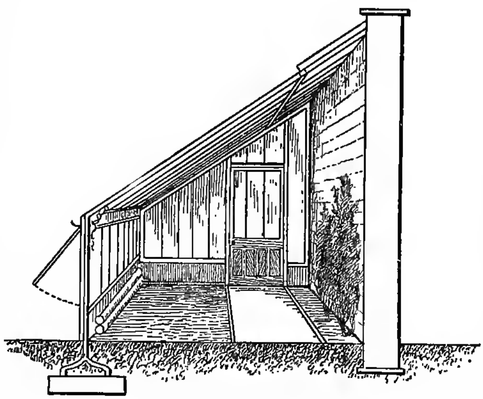


Fig. 1.—Portable Lean-to Orchard-house. (Tenant's Fixture.)

For intermediate purposes the unequal span, with the longest side facing the south or south-west, is strongly recommended, as it answers well for Peaches, Nectarines, Figs and Strawberries, still the cream of the cream of our orchard-house fruits. All the finer kinds of fruit, including the best mid-season Peaches, being in pots, and portable, the roof may either be fixed for obtaining the benefit of a maximum of light, or it may be composed of portable lights in the framework resting on iron standards. One or two pipes placed along the back and front will be abundantly plentiful, and ventilation at the apex and front must be on a very liberal scale.

For general market purposes, or for growing a large mixed collection of trees, including Plums, Pears, and Cherries, the true span with one end facing the south, the other the north, is to be preferred. A house of this kind should not be less than twenty feet in width, ten to fourteen feet in height, and sixty to one hundred feet in length. It will then admit of a raised border in the centre and narrow ones on each side and along the ends. The doors should be double or folding, and high, for the convenience of moving large trees in pots or tubs; and the gravel paths neatly edged with tiles, stone-kerbing, or a few courses of four-and-a-half brickwork where the borders are raised will make a neat finish, and answer every purpose quite as well as an expensive floor of flags or tiles. External borders being unnecessary, the foundations of the Orchard-house may be laid solid with the cheapest materials that can be obtained in the district, or, like the excellent houses erected by Mr. Pearson of Chilwell, near Nottingham, the framework may be composed of iron pillars placed ten feet apart, with iron purlins, tie-rods, and supports. These houses, which are the neatest, lightest, and most plessing structures that can be met with, are built by Messrs. Foster and Pearson, of Beeston, and they certainly do great credit to the designers. Moreover, they are cheap, durable, and movable, three qualities which should recommend them to the general public.

Fig. 2 is a view of the large orchard-house built by Mr. Pearson. It covers 2,700 square feet, and cost about 1s. 8d. per square foot, and is finished in a style fit for any gentleman's garden. Fig. 3 is a section of it.

Fig. 4 is a section of another of that gentleman's houses. It is fourteen feet in width, the framework is composed of iron, and the lights, made of wood, can be removed at pleasure. For the amateur or tenant who may be willing to build, but is unwilling to leave the structure behind him, this is a very suitable house, as it can be taken down, removed, and erected on another site without breakage or injury. All the parts of these houses being cast of uniform size, the sections can be repeated to any length, and neat structures, with all the latest improvements in ventilation and glazing, can be secured at a very cheap rate.

Ventilation, which should be abundant, may be secured by means of side-lights hinged to the top plate, and opening outwards with a longitudinal rod and lever, as in Fig. 3. The roof may be composed of movable lights, or it may be what is termed "fixed," as the trees being in pots, they can be removed to the open air after the crop is gathered and the wood is ripe. Top ventilation should, however, be abundantly provided, as all fruit-trees which are hardy, notably the Plums, Pears, and Cherries, cannot have too much air during the time they are in flower and setting their fruit, and again when it is laying on colour and ripening.

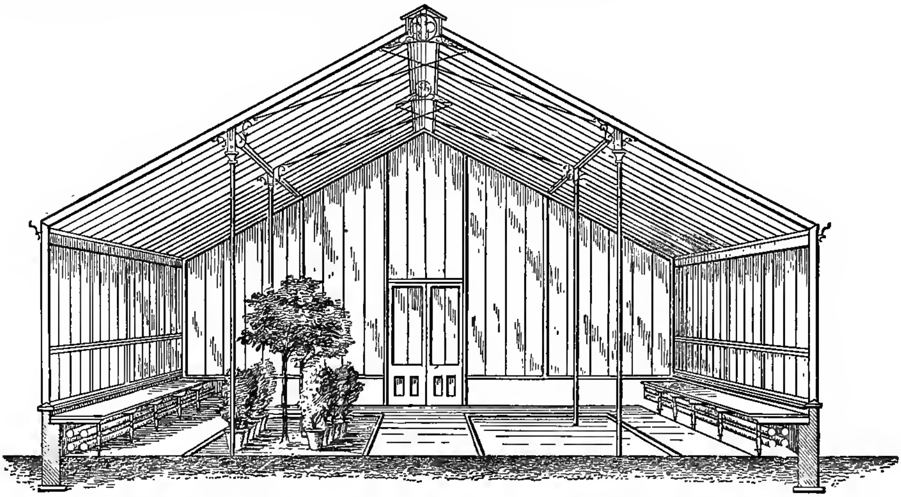


Fig. 2.—Mr. Pearson's Large Span-roofed Orchard-house.

Heating.—Last, but not least important, every house should be furnished with hot-water pipes for keeping the atmosphere dry and buoyant when the trees are in flower, and an excess of cold moisture is more injurious than frost itself. Many of the earliest trees will be in flower in March, a period at which we often have sharp frosts, when, even with the protection of twenty-one-ounce glass, an unheated house is not always safe. But frost is not the only enemy; a continuance of dark, dull, foggy weather causes the petals of the flowers to damp, and renders the pollen inert and unfit for the performance of its office. Again, where the house is to be made the most of by turning it into a Chrysanthemum house or conservatory through the early winter, warmth with a constant circulation of air are essentials that should not be lost sight of.

Water.—If the owner of an orchard-house were to overlook a liberal provision of this element, suc-

-cessful cultures would be impossible. Therefore tanks should be provided for catching all the rain-water that falls on the roof of every house and building within easy reach. Soft water answers best for syringing, as it is free from lime, and does not leave a deposit on the fruit. Next to this, water from an open tank or running stream, after it has been warmed and exposed to the atmosphere, answers very well for watering the trees and damping the floors. Cold spring-water, which one would choose for domestic purposes, is objectionable, as it chills and checks the tender foliage, and carries away the stimulating matter contained in the compost and top dressing. In dry seasons, when an abundance of water is imperative, the soft water should be husbanded for syringing with. Pond or river water should be used for watering and cleansing purposes, and spring-water, well warmed and aërated, should only be used when the others fail.

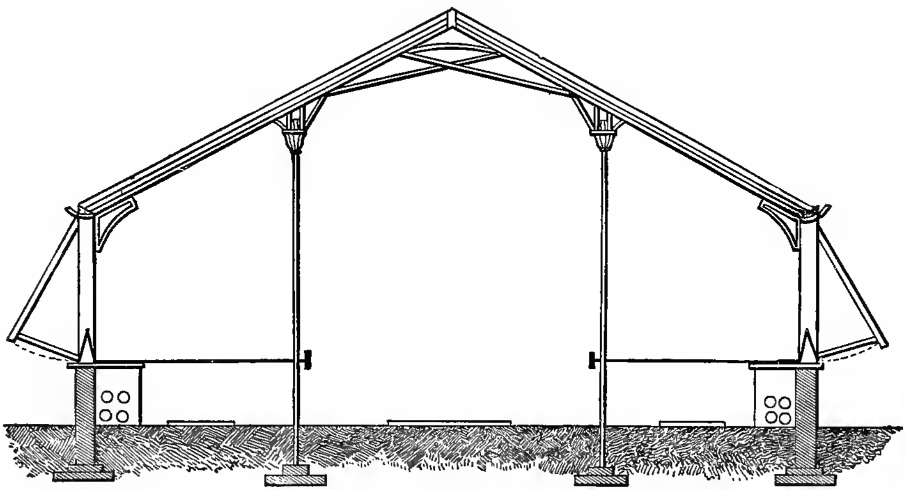


Fig. 3.—Section of Mr. Pearson's House. (*Scale: 8 feet to 1 inch.*)

In large houses a system of watering with the hose will economise labour, provided elevated tanks can be constructed for giving pressure. This, however, cannot always be secured; but be the system what it may, the supply must be plentiful and regular, as once allowed to become thoroughly dry at the root, the chances are ten to one in favour of a pot-tree being ruined for the season.

Stimulants.—Equally important is provision for supplying trees in pots with stimulating liquid. For general purposes there is nothing better than the drainings from cow-sheds, piggeries, or the frame-ground. This, it must be borne in mind, should be used in a diluted state after the fruit is set, and when the roots of the trees are in the greatest activity. Where these drainings cannot be obtained, good liquid can be made by placing bags filled with animal manure in the tanks provided for root-watering, but never in those from which water for syringing is obtained. As all fruit-trees thrive upon a change of food, weak guano-water and soot-water may be used alternately with great advantage. The latter in a weak clarified state may also be used for occasional syringing on fine evenings after the house is closed. When soot-water is judiciously used, all stone-fruit trees soon put on a dark green luxuriant growth of wood and foliage; but the amateur must bear in mind that stimulants should be administered with a careful hand, as ammonia in excess very often paralyses the roots, if it does not completely kill them.

Compost.—Where it can be obtained, good stiff loam of a calcareous nature, in which Roses and Strawberries grow well, when mixed with proper correctives, will be found suitable for all stone-fruit trees. This should be cut and stacked in thin ridges in the open air a few months before it is wanted for use. Summer drought or winter frost will then pulverise the soil and destroy wire-worm, as well as the larvæ of insects, before it is taken for use.

Pears and Figs grow and fruit well in what is termed a soft, sandy loam, which would be too light for stone-fruit trees; not that the latter would refuse to grow in it, and grow well, but the fruit would not be so fine, neither would it pass the stoning process so well as it would in a loam of heavier texture; therefore, if the two loams can be obtained, they should be stacked separately, where they can be protected from heavy rain and snow through the winter.

The best *correctives* or materials for keeping the soil sweet, open, and pervious to water, are old lime rubble, hairy plaster from chips or bits of wood, charcoal, burnt earth, or broken bricks. When one or all of these materials have been obtained—the first is indispensable, as stone-fruit trees revel in old lime rubble—two-thirds of the loam roughly chopped, one-third of rubble, and twelve per cent. of crushed bones should be thoroughly mixed and kept dry for some two or three weeks before the trees are ready for potting. Animal manure, unless the soil is very poor, need not be used, at least at first, as newly-potted trees will grow fast enough without it; but when it is required, old dry cow-dung from the feeding stalls, where corn and cake are given to the animals, will be found an excellent stimulant for mixing with light soils, while horse manure will be most suitable for heavy, clayey loams.

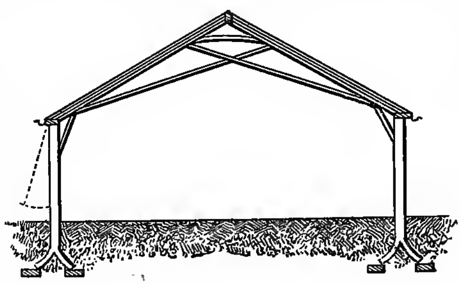


Fig. 4.—True Span Orchard-house (Portable and Tenant's Property). *Scale: 8 feet to 1 inch.*

The owner of broad acres will have no difficulty in obtaining the preceding materials, which are the best; but what must be said to the tradesman, the merchant's clerk, and the masses living in and near large towns? In populous districts where the demolition of old, and the erection of new buildings is constantly going on, *débris* from the one, and the new soil from the foundations of the other, can generally be obtained. It may be too light or too heavy; but being fresh it can be corrected by the addition of marl, ordinary garden soil, burnt earth, or parings and scrapings from lime-stone roads. If the main staple cannot be obtained in sufficient quantity, good ordinary garden soil, lime rubble, and crushed bones will together make up a compost in which any kind of fruit-tree will grow and produce good fruit.

Selection of Trees.—Where time is of more value than money, one season can be saved by purchasing trees established in pots, but they do not always grow and fruit so well as home-grown trees, at least until they have been re-potted and brought under the practical grower's special treatment. Many nurserymen keep a large stock of established trees by them, and offer them at a reasonable price; carriage and packing, however, form a heavy item, and on this account many growers prefer forming their own trees.

Assuming then that a selection of Peaches and Nectarines, which justly head the list of orchard-house trees, has been decided upon, the "maiden" tree should always be chosen, as it is young, cheap, and suitable for growing into bush, pyramid, or cordon. If possible, the experienced grower should select his own trees, while others who are not so well skilled may safely entrust their orders to any respectable nurseryman. Early autumn, before lifting is commenced, is the best time to choose the trees; it is also the proper time to pot them up, as they then form fresh rootlets before they go finally to rest for the winter. If well grown on clean stocks which suit them, good "maidens" will be from three to four feet in height, well furnished with side shoots, and the union with the stock will be clean and free from gum or blemish.

Potting. — As future success greatly depends upon the way in which the trees are potted, everything should be in readiness for use on their arrival from the nursery.

Clean pots from nine to twelve inches in diameter will be quite large enough for the first fruiting year, and these should be prepared in the following manner:—With a hammer increase the size of the hole at the bottom, place a large flat crock, convex side upwards, over it, then follow with one and a half to two inches of finer particles, free from dust or dirt, scatter a little soot over the surface to keep back worms, and place them handy for use. Prepare trees by cutting away all mutilated pieces of the roots, shorten back the strongest, and arrange them in two sizes. If the compost is dry enough to bear great pressure without becoming adhesive, introduce a few handfuls of the roughest pieces of turf, make it very firm with a short rammer, place the tree in the centre of the pot, and work the finer parts of the soil well in amongst the roots. Ram well as the work proceeds, and finish off one inch below the rim to allow for supplying water. If the autumn is fine and warm, place the trees on a sheltered sunny border out of doors; if cold and wet, set them in a cold, airy house. When all the trees are potted and arranged, give a little water to settle the soil about the roots, and dew them over with the syringe on fine days to keep the buds fresh and plump. Attach a neat indelible label or number to each tree, and defer pruning until the spring.

With the exception of Figs, which should be thoroughly established in their pots before they go to rest, the above directions apply to the potting of all kinds of fruit-trees for orchard-house culture, as the secret of success consists in having clean, dry pots and crocks, and dry compost, which will bear ramming until it is as firm as the old pasture from which it has been taken. The largest quantity of food is then placed in the smallest possible space, but little room is left for the retention of water; and the roots, in a resisting medium which they enjoy, form an abundance of spongioles by the time the buds start into growth in the spring.

It is hardly necessary to inform even the inexperienced in orchard-house culture, that maiden trees potted in October are not expected to bear fruit the following season. Therefore, they must be stored as close as they will stand in a cold house, where the pots can be well protected from frost and drought, with dry fern, litter, or spent tan. Here they may remain until the following February, when the little pruning they may require must be performed. But notwithstanding the fact that the Peaches and Nectarines will not produce fruit, it must not be assumed that the orchard-house will be for a whole year fruitless and useless. Therefore, while our pot-trees are snugly tucked up in their winter quarters, we will endeavour to show how, during the first season, the house can be made the most of. Plums, Pears on the Quince stock, and Cherries on the Mahaleb, either as pyramids or bushes, can always be obtained beautifully furnished with flower-buds. These, if potted up with the Peaches in October, will produce fruit the following year. The same compost and the same treatment recommended for Peaches will suit them, but it is not absolutely necessary that they be wintered under glass, provided the pots are secured from frost, and the buds are protected from birds. Then, again, there are Tomatoes, with which every scrap of unoccupied space can be made profitable; and, last but not least important, we have the finest-flavoured *Strawberries* for giving a supply of fruit before, and for some time after, they appear in the open air.

In order to have Strawberries properly prepared for forcing, it will be necessary to hark back to the end of June. About that time, earlier if runners are ready, take clean five-inch pots for early kinds, and six-inch pots for late ones. Crock them well, but not to any great depth, say one inch of crocks in each; then to two-thirds of strong calcareous loam, add one-third of rotten manure, and twelve per cent. of bone-dust, mix well, and place the compost in an airy shed to dry. When it is in a fit state for ramming without becoming adhesive, commence filling the pots by sprinkling a pinch of soot over the crocks to keep back worms; then a few handfuls of the roughest of the compost, which must be well pounded with a short rammer, until it is as firm as the pasture from which the loam was obtained. Continue this process until a sufficient number of pots are filled nearly level with the rim. Convey the pots to the Strawberry beds, and place them in blocks or rows near the outside, as there the runners will be strong, sturdy, and vigorous. Place one good runner that is about forming roots on the centre of each pot, and secure it with a short birch or wire peg.

Give each pot enough water to moisten the whole of the soil, and continue the supply every evening if the weather be dry. In three weeks examine the pots, and if the roots have reached the crocks, detach them from the parents, and remove the pots to a light airy situation to complete and ripen their growth. Worms having a great liking for the rich, moist compost, the station should be well faced with pounded cinders or coal-ashes, to keep them from entering the pots. Keep the plants well supplied with water, remove all runners, and increase the distance between the pots to let in light, and to prevent the foliage from becoming "drawn." If the compost is rich, and the plants make robust growth, do not apply stimulants, as grossness produces double crowns which throw up two scapes. Moderate growth results in one well-ripened crown, from which an abundance of the finest fruit is obtained. Towards the end of October plunge the pots up to the rim in some non-conducting material free from worms, quite out in the open, where the plants can have full exposure to rain and snow, and have a few sprays of bracken thrown over the crowns in very severe weather.

Like the stone-fruit trees of which notice has already been taken, the roots of Strawberries in pots should never be allowed to feel the want of water. Therefore, exposure to the elements will be less likely to lead to mishaps than coddling and starving them on dry floors or shelves in cold, arid houses. Towards the end of January the plants may be taken into the orchard-house, either in batches for succession, or in a body where profit from early fruit is an object.

AUTUMN-POTTED TREES.

First Year's Management. — *Pyramids — Pruning and Pinching.*—Having decided upon the style of tree or trees best adapted to the house, the end of February will be a suitable time to cut back the side shoots. If a pyramid be wanted, they must be cut back to within a few inches of the stem near the base, and to a single bud near the apex, the leader being shortened more or less according to its state of ripeness. If clean, straight, and well grown, Fig. 5 will be a fair representation of a maiden Peach after it has been pruned and ready for starting into growth. By the end of May the buds on the side shoots, and others on the main stem, will have formed numerous young growths, which must be pinched when they have made four or five leaves, not taking into account the one or two small ones near the base; closer where there is likely to be a scarcity of wood. In a short time these pinched shoots will throw out a fresh break of laterals which must be pinched at the third leaf, and so on until the end of July, by which time a close pyramid plentifully furnished with blossom-buds will have been formed. If the height of the house admits the leader to extend a foot, then take out the point to induce side breaks. Repeat this process as often as may be necessary, and keep all sub-laterals pinched when they have made three leaves.

Bush Trees. — The bush tree (Fig. 7), a form most generally met with, can be made by shortening back the stem of a maiden to within twelve inches of the union of the bud with the stock; all side shoots, if any have been formed so near the base, being cut back to a single bud. When both pyramid and bush forms are wanted, the tallest and best-furnished maidens should be selected for the first, as the side shoots which have been made in the preceding season at once form the framework of the future tree; while maidens having a number of dormant buds near the base make the best bushes, as they break evenly into as many well-balanced shoots in the following season. If any of these side shoots show a tendency to take the lead, pinch out the points when they have grown a foot, and continue this process if necessary, until last of all the weakest will become strong enough for stopping. If, as is rarely the case, all the shoots start away equally strong, this consecutive stopping of the bush trees will not be necessary, but all of them should be pinched about the end of July, to throw up the flower-buds which have formed near the base of each shoot.

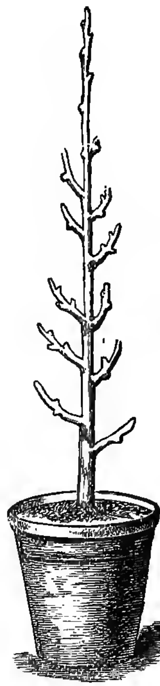


Fig. 5.—Maiden Peach pruned to form a Pyramid.

Fig. 6.—The Pyramid formed and in bearing.

Cordons.—When it is desirable to form cordons, the tallest and cleanest-stemmed maidens should be selected. If ripened up to the terminal bud they may be left the full length, otherwise they may be shortened back one-third of their length. As these trees are generally placed eighteen to twenty-four inches apart, and trained obliquely, vertically, or horizontally against back walls or trellises, all the side shoots should be cut in close home where a bud has been formed at the base, but as many of them form the first bud two or three inches away from the main stem, the cut must not be made below that bud, otherwise that particular break will be lost. All the buds will then break away evenly together, but all will not be of equal strength, therefore pinching must receive timely attention, as it is by judicious pinching more than by pruning that handsome trees of this and the preceding forms can be obtained. Some pinch their cordons as soon as they have made three leaves with buds at the base of each leaf, others allow them to make five or six leaves; but if well furnished with buds, close stopping answers best. The experienced can tell at once when and where to pinch; but, like the thinning of grapes, it is an art which can only be attained by observation and experience.

Arrangement of the Trees.—When all the trees have been pruned, wash them with warm soap-water, also wash the pots, and see that the apertures have not been tampered with by worms, then proceed to arrange them in the following manner. Place Figs where they can have the benefit of the most heat, then follow with Peaches and Nectarines, Apricots, Plums, Cherries, and Pears. Let the tallest trees occupy the centre of the house, arrange the bushes along the sides, and place the Strawberries on the shelves or side tables. The latter, prior to being taken in, should be cleansed, well rammed, watered with lime-water to destroy worms, and top-dressed with equal parts of rich loam and rotten manure. Tho distance from tree to tree need not exceed three feet the first year; in small narrow houses they may stand closer, but in large structures like Fig. 2, where it is necessary to get in amongst them, nothing will be gained by overcrowding. They should not, certainly during the first season, be placed on the surface of rich borders, otherwise the roots will leave the pots and find their way downwards, when the growths will become gross, watery, and sparely set with blossom-buds. Moreover, the inducement to fill the pots with fibrous roots will no longer prevail, the compost will become sour, and the trees will receive a violent check when those truant roots are severed in the autumn. Neglect of this important matter during the time the trees are in course of formation has led to many failures, when the system instead of the management has been condemned.

Fig. 7 —Bush Tree (Lord Napier Nectarine).

To steer clear of this danger, let each pot be placed upon two bricks or tiles, a space being left between the bricks for the outlet of water. The latter will then pass away freely, healthy roots will take full possession of the closely-rammed compost, and the growths will be short-jointed, floriferous, and well ripened by the end of September.

As detailed management of the house will be fully entered into in the second or fruiting year, it will not be necessary to prolong this section by giving it at this stage. Therefore, the end of September having arrived, Plums, Pears, and Cherries from which the fruit has been gathered, also Peaches and Nectarines which have not borne fruit, may be placed out of doors, where they can be properly supplied with water, and receive the benefit of autumnal rains. But on no account must the roots be allowed to become *dry*, otherwise the trees, being now furnished with flower-buds, will most certainly cast them when they ought to be expanding in the spring.

To relieve the amateur, for whom these pages are written, from doubt upon the performance of the operations to which attention will be given in the succeeding papers, it may be well to say that rich top-dressings, which play such an important part in the pot-culture not only of fruit-trees but of everything, will not be required the first or preparatory year. Neither will it be necessary or advisable to pot or re-pot any of the trees, at least those which are of home-make, and have been grown in eleven and twelve-inch pots. If the pots are unusually full of spongioles so much the better; this condition will be what the tyro who follows these directions may expect; but instead of casting away the bird in hand by re-potting, let him drop all such pot-bound trees into clean empty pots just large enough to receive them when he houses them in the month of January. Indeed, it is an excellent plan to place every orchard-house tree in a second pot with an enlarged aperture, not only to economise watering through the dog-days, but to protect the thousands of roots which ought to be clustering round the sides, if the trees are to produce fruit in quantity and quality worthy of our time. In neat well-kept places the pots used for this purpose should be clean or new, and of uniform size; or, better still, the handsome and cheap terra-cotta vases manufactured by Matthews, of Weston-super-Mare, and others, are specially designed for this use in conservatories. Such vases can be used with or without the saucers for pot fruit-trees, and are invaluable for hiding the pots of specimen Chrysanthemums when the orchard-house is transformed into a conservatory through the winter.

FERNS.

By James Britten, F.L.S.

Brainea insignis.—Among the smaller-growing tree-ferns there are none more deserving of cultivation than this, the only species of the genus. It is a handsome plant, with a stem—in fully-developed specimens—three or four feet in height, and three or four inches in thickness, and dark green, leathery, simply-pinnate fronds, with serrated pinnæ. Sometimes the fronds attain a length of three feet, and in healthy, well-grown specimens form a beautiful crown of foliage. It is a native of Hong Kong and the Khasya Hills. It might reasonably enough be expected that a Hong Kong plant would under cultivation thrive in a cool house; but imported stems, placed in an intermediate and cool house, have not, as far as our experience extends, justified such a course of treatment. On the other hand, they have succeeded thoroughly well in a stove, the fronds being much larger and finer, and the plants growing more freely in the warmer temperature. Brainea, too, is one of the few tree-ferns which can readily be raised from spores, if such a method be followed as that recommended for Adiantums at the commencement of these articles. During the season of growth an abundance of water is necessary; merely wetting the soil in which the plants are potted is not sufficient. The stems should be kept moist, and the entire plant frequently wetted overhead. In winter a partial drying off is desirable, though not necessary, and the temperature may be lowered and the atmosphere kept drier. Peat is the best soil for Braineas, and care must be taken to thoroughly drain the pots, in order to prevent any possibility of stagnation from the copious supply of water necessary to the well-being of the plants when growing. Provided direct sunlight is guarded against, too much light cannot well be given.

Ceratopteris.—The genus *Ceratopteris* is a very interesting, and moreover a rather anomalous one, different authorities placing it in different groups, and some maintaining it as a tribe by itself. *C. thalictroides* is the only species, and it is widely distributed throughout the tropics. In the "Synopsis Filicum" the following countries are particularised: Mexico and the West Indies southward to Brazil; the Punjaub southward to tropical Australia, Madagascar, Angola, and west tropical Africa. It is one of the few ferns of truly annual duration, and moreover is perhaps the only one which can be classed as truly aquatic. It is always found either floating or attached to the soil in shallow, still, or slightly-moving waters. The stout, tufted, thick, inflated stipes are filled with large air-cells, a provision which serves to render the plant buoyant enough for its watery home. The fronds are light green in colour, succulent in texture, the barren ones floating, simple or slightly divided when young, twice or thrice cut, with narrow linear segments when mature; the fertile ones are more finely cut, the segments being much narrower. The young succulent foliage of this fern is boiled and eaten as a vegetable by the poorer classes in the Indian Archipelago.

Cultivation.—Wherever tropical aquatics are grown, this fern can be cultivated without trouble. The spores should be sown in spring in a shallow pan of loamy soil made wet like mud, and kept constantly moist. When the plants have attained a sufficient size they are best potted in pans or pots, and these submerged an inch or two in a larger vessel, or in the tank in which such plants as the exotic Water Lilies, &c., are grown. They thrive well enough even if planted out amongst the muddy soil which is usually found best for such subjects as the Sacred Bean, *Nelumbium speciosum*, &c.; but the conditions most favourable for the full development of this strange fern obtain in the tropical Water Lily tank. The fronds—the sterile ones—are very proliferous, and, floating on the surface of the water, soon produce a crop of young plants; if, however, by means of stakes they are prevented from touching the water, the gemmæ do not develop into plantlets. In autumn the pot in which the parent plant is growing should have its rim raised above the level of the water in order to allow a crop of spores to sow themselves on the muddy surface; the next spring these will germinate freely, and thus the necessity of saving spores and re-sowing will be obviated.

The Woodwardias.—*Woodwardia* belongs to the tribe *Blechneæ*, of which *Blechnum*, *Doodia*, and *Sadleria* are the only other genera. It is a small genus of some half-dozen species, five of which at any rate are in cultivation. They are essentially cool ferns, and thrive well in the cool green-house or unheated conservatory. Unlike most other ferns in habit, they are decidedly worth growing for their distinct aspect. They occur in the northern temperate zone of both hemispheres, and are naturally divided into three groups, each containing a couple of species. In the first one (*W. radicans* and *W. orientalis*) the fronds are uniform, and the veins form at least one series of areolations between the sori and the margin. The second group (*W. virginica* and *W. japonica*) also has fronds alike in outline—that is to say, the fertile ones do not differ in shape from the barren ones; but the veins are all free between the sori and the margin. The representative of the remaining group (*W. areolata*) has dimorphous fronds, and the veins everywhere anastomose, or run into each other. All have linear or linear-oblong sori, sunk in cavities of the frond, placed in single rows parallel with and contiguous to the midribs of the pinnæ and pinnules. For convenience of reference, the species—as in the other genera already treated in this work—are arranged in alphabetical order, and not in their botanical sequence.

W. areolata, a rather rare fern, occurs in bogs in the United States from Massachusetts to Florida. The fronds are pinnatifid, the sterile ones (twelve to eighteen inches high) with lanceolate serrulate divisions, united by a broad wing; the fertile fronds are taller, with narrowly-linear, almost disconnected, divisions. This species is frequently met with in books and gardens under the name of *W. angustifolia*. *W. japonica*, from China and Japan, is a handsome plant, with dark green fronds. The erect stipes, which are scaly below, measure from six to twelve inches in length, and the broadly-ovate bipinnatifid fronds are from twelve to eighteen inches long by nine to twelve inches broad. In *W. orientalis*, the erect stipe is densely clothed at the base with large linear-lanceolate scales. The fronds vary from four to eight feet long by twelve to eighteen inches broad, and the lanceolate pinnæ, sometimes more than a foot in length, are cut down below nearly to the rachis into sinuated or pinnatifid pinnules. Not unfrequently the upper surface of the frond produces a large crop of gemmiferous buds, from which a stock of young plants is easily and rapidly raised. *W. radicans*—the only member of the genus which is represented in the flora of Europe—is wild in Madeira and the Canaries, Spain, Italy, Sicily, Northern India, Java, California, Mexico, and Guatemala. It has dark green fronds, three to six feet long by twelve to eighteen inches broad; the pinnæ are lanceolate, and are cut down below within a short distance of the rachis into finely-toothed lanceolate pinnules. Like the last-named species, this very often develops young plantlets at the base of the pinnæ; but they are usually fewer in number and larger in size. The tip of the frond, too, if it rests on a damp surface, readily roots, and forms a new plant. *W. virginica* has pinnate fronds two to three feet in height, with numerous lanceolate pinnatifid pinnæ; it is a native of Bermuda, Canada, and the United States from Vermont to Florida.

Cultivation.—In many parts of this country the species above mentioned are quite hardy, and all will thrive in the unheated green-house, particularly if planted ont in a moist spot amongst peat and leaf. They are all strong-growing ferns, and practically will succeed in good loam, provided drainage sufficient is given to guard against stagnant moisture. A copious supply of water is necessary, and shading is hardly needed.

The Osmundas.—The genera *Osmunda* and *Todea* together form a distinct sub-order of ferns—viz., *Osmundaceæ*. Only some half-dozen species of *Osmunda* are known, and nearly all these are in cultivation. The British representative of the genus is the well-known Royal Fern, the most stately and beautiful of European members of the fern kingdom; this, too, is the one which is the most widely distributed—the only *Osmunda*, in fact, which extends to southern temperate latitudes. Both in a state of nature and under cultivation this varies a great deal, and a number of natural and artificially produced forms have received from time to time distinctive names. All the species are quite hardy in this country, with the single exception of *O. Javanica*, and this too, if imported from its most northern habitats, would, in all probability, prove as hardy as its congeners.

In *O. cinnamomea*—the Cinnamon Fern, so called on account of the cinnamon-coloured sporangia—the fertile and barren fronds are normally quite separate, the latter are simply pinnate, the pinnæ being cut down nearly to the rachis into close oblong lobes. The fertile fronds are contracted and twice pinnate. When young every part of the plant is covered with rusty-brown wool, which, however, quite disappears from the sterile fronds when fully matured. Under favourable conditions this species will attain a height of about five feet. It grows in large bunches, the fertile fronds in the centre, one to two feet long, perfecting fruit as they unfold, and decaying before the sterile fronds get their growth. The geographical distribution of *O. cinnamomea* is from Newfoundland and Canada to Mexico, the West Indies, Guatemala, New Grenada, and the Organ Mountains.

O. Claytoniana is a somewhat smaller-growing plant than the last-named, rarely attaining more than two or three feet in height. Instead of the fructification, however, being produced by separate fronds, it is developed on separate pinnæ about the middle or near the apex of the frond. When young the fronds are clothed with loose, rusty-coloured wool, but become smooth by the time they are fully unfolded, when the colour is a soft, pleasing green. This species is found in Canada, throughout the United States, and in the Himalayas, where it ascends to elevations of 10,000 feet above sea-level.

O. javanica is a very distinct species, with simply-pinnate, leathery, smooth fronds, one to three feet long by eight to twelve inches broad; the fertile

OSMUNDA PALUSTRIS.

pinnæ are shorter than the others, and are made up of numerous close but distinct oblong sessile clusters. This is a handsome dark green foliage plant, well worth growing for decorative purposes in the greenhouse or cool conservatory. It occurs in a wild state from Kamschatka to Java and Ceylon. Probably the only other *Osmunda* in cultivation in this country is the ubiquitous Flowering Fern, *O. regalis*, which is found widely distributed over both hemispheres. The name "Flowering Fern" is owing to the fact of the crowded fertile pinnules forming a copious panicle at the top of the large fronds. The many-headed root-stock, densely clothed with matted fibres, sometimes attains a height of a couple of feet, and is extremely hard. The height of the fronds varies a good deal; around the margins of some of the Irish lakes they are not unfrequently met with eight, ten, and even twelve feet high.

Cultivation.—All the Osmundas are essentially water-lovers; they affect boggy spots and damp woods, and attain their highest development in sheltered shady places, where the roots can revel in a constant and abundant supply of water. Peaty or boggy soil suits them best, and in this, provided the necessary moisture is present, the fronds grow larger and finer than in any other soil. They, however, will thrive in almost any garden soil to which has been added a good proportion of leaf-mould. *O. palustris*, a variety of *O. regalis*, which occurs in Central America and Brazil, is a very graceful and beautiful plant. For garden purposes it is abundantly distinct from the type, and its young fronds, which are a fine red colour when first unfolded, render it a very valuable decorative plant. It is readily raised from spores, and by this means is largely propagated by some of the growers who supply Covent Garden. There are few more distinct and striking ferns in a small state, and none which are more rapidly and more easily grown.

The Polypodiums.—Probably few ferns exhibit greater contrasts in size and general aspect, and in the texture and cutting of the fronds, than do some of the species of *Polypodium*, the largest genus in the fern kingdom. No less than four hundred and fifty species are described in the "Synopsis Filicum," and the genus is represented in all regions, but most numerously within the tropics. As understood in the standard work just mentioned, the genus *Polypodium* includes all the ferns belonging to the tribe *Polypodiaceæ*, and is characterised by the round or rarely oblong sori—not more than twice as long as broad—being situated on the back of the lobes. By some authors the following names, arranged in alphabetical order, are made to represent distinct genera, but in the "Synopsis Filicum" they simply constitute more or less distinctly marked sections of *Polypodium*—viz., *Campyloneuron*, *Cyrtomiphlebium*, *Dictyopteris*, *Drynaria*, *Goniophlebium*, *Goniopteris*, *Grammitis*, *Niphobolus*, *Phegopteris*, *Phlebodium*, *Phymatodes*. It appears desirable to mention these, as not unfrequently they are used in nurserymen's catalogues and in horticultural literature. As, however, the specific name is nearly always the same, no matter under what genus the species may be placed, there will be no difficulty in recognising the ferns spoken of, and identifying those described in these pages. Amongst others, the late Mr. J. Smith, formerly curator of the Royal Gardens, Kew, considers *Phlebodium* as a good genus; therefore *Phlebodium aureum* of his numerous works on ferns will be readily found in these notes under the same specific name, viz., *Polypodium aureum*. (See p. 84.)

There are two principal divisions of this huge genus, well marked by a decided difference in growth, and both these are represented within the limits of the British flora.

If a plant of the common Polypody (*Polypodium vulgare*) be examined, it will be seen that its fronds are produced singly from the sides of a creeping progressing stem, which has its accrescent apex always in advance of its young developing frond, each successive frond being produced singly from special nodes, formed at more or less distance apart, and in an alternate manner on the sides of the progressing axis; the foot or base of attachment of the frond forming with the node a distinct and well-marked articulation or joint, which ultimately becomes the point of separation of the mature frond, the node remaining permanent in the form of a round, more or less elevated cicatrix. This mode of growth has been called Eremobrya by Mr. Smith, and may be taken as the type of one of his three great divisions of the fern family. The Oak and Beech Ferns (*P. Dryopteris* and *P. Phegopteris*) are, on the other hand, representatives of the second of his divisions, viz., Desmobrya, and a casual examination of either of these will show that the stipes are not articulate with the root-stock, and that after the death of the fronds they remain attached. Only a selection of the best and most striking species of those in cultivation at the present time in this country is given below.

STOVE KINDS.

P. angustifolium, a very variable species, ranging from Cuba and Mexico to Peru and Brazil, has a stout rhizome, clothed with deciduous brown lance-shaped scales, and leathery entire shortly-stalked fronds, twelve to eighteen inches long by about a quarter of an inch in breadth

P. aureum, a noble species with arching bluish-green fronds, was one of the first of stove-ferns to find its way to British gardens; the precise date of its introduction is unknown, but it was cultivated by Lord Petre (who introduced it) prior to 1742. It is a native of Florida and Mexico, southward to Brazil, and it has also been found in Australia. Whether in a juvenile or adult stage this fern is highly ornamental, presenting a distinct and striking aspect, and being readily and rapidly propagated from spores. In small pots it comes in very useful for ordinary decorative purposes, the golden-yellow or rusty scales, which densely clothe the thick wide-creeping rhizome, contrasting markedly with the somewhat coriaceous, glaucous-green fronds. Fully-developed plants have stout, erect, naked, glossy stipes, one to two feet long, and bold, handsome fronds, three to five feet long by nine to eighteen inches broad. This is one of the ferns that are grown largely to supply Covent Garden, a pretty sure test of its value for "furnishing."

P. fraxinifolium, as might be expected from its name, has pinnate fronds, resembling in outline the leaf of an Ash; the stout rhizome is clothed with deciduous, spreading, dark brown, narrow scales; the firm, erect, naked stipe measures one to two feet in length, and the frond itself (in old plants) two to four feet long by a foot to a foot and a half broad. In texture it resembles the last-named species, and in a wild state occurs from Columbia to Brazil and Peru.

P. guatemalense somewhat resembles *P. fraxinifolium* in general aspect and texture. It has naked straw-coloured stipes, six inches to a foot in length, and fronds two to three feet long by a foot or more in breadth. It is a native of Guatemala.

P. hastæfolium owes its name to the sharp distinct auricle which is found at each side at the base of the blunt entire pinnæ. The wiry, deciduously scaly, tufted stipes are one or two inches long, and the fronds six to nine inches long by one and a half to two inches broad. They are slightly leathery in texture, the rachis is hairy, and the under surface of the frond nearly naked. It is a native of the West Indies.

P. irioides has sessile or nearly sessile sub-coriaceous undivided fronds, narrowed gradually to both ends. They are naked on both surfaces, and the very small and numerous sori are irregularly scattered over the lower one. The rhizome is stout, and is clothed with dark brown blunt scales. This species has a wide distribution, being found from North India and Chusan to Fiji, the Isle of Pines, and New South Wales, the Mascarene Islands, Zambesi-land, Natal, Angola, and the Guinea coast.

P. leiorhizon has a very thick rhizome, clothed with ovate, adpressed peltate scales and erect stipes, one to two feet long, surmounted by fronds, two to four feet long by one to two feet broad; the pinnæ are narrowed at the base, and have entire edges. This is a native of Northern India, where it ascends to elevations of 7,000 feet above sea-level.

P. longissimum is a handsome plant, with deeply pinnatifid leathery fronds, one to four feet long by six to twelve inches broad; the firm glossy stipe frequently measures three or four feet in length; the wide-creeping rhizome is clothed with ovate, brown, adpressed scales. This makes a fine specimen plant, either in a large pan or planted out amongst stones, &c., in the stove fernery. It is a native of North India, the Neilgherries, Malacca, the Philippines, and Formosa.

P. Meyenianum belongs to the section Drynaria, which is characterised by having either a separate sterile frond, or the base of the ordinary one pinnatifid like a sessile Oak-leaf, brownish in colour and rigid in texture. It has a very stout rhizome, clothed with linear, crisped, bright reddish-brown, narrow scales, half an inch in length; the fronds are two to three feet long and eight to twelve inches broad. This very distinct and strikingly handsome species is a native of the Philippines.

P. neriifolium is a near ally of *P. guatemalense*, already described. It differs principally in the grey, lance-shaped spreading scales of the stout rhizome, in the sinuated terminal pinna, and in its more leathery texture. It is found from the West Indies and Mexico to Brazil and Peru.

P. pectinatum is a graceful species, with a stout fibrillose rhizome, finely hairy or naked stipes, two to six inches long, and deep green fronds of a thin, papery texture, one to two feet long by two to six inches broad, cut down to the rachis into numerous close, horizontal, entire or slightly-toothed pinnæ. The rachis and both surfaces are either naked or finely hairy, and the veinlets are pellucid. In a wild state it is abundant from Mexico and the West Indies to Peru and Brazil.

P. percussum has a wiry, wide-creeping rhizome, with lanceolate, adpressed, deciduous scales; short, firm, erect stipes; and very leathery, rigid, entire fronds (gradually narrowed to both ends) from six to twelve inches long by three-quarters of an inch to an inch and a half broad; the under surface is clothed with fine scattered scales, and the round sori are distinctly immersed. It is a native of the New World, ranging from Columbia to Peru and Brazil.

P. Phyllitidis, a species abundant from Florida to South Brazil, is an ally of *P. angustifolium*, the first species described here. It has rigid, very leathery, naked fronds, from one to three feet long by one to four inches broad, with an acute point, and the lower part very gradually narrowed, the margin being entire or slightly sinuated. The stipes are scattered or produced in small clusters, short or sometimes altogether suppressed.

P. Phymatodes is widely distributed throughout the Southern Hemisphere, and also occurs in Formosa and Loo Choo. The wide-creeping woody rhizome is clothed with dark brown fibrillose scales, and the leathery naked fronds vary a good deal in size and outline. It belongs to the same section as *P. longissimum*, already mentioned.

P. piloselloides is widely different from all the preceding species. It is a tiny and very curious plant, thoroughly suitable for cultivation in the Wardian case or for clothing moist surfaces of stones, &c., in the stove rockery. It has a widely-creeping, slender, climbing rhizome, clothed with fibrillose scales and dimorphous coriaceous fronds, the barren ones oblong, entire, one to three inches in length by half an inch to three-quarters of an inch broad, and the fertile ones narrower and longer, both borne on short ciliated stipes. This species is common throughout tropical America, including the West Indies.

The nearest ally of *P. quercifolium* among those which have been mentioned above is *P. Meyenianum*, from which this differs in the sessile sterile fronds being really distinct from the long-stalked fertile ones. It is a noble plant, well worth growing in any collection of stove ferns. It is found from North India and South China to Ceylon and Queensland.

GREEN-HOUSE KINDS.

P. Billardieri, from New Zealand, South Australia, Tasmania, and the neighbouring islands, is a near ally of *P. Phymatodes*, already described among the stove species.

P. juglandifolium, the Walnut-leaved Polypody, is the green-house representative of the stove *P. leiorhizon*. It inhabits the same country, viz., Northern India, but ascends to elevations of 10,000 feet above sea-level. The large, oval, bright reddish-brown scales, which clothe the stout woody rhizome, afford a striking contrast to the deep green of the large, somewhat leathery, pinnate fronds.

P. plebeium, a native of the New World from Mexico to Peru, is intermediate as far as general habit is concerned between *P. pectinatum*, above mentioned, and our indigenous *P. vulgare*. It has a stout wide-creeping rhizome, clothed with small grey scales, the rachis and under surface of the pinnæ covered with small scattered scales.

P. punctatum is very widely distributed throughout the Southern Hemisphere, and is also found in Northern India and Japan. It is an ally of our native Beech Fern, but is a very much larger and finer plant. From the firm, wide-creeping, hairy rhizome, spring the firm, erect, straw-coloured, polished stipes, surmounted by the thin-textured compound fronds. The variety *rugulosum* has a less cut and more leathery frond, with a deep purplish-brown and densely viscid rachis.

P. pustulatum, from New Zealand and both temperate and tropical Australia, is nearly related to *P. Phymatodes* and *P. Billardieri*. It varies from six inches to a foot in height, and is well worth a place in a collection of green-house ferns.

P. serpens has a firm rhizome, clothed with linear rusty-coloured scales. The stipes are short, erect, and the fronds dimorphous, the barren ones round or elliptical, and the fertile ones longer and narrower, these latter only attaining a length of four to six inches by a breadth of half an inch, or slightly more. The texture is leathery, the upper surface being scattered, and the lower densely coated, with close whitish tomentum. This species occurs from Australia and New Zealand eastward to the Society Islands.

HARDY KINDS.

The Alpine Polypody (*P. alpestre*) has such a remarkable resemblance to the common Lady Fern, that until within comparatively recent years it was, although common on some of the Scotch mountains, overlooked, the plants having been supposed to belong to that species. It is essentially a cold-loving plant, the geographical distribution being given in the "Synopsis Filicum" as follows: "Lapland and Scotland to the Pyrenees, Alps, and Central Russia; Sitka, Oregon, and California."

The Oak Fern (*P. Dryopteris*) is one of the most graceful and delicate of all hardy ferns; it does well in pots, in Wardian cases, or on sheltered shady rockwork, and requires an abundance of moisture, its bright light green fragile fronds soon becoming rusty and withered by exposure to heat or drought. In addition to the British Isles, the Oak Fern is found throughout Europe, North and West Asia, the Himalayan region, and in North America.

P. Kremeri, a recent introduction from Japan, has the same delicate light green colour as the last-named plant, but differs somewhat in the form of the frond.

The Beech Fern (*P. Phegopteris*) has a slender, extensively creeping and slightly scaly stem, and hairy, pale green, triangular fronds, which are killed by the first autumn frosts. It generally grows in moist mountainous situations, and in damp woods, and extends throughout Europe, North and West Asia, and North America.

The Limestone Polypody (*P. Robertianum*) differs from the Oak Fern—of which it is considered by many authorities to be a mere variety—by its less decidedly three-branched, firmer, glandular pubescent, dull deep green fronds, and its stouter root-stock. This is one of the few ferns which appear in a state of nature to confine themselves to calcareous or chalky soils, but under cultivation neither chalk nor limestone is by any means essential to its successful management. *P. Robertianum* has nearly as wide a range as *P. Dryopteris.*

At first sight, the evergreen *P. Scouleri* calls to mind our native *P. vulgare*, but the fronds are of a much more leathery texture, and are broader in second time; this form is always barren. A variety, *semilacerum*, usually called the Irish Polypody, has the lower portion of the frond resembling the variety *cambricum*, and the upper more like the typical *P. vulgare*. It is a very fertile form, and one which could not fairly be excluded from even the most select collection of hardy ferns.

POLYPODIUM (or PHLEBODIUM) AUREUM.

comparison with their length; it is a native of Vancouver's Island, Oregon, and British Columbia.

The British *P. vulgare* worthily concludes the list of hardy Polypodies, and, under favourable conditions as to shelter, shade, and moisture, it forms a very beautiful specimen. Some of its numerous varieties can certainly vie for elegance of form and grace of habit with any other hardy fern. The best known of these, the Welsh Polypody, *P. vulgare*, var. *cambricum*, has much broader fronds; the lobes, instead of being simple, are deeply and irregularly lobed a

Among the numerous garden forms which will be found mentioned in the catalogues of nurserymen who make ferns a speciality, the most remarkable of all is that called *trichomanoides*. In cutting this resembles in a marked manner the Killarney Fern, and is worth cultivating as a pot-plant for greenhouse or cool conservatory decoration.

Cultivation.—Some of the species described as Stove Ferns in the above notes will certainly (especially if plants have been imported from outlying countries with a cooler climate than that of those which may be regarded as the head-quarters of the species) thrive under green-house treatment, and many of those marked Green-house will succeed equally well in the warmer atmosphere of the stove. The strong-growing sorts do well with their rhizomes fastened down on pans of well-drained fibrous loam and leaf-mould; the smaller ones with more slender rhizomes need to be attached, by means of wire or some similar contrivance, to cones or mounds of fibrous peat. The smallest growers, with small thread-like rhizomes, are quite at home fixed on fibrous tree-fern stems, like those of *Dicksonia antarctica*, for example. Moss-covered porous pieces of rock afford suitable quarters for the latter section, and the slender root-stocks soon attach themselves. Stagnant moisture is obnoxious to all the Polypodies, although all like an abundant supply of moisture when growing. When the plants are more or less at rest, water must be more sparingly administered, but they must never be allowed to get dry. Shade is enjoyed by all; if grown in too light a place the fronds will not attain so large a size, nor will the plants grow as freely as when shaded. The hardy kinds do almost in any soil, provided good drainage, abundant moisture, shade, and shelter be accorded them.

ORCHIDS.

By William Hugh Gower.

Dendrochilum.—A small genus, the members of which are found growing high up in the forest trees in the Malayan Archipelago. Pot-culture suits them best, and the compost should be about equal parts of rough fibrous peat and Sphagnum moss. They require an abundant supply of water, and very little drying off is requisite when the growth is completed. East Indian House.

D. filiforme.—A dwarf compact and elegant plant, producing small, smooth, oval pseudo-bulbs, about an inch and a half high, deep green, bearing a single narrowly-lanceolate deep green leaf. The racemes are borne upon a slender stem, which is about a foot long and arching. Upon this the small yellow flowers are arranged in double rank, the whole having the appearance of a chain of gold. June and July. Philippine Islands. Now called *Platyclinis filiformis.*

D. glumaceum.—Although this species cannot boast of gaudy colours, it is nevertheless a very graceful plant. Pseudo-bulbs ovate, some two inches high, dark green, and bearing a solitary broad dark green leaf, which bears some resemblance to that of the Lily of the Valley. Flowers small, ivory-white, arranged in a distichous manner upon a long slender spike, delicately perfumed—something between Heliotrope and Hawthorn. Winter and spring. Philippine Islands. Now called *Platyclinis glumacea.*

Disa.—A large genus of terrestrial plants, many of them very beautiful, but cultivators have hitherto failed to keep them alive any length of time. They are peculiar to South Africa, saving a few species which are found in Abyssinia.

These plants require a plentiful supply of moisture in the air, and free ventilation. The soil should be a mixture of rough peat, Sphagnum moss, and leaf-mould in about equal parts, with a little sharp sand added. The plants should not be raised above the rim of the pot. When growing they enjoy a copious supply of water; but after flowering and growth are finished, encourage them to lie dormant by placing them in a frame under a north wall, or some similar position. Here, however, the surroundings should be kept moist by filling in between the pots with Sphagnum, which should be frequently syringed. When growth commences again, which will be about the month of October, more water will be required, and care must be taken to keep away green fly and thrips when growing. Peruvian House.

D. grandiflora, and its variety *superba*, are at once the most difficult to manage and the most gorgeous in colour of all cool-house Orchids. Dr. Harvey says of this plant, "It is the pride of Table Mountain, where it grows in great profusion on the borders of streams and water-pools which are dry in summer, producing its gorgeous flowers in February and March. The stems grow two and a half feet high, and are furnished with a number of broad grassy leaves, and terminated by from one to four splendid flowers, measuring from three to five inches across. The lateral sepals are of a bright crimson, the dorsal one paler on the outside, blush-coloured and delicately veined with crimson within." Under cultivation in this country it is usually about midsummer when the flowers appear, which last for several months in full beauty. Cape of Good Hope.

Epiphora.—A genus containing one species only, nearly allied to *Polystachya*, its chief distinction being the attachment of the pollen-masses, which are four in number, and attached to a small short caudicle. Should be grown upon a block. Brazilian House.

E. pubescens.—A dwarf compact plant, with tufted ovate pseudo-bulbs, bearing two to three oblong-linear leaves, which are dark green. The raceme rises from between the leaves, and is erect, bearing numerous bright yellow fragrant flowers; the lip, which is erect, and stands uppermost, being streaked with reddish-purple. It is a perpetual bloomer. The original form was introduced from Algoa Bay, but more recently a much finer and more gigantic form has been brought from Madagascar.

Epidendrum.—The name comes from *epi*, "upon," and *dendron*, "a tree," the natural habitat of the various species in a state of nature. The genus is thus defined by Lindl:—"Sepals patent, nearly equal; petals equalling the sepals, or narrower, rarely wider, patent, or reflexed; lip connate, wholly or in part, with the margins of the column, the limb entire or divided, the disc often furnished with a callosity, ribbed or tuberculated, sometimes prolonged into a spur, adnate with the ovary, and forming a bag. Column elongated. Anther fleshy, two to four-celled, pollen-masses four."

In treating of the genus *Dendrobium* we remarked that it was a very large family, and contained an immense number of species and varieties of a highly ornamental character. The same remarks apply to the genus *Epidendrum*, but with this difference—that it contains an immense number of species so weedy in appearance, and possessing so little beauty, that they do not find favour with cultivators of the present day. There are, however, a goodly number of grand species of Epidendrums, which will always keep the genus represented in our plant-houses.

Amongst the curious plants of this genus we may mention *E. funale*, from Jamaica, which has neither stem nor leaves, but simply forms a small crown, and a mass of white cord-like roots. From this crown arise, at various seasons, numerous rather large white flowers, furnished with a somewhat long spur. Another interesting plant is *E. conopseum*, not beautiful, for the flowers are small and greenish-yellow, but it is remarkable as being the most northern epiphytal Orchid known, its native habitats being on Oaks and other evergreen trees in East and West Florida, on the Georgian and Carolina coast, &c. Again, *E. cochleatum* is a curious plant, the flowers of which appear to be reversed, as the lip stands erect, point upwards, in the shape of a half-bivalve, rich crimson-purple in colour. Several other species belong to this section, and although not showy in colour, they are very fragrant. There are two sections of Epidendrums, totally distinct in their manner of growth, viz., those with tall slender reed-like stems, which have their leaves arranged in a two-ranked manner, and bear on the apex large dense panicles of flowers. This class have hitherto not conformed kindly to cultivation. To some extent this may be accounted for through their having been kept in too high a temperature. The second section are those of dwarf habit, forming small clustered, usually ovate, pseudo-bulbs, and thick coriaceous leaves. The former require to be grown in pots, but many of the latter thrive best upon a block or in a basket. The compost should be equal parts of peat and Sphagnum, with ample drainage; all the members of the second section should be well rested, but the others cannot suffer a long drought. Mexican division and Peruvian House.

E. atropurpureum.—This plant succeeds best upon a block or in a basket. It is a very beautiful species, frequently to be found in collections under the name of *E. macrochilum*. Pseudo-bulbs ovate, smooth, bearing on the summit a pair of narrow, acute, dark green, coriaceous leaves, from between which the long spike arises, bearing numerous large showy flowers. Sepals and petals brownish-purple; lip large, three-lobed, side lobe forming a complete hood over the column, middle lobe spreading, pure white, ornamented with a blotch of reddish-purple at the base. In the variety *roseum* the lip is rose-colour, very dark rose at the base. April and May. Guatemala and Mexico.

E. bicornutum.—A totally distinct plant, now called *Diacrium bicornutum*. It is difficult to keep it long in health. It thrives best when fastened upon a bare block of wood, with full exposure to the sun; but, at the same time, the atmosphere must be kept well charged with moisture. Pseudo-bulbs twelve to thirteen inches high, ribbed, tapering slightly at both ends, hollow in the middle; leaves short and leathery, spreading, and light green. Raceme six to twelve-flowered; these are flat, and of great substance, resembling a Phalænopsis flower, ivory-white; lip three-lobed, ornamented with a few spots of crimson. Spring and early summer. Guiana.

E. Brassavolæ.—A singular and handsome species, producing long flask-like pseudo-bulbs, bearing a pair of oblong-acute leaves. Raceme erect, about two feet high, many-flowered; flowers three to four inches in diameter, sepals and petals spreading, narrow, the colour of chamois leather; lip flat, pointed in front, where it is broadly tipped with rich mauve, pure white at the base. It has been collected in the mountains of Guatemala and also on the volcano of Chiriqui. Summer months.

E. catillus.—This species has long reed-like stems, clothed with large, oblong-acute, dark green sheathing leaves; panicle of bloom terminal, drooping and many-flowered. The whole of the flower is of a uniform bright cinnabar, except the front of the fringed lip, which is white. Spring months. New Grenada.

C. cnemidophorum.—A grand and stately plant, which, like so many of these paniculate Epidendrums, requires abundance of pot-room and cool treatment. Stems three to five feet or more high, clothed with very long, ligulate-acute, sheathing leaves. Panicle terminal, pendent, a foot or more long, and many-flowered; sepals and petals pure white at the back, the former being the broadest, in front pale yellow, streaked and mottled with rich brown; lip deeply cut; creamy-white, tinged with rosy-pink. Spring months. Guatemala, 7,000 to 8,000 feet elevation.

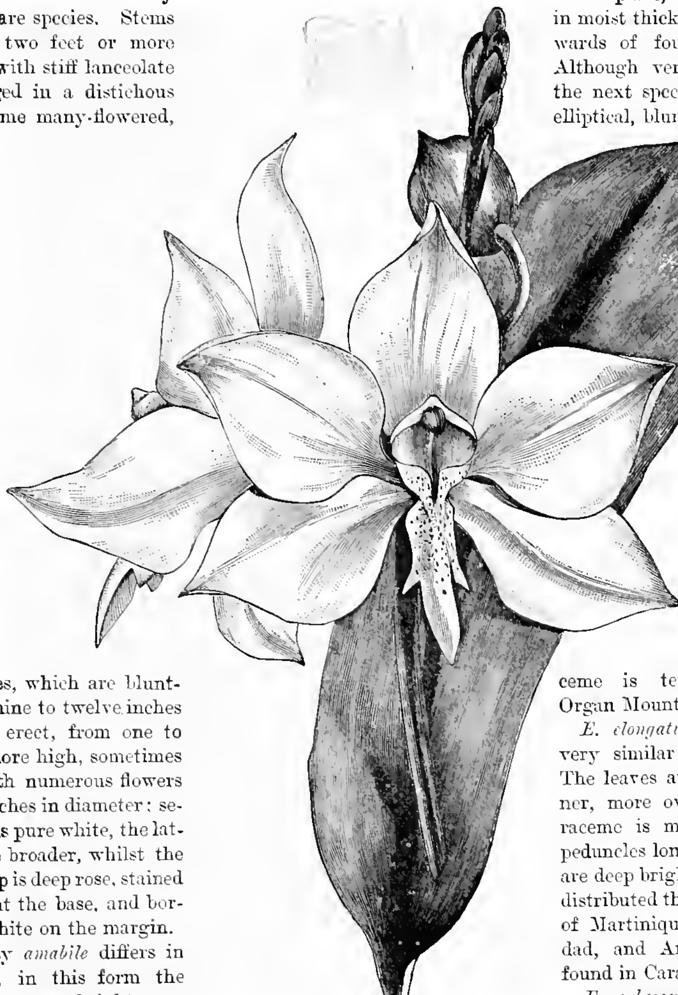
C. Cooperianum.—This is a very distinct and rare species. Stems erect, one to two feet or more high, clothed with stiff lanceolate leaves, arranged in a distichous manner; raceme many-flowered, flowers thick and fleshy; sepals and petals yellowish-brown; lip large and broad; deep bright rose. Spring and early summer. Brazil.

E. dichromum.—The pseudo-bulbs smooth, and slightly tapering at both ends, bearing on the summit two to three ligulate coriaceous leaves, which are blunt-pointed, and nine to twelve inches long; scape erect, from one to two feet or more high, sometimes branched, with numerous flowers nearly two inches in diameter; sepals and petals pure white, the latter much the broader, whilst the three-lobed lip is deep rose, stained with yellow at the base, and bordered with white on the margin.

The variety *amabile* differs in colour only; in this form the sepals and petals are bright rose, and the lip intense crimson, with a paler margin. Summer and autumn. Brazil, about Bahia.

E. eburneum.—A beautiful species, with erect slender stems and alternate, sheathing, coriaceous, dark green leaves; racemes terminal, bearing three to six flowers, which measure about four inches in diameter; sepals and petals pale yellow; lip large, cordate in front, ivory-white. Panama.

E. ellipticum.—Stems tender, erect, with short coriaceous sheathing leaves, arranged in a two-ranked manner. It varies considerably in height, for we are told that "it is frequently found growing upon rocks, quite exposed; in such situations it is a dwarf plant, but when it grows in moist thickets it attains to upwards of four feet in height. Although very nearly allied to the next species it differs in its elliptical, blunt, succulent leaves; its flowers are paler; and especially in the form of the tubercle of the lip, which is deeply furrowed or plaited, shouldering off to the lateral lobes, and is not furnished there with a free tubercle, as in *E. elongatum*." The flowers are light rose, and the raceme is terminal and erect. Organ Mountains, Brazil.



EPIDENDRUM BICORNUTUM.

E. elongatum.—The habit is very similar to the preceding. The leaves are longer and thinner, more ovate and acute, the raceme is more dense, and the peduncles longer, and the flowers are deep bright rose. It is widely distributed throughout the islands of Martinique, Dominica, Trinidad, and Antigua. It is also found in Caracas.

E. erubescens.—This is a rambling plant, with long woody stems, and forming its fusiform pseudo-bulbs some six inches apart. It roots freely on the under side, and in this way it runs over the Oak-trees, and produces its large panicles of rosy mauve-coloured flowers in great profusion. Mexico, about Aaxaca, at from 5,000 to 8,500 feet elevation.

E. evectum.—A species with the habit of *E. elongatum;* its stems are branching, and it bears in profusion its rather lax racemes of bright purple flowers. New Grenada.

E. Frederici-Gulielmi.—A remarkably tall-growing species, with reed-like stems, which are clothed with broad-oblong, sheathing, dark green leaves, arranged in a two-ranked manner; the raceme is terminal, dense, and the flowers are borne upon long foot-stalks, and are of a uniform chestnut-brown, except the base of the lip, which is white. Mountains of Peru.

E. ibaguense.—Another of the reed-like stemmed species, of great beauty. It is thus briefly described: "Leaves an inch and a quarter broad, and the stems as thick as a swan's quill, apparently often branched. When old they become as smooth as bamboos;" the flowers are very conspicuous, being rich orange-scarlet in colour. Winter and spring months. Native of rocky places about Loxa, in Peru, and near Ibague in New Grenada, at upwards of 4,000 feet elevation.

E. myrianthum.—Unfortunately this most beautiful species still remains scarce in cultivation, the majority of the plants that arrive in England being killed by kindness. The stems are slender, three or more feet high; the linear-lanceolate leaves being arranged in a distichous manner, and bearing on the summit immense erect branched panicles of rich magenta flowers. Spring and early summer. High mountains of Guatemala.

E. nemorale, var. *majus.*—This grand species and its variety are dwarf compact growers; pseudo-bulbs ovate, some four inches or more high, bearing a pair of long ensiform pale green leaves. From between these the panicle arises. This differs in density and length in different varieties; in the original *nemorale* it is unbranched, but in the best forms the panicle is much branched. Sepals and petals two inches or more long, narrow, and delicate rose in colour; lip large, white, bordered with deep rose. Summer months. Mexico.

E. paniculatum.—A superb cool-house species. Its reed-like stems attain a height of about four feet, clothed with lanceolate spreading leaves some six inches long, and deep green. Racemes erect, much branched, and upwards of a foot long; flowers large, delicate rosy-lilac, and very fragrant. April and May. Peru and New Grenada, at elevations of 7,000 to 8,800 feet.

E. prismatocarpum.—This is an elegant and dwarf-growing plant; pseudo-bulbs flask-shaped, slightly furrowed, and bearing two to three bright green leaves nearly a foot long. From the centre of these the erect scape arises, bearing a many-flowered raceme about the same length as the leaves. Sepals and petals about equal, creamy-yellow, spotted and blotched with black; lip pink, tinged with green at the base, very fragrant. June and July. Central America.

E. syringothyrsis.—This very beautiful plant resembles *E. myrianthum* somewhat, but it is more robust in habit; the reed-like stem attains a height of about four feet, bearing a very dense head of large deep lilac flowers. Spring and early summer. Bolivia, at considerable elevations.

E. radicans—also known by the name of *E. rhizophorum*—is a plant of great beauty. It belongs to the slender-stem section, and is undoubtedly one of the best of its class. It produces large terminal racemes of orange-scarlet flowers. It blooms at various times of the year. This plant luxuriates amongst grass and other low herbage in Mexico and Guatemala.

E. vitellinum, and its var. *majus.*—Although last, this still stands in the first rank of beautiful flowers. It is found growing upon Oak-trees at great elevations, continually enveloped in foggy mists; the pseudo-bulbs are ovate, and, like the leaves, of a glaucous hue. Scape erect, many-flowered; sepals and petals spreading, thick and fleshy, bright orange-scarlet; lip bright yellow. A continual bloomer. Mexico.

Epistephium.—Although this genus contains numerous species, one only is at present in cultivation, and that is extremely rare. Epistephiums are nearly allied to Sobralias, but do not, like them, form reed-like persistent stems. Pot in loam and sand, in about equal proportions, drain well, and water freely during the growing season, but the plants must not be elevated above the rim of the pot. Brazilian House.

E. Williamsii.—A terrestrial plant of great beauty, forming fleshy under-ground roots from which the stems proceed; these attain a height of from twelve to eighteen inches or more, and are clothed with alternate oblong leaves, which are stem-clasping, thick and fleshy in texture, and dark shining green. Spike terminal, erect, and bearing several flowers upwards of three inches in diameter. Sepals and petals bright reddish-purple, the latter much the broader. Lip divided in front, deep reddish-purple, white in the centre. Summer months. Brazil, in the neighbourhood of Bahia.

Galeandra.—A small genus of elegant epiphytes, nearly related to *Eulophia*. The name is derived from *galea*, "a helmet," and *aner*, "a stamen," in reference to the shape of the lip and the crested male organ on the top of the column. They are plants of erect growth, with somewhat slender fusiform pseudo-bulbs, which are deciduous, and from the apex of which the scape arises just about the time the growth is complete, and the leaves are in full vigour. With care these plants may be grown upon blocks, but we prefer pot-culture, the compost being equal parts of peat and Sphagnum. After growth is complete and flowers faded, gradually dry them off and give a thorough rest. East Indian House when growing, but Brazilian House when at rest.

G. barbata.—Pseudo-bulbs clustered, ringed, and bearing on the summit several linear-lanceolate acute leaves, dark green above, paler below. Raceme nodding, bearing numerous showy flowers. Sepals and petals erect, tawny-brown. Lip large, convolute, with a long spur, rosy-pink, bordered with white, and lined with deep rosy-crested lines on the disc. Summer months. Brazil.

G. Devoniana.—A tall-growing species, with slender pseudo-bulbs, usually two to three feet high, often more. Sepals and petals about equal, lanceolate and erect, of a uniform purplish-brown, and bordered with yellowish-green; lip large, helmet-shaped; spur short and blunt; creamy-white, broadly tipped with intense rich rose, and transversely barred with dark purple lines. Summer months. Banks of the Rio Negro.

Gongora.—In this genus we have numerous most interesting and curious plants. The name is given in honour of a Spanish Viceroy of New Grenada.

Although Gongoras were much sought after in the earlier days of Orchid-culture, they have to some extent lost caste at the present time, probably because their flowers are not sufficiently gorgeous to satisfy the prevailing taste.

Gongoras are all natives of South America, where they luxuriate upon the branches of the forest trees; when not in flower they resemble each other very much in appearance; the pseudo-bulbs are oblong, ribbed, and bear a pair of dark green leaves, which are broadly-lanceolate, and about a foot high; the flower-spike springs from the base of the pseudo-bulbs, and is pendulous, hanging down sometimes the length of two feet; the racemes bear some of the most fantastic-shaped flowers it is possible to imagine, in some instances resembling those artificial flies with which the angler seeks to lure the finny tribe from the silvery stream. On account of the drooping flower-spikes, Gongoras must be grown in hanging baskets, in a compost of equal parts rough peat and Sphagnum, and a few nodules of charcoal; these plants enjoy an abundant supply of water, but *after* growth is complete they require a thorough period of rest. Cool end of Brazilian House.

G. atropurpurea.—The racemes long and many-flowered; the sepals are all bent back; the flowers, which resemble an insect in shape, are of a uniform deep purple. Summer months. Trinidad.

G. bufonia—so called from its resemblance to a toad in its markings—was one of the first introduced species. The whole flower is beautifully variegated with purple and white: in the variety *leucochila* the flowers are purple, with a white lip, which is tipped with yellow. Spring months. Brazil.

G. maculata.—This is a very showy species; the flowers resemble an artificial fly-hook; ground-colour bright yellow, profusely spotted with blood-red. In the variety *alba* the flowers are wholly white, saving a few rose-coloured spots on the lip. Spring months. Demerara.

G. portentosa.—A somewhat more robust-growing species than any of the others; flowers numerous; sepals yellow, turned back; petals and lip creamy-white, dotted with violet. Summer months. New Grenada.

G. truncata.—The sepals in this species are more obtuse than the others, and the lip shines as if varnished; the flowers are wholly yellow and reddish-brown. Spring months. Mexico.

Goodyera.—A genus of small-growing terrestrial Orchids, named in honour of J. Goodyer, a British botanist, which have for the most part small and unattractive flowers, but like their near allies, the *Anæctochili*, many of the species have beautifully veined and netted leaves; one species (*G. repens*) is abundant in the Scottish Highlands; its leaves, however, are unornamented, being a rather soft plain green, whilst the small racemes of flowers are greenish-white. The species and varieties from warm latitudes are mostly grown with the *Anæctochili*, to which they form admirable companions, and the same treatment suits them; but species from cooler regions thrive best in the Peruvian House.

G. Dawsoniana.—A robust and free-growing plant; leaves somewhat cordate-acute, the upper surface glossy and shiny, an intense deep bronzy-green, veined and netted with gold, under side deep port-wine colour; raceme erect; flowers pure white, and very effective for either button-hole bouquet, or shoulder-sprays. Malay Archipelago. (Correct name *Hæmeria discolor Dawsoniana.*)

G. discolor.—This is a smaller plant than the preceding, but a free and robust grower, with ovate, nerveless leaves, which are dark velvety-chocolate, sparingly veined with white; raceme dense, bearing white flowers, stained with pale yellow on the lip. Brazil. (Correct name *Hæmeria discolor.*)

G. Dominiana.—Leaves dark bronze, with a rich, velvet-like appearance, prominently veined and netted with creamy-white. It is a very handsome plant, one of the Veitchian hybrids obtained from seed in this country.

G. macrantha.—This species was obtained from gardens in Yeddo, and was highly prized by the cultivator. It is a close, dense-growing plant, with ovate-acute leaves of a rich deep olive-green, beautifully veined and netted with light green and white. It produces two to three large terminal flowers with linear-acute sepals and petals, white suffused with rosy-pink. In the variety *luteo-marginata*, the leaves in addition are broadly margined with yellow. It does not appear to have been found by any European collector in a wild state, but is probably a native of the southern islands of Japan.

G. Ordiana.—In general habit and size this plant resembles *G. Dawsoniana;* indeed, many consider it a variety of that plant; if so, it is very distinct in colour. The leaves are large, cordate-acute, ground-colour the most brilliant green, over which lies a network of golden veins. Malay Archipelago. (Correct name *Hæmeria discolor Ordiana.*)

G. Rollissonii.—A robust and handsome plant, with large cordate leaves, which on the under side are of a deep vinous-red, upper side deep green, with a velvety appearance, broadly margined and flaked with creamy white. Probably from Brazil.

G. rubro-venia.—In this beautiful plant the leaves are ovate-acute, deep bronzy-black above, with three parallel stripes of reddish-crimson traversing the entire length, beneath vinous-red. It is considered by some to be a variety only of *G. discolor*. Brazil.

G. velutina.—A dwarf-growing robust plant which comes to us from the same gardens in Yeddo as *G. macrantha*, and which, like it, has not been found in a wild state. Leaves dense, rather small, ovate-acute, deep vinous beneath, tinged with violet on the upper side; the ground-colour is deep purplish-green, with a rich velvety appearance, midrib banded with a broad stripe of pure white; flowers white, suffused with pink. Japan, probably from the southern islands.

Grammatophyllum.—This is a small genus of large and bold-growing plants. Indeed, *G. speciosum* may be said to make the largest growth of any Orchidaceous plant yet discovered. The name comes from the word *grammata*, signifying "letters," and *phyllon*, "a leaf," but the peculiar markings having some resemblance to letters are not on the leaf, but on the sepals and petals. As a genus *Grammatophyllum* is nearly allied to *Cymbidium*, from which it differs in having a crescent-shaped gland instead of a triangular one, with one pollen-mass at each point of the crescent, and in having a bladder-like formation at the base of the column and lip.

These plants require plenty of pot-room, and should be placed in the hottest and dampest part of the house. The compost to be half-and-half peat and Sphagnum moss, with ample drainage, so that water can be continually poured into them when growing. After growth is finished water can be withheld and the temperature reduced in order to mature the pseudo-bulbs, without which it is useless to expect flowers. East Indian House.

G. Ellisii.—This species is of comparatively recent introduction, and is the dwarfest and freest-flowering kind yet introduced. For a knowledge of it we are indebted to that indefatigable explorer, the late Rev. W. Ellis, who detected it growing in his favourite island of Madagascar. He says, "Among the plants which I brought from Madagascar was a large-bulbed plant, something like *Anguloa Clowesiana*, only the bulbs are square instead of being round. I found it growing on the branch of a tree about the size of a man's leg, and stretching over a river at about twenty-five feet above the water." The spike comes up with the young bulb, and attains a height of about two feet or more, bearing a great number of flowers of such a fantastic shape that no description can adequately describe them. Sepals plain yellow at the back, in front transversely striped and blotched with chocolate; petals small, white; lips mall, white, streaked with rosy-purple. Autumn months. Madagascar. (Correct name *Grammangis Ellisii.*)

G. speciosum.—This is the species upon which the genus was founded. The pseudo-bulbs are gigantic stems reaching ten feet in height, and measuring upwards of seven inches in circumference. The leaves are nearly two feet in length, distichous and dark green. Scape arising with the young growth, stout and nearly six feet high, bearing numerous immense flowers, upwards of six inches in diameter; sepals and petals broadly-oblong, about equal in size, and spreading; yellow, plain behind, but in front grotesquely and profusely spotted and lined with reddish-purple and brown. Lip small, three-lobed, the side lobes rolled over the column, middle lobe ornamented with several crested red lines, disc plaited. Autumn months. Java and Cochin China.

Helcia.—This genus is nearly allied to *Trichopilia*, but is distinguished from it by its erect, terete, and slightly fringed column. Only one species has yet been introduced. It thrives best in a pot, with half-and-half peat and moss. Peruvian House.

H. sanguinolenta.—A dwarf compact plant, with tufted, somewhat ovate pseudo-bulbs, bearing a solitary narrow leaf, some six inches long, waved at the edges, and dark green. The peduncle bears a single flower, which is upwards of two inches in diameter; sepals and petals greenish-brown, and spotted with crimson; lip obovate, notched in front, white, streaked with crimson and yellow. Spring and early summer. Peruvian Andes.

Houlletia.—Named in honour of M. Houllet, a French gardener who travelled in Brazil, and sent home numerous new and interesting plants to the Jardin des Plantes in Paris. The genus is allied to *Stanhopea*, but is nevertheless abundantly distinct. Brongniart, who established the genus, says "It differs from *Stanhopea* in the spreading sepals and petals, and in the lip being articulated in the middle, with two horns on its lower half directed towards the column." They may be known by their short ovate or conical pseudo-bulbs, which are more or less grooved, and bear on the apex a solitary, long, petiolate, plaited leaf; the raceme issues from the side of the pseudo-bulb near the base, and is mostly erect, bearing numerous large, curious, and very handsome flowers. A few species only have up to the present time been discovered, but as these are found in such distant parts of America, there are no doubt many more species or varieties still unknown, which one day may arrive to gladden the heart of some enthusiastic Orchidologist.

HELCIA SANGUINOLENTA.

Houlletias are all mountain plants, and are oftentimes found beside streams and rivulets, where they enjoy an abundant supply of moisture during the growing season, and in such situations they do not have a very severe drying up even when at rest. Cultivators should make a note of this. Pot them in a mixture of peat and Sphagnum, with a little sharp silver sand. Cool end of Brazilian House.

H. Brocklehurstiana.—Pseudo-bulb ovate, bearing a long and broad, petiolate, plaited dark green leaf, upwards of a foot long; raceme erect, longer than the leaves, five to six-flowered, each measuring nearly four inches in diameter, and very fragrant; sepals and petals oblong-obtuse, spreading, nearly equal, orange-yellow, mottled with reddish-brown, and spotted with blood-red; lip yellow, purple at the apex, spotted with brown, and furnished with two short fingers which point towards the column. This species was first discovered on the Organ Mountains in the neighbourhood of Rio Janeiro, and requires more heat than the other kinds. Summer months. Brazil.

H. odoratissima.—Pseudo-bulbs ovate, furrowed: the solitary leaf is long and narrow, with a very long petiole; scape erect, five to six-flowered, deliciously sweet; sepals and petals oblong-acuminate, the latter narrowest, of a uniform brick-red; lip very curious, and with the large column pure white, tipped with pale yellow. Summer months. It is found growing beside small streams in the province of Ocana, New Grenada, and also on the banks of the Rio Magdalena in Columbia.

H. odoratissima, var. *antioquiensis.*—This is a rare and splendid form, differing in its much larger flowers; the petals large and blunt, and of a rich blood-red, suffused with purple. Summer months. Province of Antioquia, Columbia.

THE ROSE AND ITS CULTURE.

BY D. T. FISH.

STANDARD, HALF-STANDARD, WEEPING, BUSH OR DWARF, AND PEGGED-DOWN ROSES.

NOTWITHSTANDING the ridicule that has been heaped on Roses on stilts, these are as numerous, and apparently as popular as ever. They are less numerous relatively to other forms of Roses, not because the number of standards is less, but owing to the enormous increase of dwarfs. The demand for standards of all heights also keeps abreast or rises ahead of the supply. Nor is this greatly to be wondered at, for there is no mode of increasing Roses on the whole more rapid or more successful than the working of them on the Dog-rose or common briar of our woods and hedgerows. That has been adverted to in our chapter on Propagation, and need not be noticed further here.

But briars, ugly as many people affect to think them, have other merits of their own. However much our modern æstheticians—to coin a word—may decry standard Roses, they may nevertheless be moulded into things of beauty and a joy for many years, if not for ever, to not a few Rosarians and lovers of their gardens.

Not a little of the abuse that has been so liberally heaped on this form of Rose has arisen from the bad form and condition in which they are found in so many gardens. Tall semi-dead briar-stems, inclining at all angles towards the earth, instead of standing up boldly at right-angles with it, carrying tops consisting of a few irregular branches, the living sadly intermixed with the dead, pictures rather of death and desolation than of health, life, vigour, and symmetry, such scarecrows have done very much to banish standard Roses of all and every height from our gardens.

But there are few gardens that might not be further enriched by the addition of few or many good standard Roses. While not incompatible with the beauty of gardenesque scenes, their elevating power is often a matter of much convenience to Rosarians. By judicious selection and regulation of height of stem the Rose may at once be lifted to our own level; thus the stooping to conquer, the only legitimate mode of enjoying dwarf Roses, is avoided in the garden. Only devoted Rosarians, who find their highest enjoyment of their Roses on their trees, can truly appreciate the solid advantages of lifting up the blooms to our own level. No doubt Roses may be grown as well as worked into stature; but not a few of our finest Roses grow rather slowly, and would take several years to get up to a height of three or five feet.

The glowing colour of Roses may often be needed at considerable height in gardens to relieve to some extent the verdant green of wide expanses of Laurels, Hollies, and other evergreen trees and shrubs. Dwellers in towns can hardly imagine an excess of green in a garden. It is different, however, in the country, which is all green in many places throughout the greater part of the year. Liberal dashes of colour in gardens, thus set in green frames, many broad acres in width, are as welcome as sunlight dispersing a fog; or an Ivy or Rose-clad house in a dirty, crowded town.

By placing tall standards at the back of groups, and shorter ones in succession, the standards may be made to melt and merge into dwarfs in front, and thus a bold bank of Roses of any extent be formed on level ground in less time and at less cost than could be done by any other method.

The following illustrations of standards of different heights will make all this plainer than any detailed description.

The first is of a tall standard. These may range in heights from five to seven feet. Fig. 46 represents a standard six feet in height, with a head in proportion. The latter is a point of great importance; a top out of harmony with the height of stem, ill-balanced, or one-sided, is as great an eyesore to the Rosarian of taste as a wall out of the perpendicular is to the architect or builder.

Fig. 47 represents the more common standard, with a stem three feet high, and a head about a yard through. This is a most convenient height, and looks better, on the whole, than any other.

For an illustration of the dwarf standard we need only refer to Fig. 39, page 112, Vol. II. The dwarf standards become so much like a dwarf that it is hardly worth while giving an illustration. Cut a foot or eighteen inches off the stem, and slightly reduce the top, and the effect of dwarf standards is seen at once.

Weeping Roses.—These are decidedly more artistic and far less common than standards. This arises in part from the far greater difficulty in forming them, and keeping them in good shape afterwards. There are also comparatively few Roses well adapted for moulding into weeping forms, and some of these, notably Niphetos and Maréchal Niel, are rather too tender to be relied upon in our fickle climate. The two finest weeping Roses, however, ever seen by the writer were of those two varieties. Some other rather tender Roses make capital weepers —Triomphe de Rennes, Céline Forestier, and Lamarque. In each of those fine Roses it will be observed the flowering branchlets are sufficiently long and slender, and the flowers so numerous and so weighty, as to allow the Roses to weep naturally.

The meaning of this will be more apparent if the habit of those Roses is compared with that of the Baroness Rothschild and her various sports, which no skill could compel to weep.

The majority of the more slender-growing Teas also weep fairly well, and are well worth a trial where

Fig. 46.—Tall Standard (6 feet of stem).

the climate is sufficiently mild for them. The same remarks apply to the China, Bourbon, Hybrid China, and Noisette Roses. The Hybrid Teas, too, of the type and shape of Cheshunt Hybrid, will all make good weeping Roses. But such floriferous Teas as the Gloire de Dijon are almost too short and stiff in their flower-stems and flowering branchlets to form a graceful weeping Rose. For the same reason almost all the Hybrid Perpetuals refuse to weep, Boule de Neige, rapidly grown and carefully trained, being the most likely one to succeed with. The climbing Aimée Vibert weeps well, and even that bright and brilliant yellow Rose, Harrisonii, where it grows freely, may be formed into a small weeping Rose of a very unique colour and character. A good many of the more moderate-growing Perpetuals may also be converted into semi-drooping standards, a pretty hybrid form, about intermediate between the true standard and the weeping Rose.

But to have true weeping Roses really worthy of the name, we must fall back upon the Ayrshire, Evergreen, and other true climbing Roses. As several of these can run to a height of from eight to eighteen feet, it follows that they will weep down almost as far; and hence, with such material, the height and size of weeping Roses can be easily determined by the height of our budding or starting-point. For there are but two general modes of forming weeping

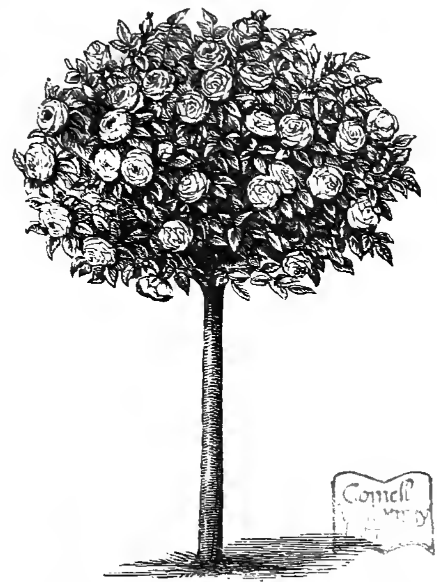


Fig. 47.—Average Standard (3 feet of stem).

Roses: that of budding on tall briars, or selecting and supporting a growth of the Rose to any desired height, then beheading it and forcing it to break into the requisite number of shoots, and suppressing all others on the plant. The first is the quickest and best method of forming and establishing weeping Roses. As the strain on weeping Roses is very great, their area being often so considerable as to form a covered arbour, with a seat under their far-spreading boughs, they should be either trained up the bole of a living tree, sufficient branchlets being left on to keep it alive, or have a strong iron support given them at once; to this one or more wire hoops could be attached at the top to train the Rose over, to give it at once stability and symmetry (see Fig. 45, page 114, Vol. II.). Some little pruning and stopping would be needed the first two or three years to secure a sufficiency of shoots at the proper places. So soon as the space is fairly covered, a little thinning and regulation of shoots, and removal of all dead or dying matter once a year, would be all that is needed to preserve the health and form of weeping Roses.

The process of forming standard Roses of all height is somewhat similar and even more simple. No hoop nor other support but one central stake to keep the stem a fixture is needed. By pruning back to the proper buds, at the right times, the embryo head is soon formed, and ordinary care and culture does the rest.

Standards are generally formed of Hybrid Perpetual Roses; but all the better sorts of Bourbons, Noisettes, Hybrid Teas and Chinas, make good standard Roses. Few are more effective as white Standards than the very old-fashioned Aimée Vibert and Madame Plantier, and the two brilliant pinks, Coupe d'Hébé and Charles Lawson. These white and pink Roses alternately, form an avenue by the side of main walks, or round a Rose-garden, such as few other Roses can equal.

It must also be noted that the more robust-growing Hybrid Perpetuals make the best standards.

Not a few varieties of Roses may produce good show-flowers on the heads of standard briars, that refuse nevertheless to form good standards; while such varieties as those recommended for pillar or pyramid, and almost all that are named as garden Roses, will grow into fair form as standards, and thrive for many years in that form.

Varieties for Standards.—As standard Roses almost invite all beholders to test their fragrance, it is most important that as many of them as possible should be sweet-scented. For this reason the following list of the more fragrant Roses is given here. Almost the whole of those selected for their sweetness may also be relied upon as of sufficient vigour to grow into good-formed standards:—

Abel Grand.—Carmine and blush.

Adolphe Brongniart.—Carmine-red.

Baronne Prevost.—Very large, pale rose.

Beauty of Waltham.—Lovely crimson.

Bessie Johnson.—Pale blush, almost white.

Boule de Neige.—Smallish, in clusters; one of the best and most fragrant of all white Roses.

Camille Bernardin.—Large, red, and edged with white.

Charles Margottin.—Carmine-red.

Comtesse de Chabrillant.—Large, full, pink.

Duchess of Sutherland.—Soft flesh; old, but good.

Duke of Edinburgh.—Very brilliant vermilion.

Elizabeth Vigneron.—Light rosy-pink.

François Courtin.—Purple-cerise.

Glory of Waltham.—Rich crimson.

Harrison Weir.—Full, velvety-crimson.

Heinrich Schultheis.—Delicate pink and rose.

John Grier.—Bright red.

Madame Alice Dureau.—Rich rose, very bright.

Madame Boll.—Bright rose, large and double.

Madame Charles Verdier.—Full, dark rose-coloured.

Madame Elize Faisson.—Large, bright cherry-red.

Madame Ferdinand Jamain.—Clear deep rose.

Madame Fillion.—Finely-cupped, salmon-rose.

Madame Furtado.—Bright rose.

Madame Korr.—Deep pink, with rosy centre.

Madame Marie Cirodde.—Very pale rose, large and full.

Madame Montet.—Delicate rose-coloured; large petals.

Madame Moreau.—Large and double, shaded crimson.

Madame Thivenot.—Deep violet-crimson.

Mdlle. Marguerite Dombrain.—Delicate silvery-rose.

Miss Hassard.—Flesh-coloured pink.

Miss Poole.—Soft silvery-rose.

Souvenir de Leveson-Gower.—Rich ruby-red.

Souvenir de Monsieur Boll.—Bright cerise, large.

Triomphe de France.—Bright carmine, large and good.

Virgile.—Rich salmon-rose.

William Jesse.—Deep bright rose.

These will all be found sweet Roses; perhaps the Duke of Edinburgh being the least fragrant of any among them. Apart from their fragrance, most of the Hybrid Perpetual Roses named in our list of Exhibition, Pillar, and Garden Roses, are equally fit for moulding into standards. It is well for the Rosarian to study local characteristics and growths of particular Roses in different places as far as may be, before going largely into standard Roses. Other qualities being good, the Roses that grow most freely in any given localities are the best to choose for standards.

Following out our idea of making fragrance one of the most essential qualities in standard Roses, Maréchal Niel must stand at the head of all the Tea and Noisette Roses, inasmuch as it is either or neither, or both combined, and excels them all for the fulness of the fragrancy, and the weight and numbers of its well-filled blooms of gold.

Céline Forestier is about the sweetest of the Noisettes after Maréchal Niel, and the pure white Lamarque has also a pleasant odour. Desprez à Fleur Jaune, a curious combination of buff and red, rare among Roses, is also fragrant.

The only Bourbon worth growing for its fragrance, and that is peculiar, is Souvenir de la Malmaison, which is especially useful in the autumn.

Nearly all the Tea Roses are more or less sweet, and do well as standards in sheltered places and mild localities, the following being, however,, the sweetest. As a good second to Maréchal Niel comes Devoniensis, which forms a capital standard, the climbing variety being equally sweet with the common, and being most useful and floriferous on tall briars.

Eugène Desgaches.—Large and fine; pale rose.

Gloire de Dijon.—One of the sweetest of all, and the most free-flowering; orange and buff.

Goubault.—Less grown than it deserves to be from its full fragrance; bright rose.

Letty Coles.—Said to be a sport from the above, and retaining most of its characteristic fragrance.

Madame de St. Joseph.—A mixture of fawn and rose; not very vigorous, but worth trying for its sweetness.

Madame Willermoz.—White and salmon.

Narcisse.—Pure white, but only fit for dwarf standards in a mild, warm situation.

President or *Adam.*—Rose-shaded salmon.

Reine de Marie Henriette.—A red Gloire de Dijon.

Triomphe de Guillot fils.—White and rose.

Those who enjoy the sight and the fragrance of the old-fashioned Cabbage, Provence, Gallica, and Moss Roses, may work a few of them as standards. They do not grow freely thus elevated; still it is something to be able to raise them so much nearer to our level of facile enjoyment. One of the most popular Roses in a large garden, a few years since, was a nice, round-headed standard of the York and Lancaster Rose. A second was the so-called Maiden's Blush, little better than a semi-double of the Alba class; and a third was a round-headed semi-weeping example of the Golden-yellow Briar, Harrisonii. Some of the stronger-growing Perpetual Moss Roses form better standards than the common Moss, Laneii, Luxemburg, and White Bath. Very tall standards may be worked with climbing Roses, and among these the Musk Roses, and Baltimore Belle, Riga, and Splendens, are the more fragrant.

Varieties for Weeping Roses.—Few things are more welcome, none can be more graceful, in gardens, than these. To exhibit their beauty to the full it is obvious they must either weep over or weep under us. Weeping on our own plane of vision, much of their beauty must of necessity be lost. From three feet to nine or ten includes the extremes of height in weeping Roses. Four and eight are both good heights. The first can easily be looked down upon, the other looked up at. As not a few of our climbing Roses, however, can rise from ten to fifteen feet, it follows that there is no limit to the height of weeping Roses, excepting that of available stocks to work them upon. Now, the Wood-briar or Dog-rose, seldom grows much higher than from eight to ten feet. Hence, if weeping Roses are desired taller than this, strong shoots of the Boursault, Ayrshire, or Evergreen Roses, should be run up, carefully disbudded to within a foot or so of the top, and firmly staked. These, with careful culture and training, will form admirable weeping Roses. The commoner way, however, consists in budding climbing Roses on to the summit of the tallest Dog-briars that can be obtained.

As to the selection of sorts, all the more flexible-growing species and varieties of Roses may be used to form weepers. The weaker the wood the better and easier it will droop. Hence, were they only more hardy, the Banksian are really the very beau-ideal of perfect weeping Roses.

Next to them, follow the Ayrshires, Evergreen, Boursault, Noisette, Hybrid China, Perpetual Musk, and Multiflora Roses. All the varieties of the Sweet-briar also form charming weeping Roses. The exquisite buds and rich-coloured flowers of these never look so brilliant as when seen in drooping sprays. While to sit under a weeping Briar-bush at dewy morn or eve is, indeed, to reap harvests of sweetness, such as Gray so well describes:

> "Sweet-briar fragrant as the breath
> Of maid belovèd when her cheek is laid
> To yours, in downy pressure soft as sleep."

Dwarf Roses.—There are fashions in Roses as in ladies' dresses or bonnets, and the lawless caprice is, perhaps, as great in the one as in the other. Of late years the fashion has run on dwarfs. Only a few years ago it was all for standards, the taller almost the better. Thus it has happened in Roses, as in other things; swayed by fashion, we have got back to our starting-point, and as dwarfs were our first Roses, they are likely to be our last. But, be that as it may, it seems well that our Roses in the mass should get back nearer to earth, as perhaps dwarf Roses are more easily cultivated and managed than those of any other form. When the time arrives that all dwarfs should also be own-root Roses, their culture will become even more simple, being no longer complicated with the dual life, and consequent competing interests, of scions and stocks. At present, however, the majority of our dwarf Roses are budded or grafted on the Manetti, briar, or other stocks, wherein lies a considerable danger to amateur growers, who not seldom mistake the vigorous growths and suckers from the stocks, for the Roses worked upon them, and thus find their Roses but wildings after all.

Hence, and also for other reasons, the best dwarf

Roses are those on their own roots, and these, as well as worked dwarfs, are admirably adapted for many places and purposes, for which other forms of Rose-plants are less suitable. For fringing beds or borders of standard Roses, and bringing the plants down to kiss or rest on the turf, dwarf Roses are indispensable. They are also the most effective for the filling of detached beds on lawns, or groups of beds, in Rosaries. In the latter each bed may be furnished with one variety, or varieties of a similar colour. Such groups, edged with Roses of a contrasting colour or character, are among the most effective of all methods of garden furnishing.

To enumerate all these would be like repeating all the best already given; for there are few or none amongst them that might not naturally grow or, with a little manipulation, be moulded into dwarfs. In general terms it may be stated that nearly the whole of the Hybrid Perpetuals, all the Teas, with perhaps the single exception of Maréchal Niel, all the Bourbons, Chinas, Provence, Moss, Scotch, and Multiflora sections, and several of the Noisettes, make capital dwarfs.

The following will, however, be found among the very best to grow in single lines, or in masses in beds and borders.

To prevent repetition and economise space, the Hybrid Perpetuals will appear under colour headings, and all further description be dispensed with. It must not, however, be assumed from this that the colours are the same through the whole group. On the contrary, they vary very much indeed, though they will be found sufficiently alike to mass together in the same group or bed.

Hybrid Perpetuals.

Dark Crimson.

Abel Carrière.	Mons. Boncenne.
Baron de Bonstetten.	Pierre Notting.
Charles Lefebvre.	Prince Camille de Rohan.
Duke of Wellington.	Prince Arthur.
Duke of Edinburgh.	Queen of Bedders.
Ferdinand de Lesseps.	Reynolds Hole.
Fisher Holmes.	Sultan of Zanzibar.
François Louvat.	Thomas Mills.
General Jacqueminot.	Vicomte Vigier.
Louis Van Houtte.	Xavier Olibo.
Maurice Bernardin.	

Light Crimson.

Beauty of Waltham.	Jules Margottin.
Camille Bernardin.	Louisa Wood.
Countess of Oxford.	Madame Crapelet.
Etienne Levet.	Mrs. Charles Wood.
Hippolyte Jamain.	

Reds of mostly Brilliant Shades.

Alfred Colomb.	Mdlle. Annie Wood.
Auguste Rigotard.	Maréchal Vaillant.
Comtesse de Paris.	Marie Baumann.
Dr. Andry.	Red Dragon.
Duchesse de Caylus.	Red Gauntlet.
Dupuy Jamain.	Senateur Vaisse.
John Stuart Mill.	The Shah.
Madame Victor Verdier.	Sir Garnet Wolseley.
Mdlle. Marie Rady.	Star of Waltham.

Carmine or Rose.

Anna Alexieff.	Magna Charta.
Annie Laxton.	Marguerite de St. Armand.
Edouard Morren.	Marquis de Castellane.
François Michelou.	Mons. Etienne Duprez.
John Hopper.	Paul Neron.
La Duchesse de Morny.	Princess Beatrice.
Madame Thérèse Levet.	Victor Verdier.

Pink or Pale Rose.

Abel Graud.	Mons. Hassard.
Elie Morel.	Mons. Noman.
La France.	Princess Mary of Cambridge.
Madame Cointet.	The Rev. G. B. M. Camm.
Madame Fillion.	Royal Standard.

Blush or Flesh-coloured.

Baroness Rothschild.	Jules Finger.
Bessie Johnson.	Madame Vidot.
Captain Christy.	Mdlle. Bonnair.
Comtesse de Serenye.	Miss Ingram.
Centifolia rosea.	Princess Beatrice.
Duchesse de Vallombrosa.	Thyra Hammerich.

White Bedding Roses.

Boule de Neige.	Paul's Single White Perpetual.
Coquette des Blanches.	Perle-de-Lyon.
Louise Darzens.	White Baroness.
Mabel Morrison.	
Madame Lacharme.	

Yellow Bedding Roses.—The time may come when the great family of Hybrid Perpetuals will furnish our beds and borders with golden Roses. But this time seems still afar off, not the slightest break having yet been made into this new ground. Our best golden Rose—the Maréchal Niel—is too weakly in its stems, and too weighty in its blooms, to look its best as a dwarf Rose. Harrisonii makes a brilliant bed, as also does Céline Forestier, Triomphe de Rennes, Safrano, and Belle Lyonnaise. Gloire de Dijon, however, is still the very best yellowish Rose for groups or beds. All the hardier Teas are also well suited for growing as dwarfs. Bourbon Roses are admirably adapted for dwarfs; but nearly all being destitute of perfume, with the exception of one of the best of all autumnal-blooming Roses, Souvenir de la Malmaison, they are but little grown. Baron Gonella and Acidalie are, however, well worth growing. Neither must the old blush China, the crimson and the various improved varieties of the same, as Cramoise Supérieure, be neglected. Clara Sylvain is still the best white, though more tender than the others. Such showy Roses as Coupe d'Hébé, Charles Lawson, Paul Ricaut, Gloire de Rosamene, Aimée Vibert, Madame Plantier, the common and Perpetual Moss, Cabbage, York and Lancaster, as well as the Scotch, Austrian Briar, and Alba Roses, make capital dwarfs. Singularly enough, some of these sorts, notably the Moss Rose, are so wedded to the dwarf forms that they seldom thrive either as standards, pillars, or pyramids. Such distinct species as the Musk, Polyantha, or Multiflora Roses, the best of which are the two whites, Anna Maria de Montravel and Madame Parqueritte; and the two pinks, Madame C. Brunner and Mignonette, and the Fairy Roses, are dwarf by nature and character, though some have moulded them into liliputian standards.

Pegged-down Roses.—This is a mode of culture rather than a special form. Almost any variety of Rose may be forced to the ground by pegging, though those of slender growths and of perpetual blooming qualities are best adapted for the purpose. Such Roses as the old Monthly or pink and crimson Chinas, may be accepted as the very best types of Roses for pegging down. All the Tea Roses, most of the Bourbons and Noisettes, and the majority of the Hybrid Perpetuals, yield readily to this mode of treatment. It has two prominent advantages above most other methods of training Roses; that of covering the ground more rapidly and completely, and the annual re-invigoration of the plants near their collars or root-stock, the centre of their vitality and life.

It is impossible to exaggerate the obvious advantages of pegging-down Roses. Charming as Roses are in blossom and foliage, it is yet a fact that as generally planted they add but little to the landscape beauty of gardens or pleasure-grounds. The plants are either too tall, formal, stiff, or too much bare ground is seen around or among them. Let the latter be covered with their own branchlets, and these objections vanish at once.

Pegging-down improves the Roses even more than the landscape. By bending the branches towards the ground considerable strain is placed on their bases. This strain forces the buds at these points to break with great vigour and strength. The result is that during the summer a series of shoots are formed very often stronger than those of the preceding year. Hence, at the end of the season all that is necessary is to cut away the whole or a portion of last year's blooming shoots, and bend these maiden shoots down in their places, and thus the beauty and vigour of the plants are annually renewed, and one of the most serious eyesores that disfigure so many gardens, that of dilapidated Rose-trees or bushes climbing rather than covering the ground, avoided.

In the brief lists given of Roses adapted for dwarfs and other forms, it must not be assumed that others not named are not as suitable or as beautiful. Because these will answer for moulding into the forms indicated, is no reason why others will not, and almost any Rose may be grown into any shape or form desired, though some are more pliable than others. Those specified in these lists are not only suitable, but mostly cheap; and the dwarfs especially may be purchased in quantity on specially favourable conditions from most of the larger firms in the trade.

GLASS STRUCTURES AND APPLIANCES.

PLANT-STOVES AND ORCHID-HOUSES.

JUST as the chief, often the only difference between the dining and drawing-room, resolves itself into a mere matter of furnishing and arrangement, so the main distinction between the plant-stove and the conservatory lies in their different temperatures, and the distinct character of the plants found in the two sets of houses. The structures may be identical in size and form; so much, indeed, is this the case, that the conservatories already described and illustrated are almost equally suited for plant-stoves and Orchid-houses. The furniture and temperatures are the chief considerations that determine the nomenclature of our glass structures. Hence, houses devoted to Vines are called Vineries; to Peaches, Peacheries or Peach-houses; to Pines, Pineries; to collections of more or less hardy fruits, either planted out or in pots, orchard-houses; to the semi-tender plants of temperate regions, greenhouses; to these and other plants in flower, conservatories; to tropical plants, plant-stoves; and to Orchids, Orchid-houses. Many sections of structures suitable for such special purposes have already been given in articles upon the Vine, the Pine-apple, &c.; and others will appear as occasion calls for them. The division or classification is often carried much further in large places, whence Ferneries, Orangeries, Fuchsia-houses, Pelargonium-houses, Succulent-houses, Palm-houses, simply mean glass structures devoted wholly or chiefly to the cultivation of these special plants. Occasionally the houses are built for the tenants, and in this way they have a double claim to their name. But far oftener it is not so; as a collection of plants increase or multiply, they occupy first a part and then the whole of any existing house, and henceforth bestow their names upon it. Hence there may or may not be any special structural feature to give significance to the name of the house, or specially suit it for the purpose to which it is set apart. As horticulture advances, however, it is possible that the multiplication of names will greatly increase, until almost every family or genus of plants will have its house to which it will impart its name, or for which it will be structurally and physically fitted with the greatest nicety. This is already the case in the great family of Orchids, and hence we have not simply Orchid-houses, but distinct houses for Phalænopsis, Cattleyas, Dendrobes, Aerides, Odontoglots, &c. &c.

In the olden times glass-houses were comparatively few, and they were mainly classified by temperature, a system which is still retained to a great extent in practice. Hence, we have cold houses, that is, unheated; temperate houses, heated from 45° to 55°; tropical houses, heated from 66° to 75°. In modern as in olden times, too, the quality as well as the amount of heat becomes practically a means of classification. Hence, we have dry-stoves and wet-stoves—in other words, those for the vegetation of the dryish table-lands of tropical countries, and those for plants from the semi-saturated regions of stuffy woods and steaming swamps.

From all this we arrive at a threefold general basis of classifying plant structures. The first is the plants, the second the temperature, the third the amount of vapour in the atmosphere. And it is in regard to the last that the chief difference is found between the general plant-stove and the Orchid-house. Even in the latter, temperature is a shifting ground; for the cool Orchid-house is little, if at all, warmer than many conservatories. As a rule, however, it is more moist, and this greater degree and amount of moisture is one of the distinguishing marks of such houses.

Moisture.—Considerable diversity of opinion exists as to the best means of providing this extra moisture to the atmosphere of Orchid-houses, or moist-stoves. Surface sprinkling of all surfaces, such as walks, stages, shelves, the surface of leaves, pots and baskets: the placing of evaporating-pans on hot-water pipes; the use of tanks for warming, and occasional uncovering of portions of them to allow of the escape of vapour into the house; the use of a small jet of steam from the boiler, or a separate source, to charge the atmosphere with vapour when wanted—are some of the many methods employed for generating and maintaining a moist atmosphere. One of the earliest and best is that of exposing large open tanks of water under the shelves or plant-stages, or under the paths, almost the whole length of the house, the latter being covered with strong iron gratings, of various patterns, and sufficiently open to allow of the free passage of aqueous vapour from the tanks into the atmosphere of the house. The whole body of the atmosphere of the house will then have free access to the water, and will take up neither less nor more than the state and temperature of the same will warrant. For there is a curious twofold correlation of air in regard to water; that given free access to the latter, the air will drink up moisture exactly in the dual ratio of its dryness and its temperature, and hence any scarcity or excess of moisture in the air of plant-stoves and Orchid-houses become almost alike impossible when a sufficient surface of water is exposed to the air. This was early recognised by most Orchid-growers, and hence the Orchid-houses of the late Mrs. Lawrence had a central tank, called the Lake, with hot-water pipes passing through it. Mr. Rucker, one of the earliest and most successful of Orchid-growers, had a large open tank under his centre stage. In another old Orchid-house known to the writer, a large tank, four feet broad and three deep, was carried the whole length of the house. Mr. William Bull, in his group of about twenty houses, each sixty feet long, in the Ashburnham Nursery, King's Road, Chelsea, has carried tanks along one or both sides of most of them, for the storage of water and the dissemination of insensible vapour.

Of course there are other great advantages in this mode of storing water, besides its being a self-acting system of charging the air with the requisite proportion of aqueous vapour, though it is almost impossible to exaggerate its importance in this respect. One point of great and vital moment in favour of such means of charging plants and the air with water is often overlooked: all the water thus distributed through the air is *pure*. Such means of raising moisture leaves all the impurities of the water behind. This is very far from the case by the use of the garden engine or syringe, as the lime and filth stains on so many fine-foliage plants and Orchids abundantly testify.

Again, water thus stored naturally assumes the average temperature of the house. It thus becomes a mediating and moderating force during the heat of bright days and the cold of frosty nights, absorbing heat when it is least wanted, and giving it back to the air when the latter cools. A large body of water husbanded in this manner, and freely exposed to the general atmosphere of the house, becomes a powerful moderating force between the evils of extremes of temperature. Water thus exposed is mellowed and sufficiently genialised to be used for watering and sprinkling purposes with little or no additions of warmer water to it. By being spread over a large surface in this way, it is also clarified by the deposit of any impurities. Of course there are some drawbacks in winter, as snow-water and cold rains in filling the tanks may also run down the temperature. But a little extra heat will counteract that, and in some cases a small return-pipe has been laid back through such tanks, to add a gentle warmth to the water, and assist in the elevation of an almost insensible vapour into the atmosphere of the Orchid-house. But this must be done tentatively and with care, and such water-heating pipes should be so arranged as not to form part of the regular circulation, and so as to be readily shut off and on when required or desired. Unless on a very large scale, a two-inch pipe would generally suffice for the purpose. Should such pipes be large, and form part of the general circulation, the chances are that the house would be most densely filled with vapour when it was least wanted. This system of having a small offset pipe specially for warming tanks of water is by no means confined to Orchid-houses, but is often used for plant-stoves and fruit-forcing houses, such as Pineries, Vineries, or early Peach or other forcing houses.

Structural Peculiarities of Plant-stoves and Orchid-houses.—These, unless erected for very tall tropical plants or shrubs, Palms, Ferns, or large flowering or foliage plants, are mostly built rather lower, and constructed with greater care and closeness, than conservatories or Orangeries. And this on the ground of economy, as well as for cultural reasons. Chinks in the glass, indifferently fitting lights, ventilators, or doors, are matters of little moment where the temperature is comparatively low. But where a temperature of fifty, sixty, or more of artificial heat has to be kept up against all the antagonism of wind and weather, a close fit between the internal and external air becomes indispensable. The loss of heat through bad glazing, or bad fits, is incalculable. That loss rises in magnitude and importance as the disparity between the internal and external temperature increases.

Nor only this, but the loss of heat is intensified, and the injury inflicted by the free admission of cold air, or emission of warm air, is increased, in the ratio of the moisture in the internal air. The capacity of air to carry vapour is in proportion to its temperature. The colder the air the less moist, and *vice versâ*. Hence, as cold air rushes into a plant-stove, or Orchid-house, it commits a two-fold robbery abreast. It steals caloric and aqueous vapour from the air, and if it cannot find enough to satisfy its craving necessities for moisture in the air, it steals it, as we have already seen, from the leaves and flowers of the plants. But as considerable heat was first of all expended in the conversion of water into vapour, it follows that a compound waste of caloric takes place in the escape of heated air into the outside atmosphere, and the ingress of the external air into tropical plant houses. Besides, the evaporation of water from heated surfaces to satisfy the wants of dry cold air for moisture, cools or chills these surfaces, and is thus a source of local evils as well as of a general depression of temperature throughout the entire area of hot-houses.

These principles have an important bearing on ventilation, as we shall see, for the effect of cold air on local atmosphere is the same whether the air be admitted through imperfections of structure, or of express purpose through wilfully opened apertures, called ventilators. Though it is needful to provide all plant structures with such appliances for the purpose of moderating their heat and renewing their atmosphere, yet the tendency of the latest discoveries in science, and of the more advanced practice, both run in the direction of using ventilators much more seldom and to a lesser extent than formerly. At one time no end of energy, time, money, and appliances were expended in the heating of plant-stoves to the necessary temperature, and the sweeping of the heated air out again through open ventilators, to the injury of the plants, and the reckless waste of heat and aqueous vapour. In regard to the ventilation of all tropical plant houses it may be well to be furnished with the power of a giant, but very unwise to use it with a giant's might. The old dogma about the exhaustion of the air through the economy of plant-life is now very generally exploded. The idea seemed to prevail that the same air could only be used once, as water through a watering-pot, or corn through a sieve. But plants use air many times without abusing it—that is, exhausting it—if, indeed, they can exhaust it; and hence the importance of treating air once heated and charged with moisture as a force to be used many times, utilised to the uttermost, and not simply used once, and swept out at open doors or windows—that is, ventilators. Moist air is the product of many forces, the result of many energies—such, for example, as perfectly constituted houses, coal, labour, water—all of which cost time and money, and hence ought to be utilised to the very uttermost.

Height.—It may be needful at times to have lofty and what are called semi-architectural houses for some plants, for effect. But so far as successful culture is concerned, such are by no means needful. In fact, and in practice, size and height of house are rather unfavourable to culture than otherwise. Large and lofty houses are mostly cold, and the coldness arises very much from their size and their loftiness. Of course any sized house may be heated if a sufficiency of furnace and boiler area and hot-water pipes are used. But even then such houses seldom equal the cultural results obtained in lower and smaller houses. Fortunately, too, houses may be large without being lofty, and larger cultural areas be enclosed at less cost within from six to ten feet of the ground than sixty. Nor does the effort after low houses end on the surface. A great many plant-stoves and Orchid-houses are sunk several feet below it. The system is most economical as well as favourable to culture; for all the underground portions of such houses are impervious to any amount of cold in the atmosphere. Such houses are virtually glass roofs spanning the walls. Not unfrequently the front wall is buried right up to the wall-plate on which the roof-lights rest in front. The back walls are built hollow or flued, and the spent products of combustion are carried through or along the latter. Thus the front walls are impregnable to cold, and the back becomes an active and potent source of heat.

Some of the finest Cattleyas and other Orchids ever seen by the writer, and a party of specialists in Orchid-culture, were growing on a shelf along the front of such a sunk house. They were perfect pictures of healthy vigour and verdure, so much so as to excite special admiration and commendation. The house was so simple in its construction, and withal so cheap, that for a time it obtained no credit. But at last the cultivator declared the moist warm wall had very much to do with it, an opinion that all ultimately endorsed. Here was a house little better than a cold-pit, with a path and side shelves all round it, and a bed in the centre, with a faultless collection of Orchids! Just such a house as any amateur might build for himself, or have erected for him at the smallest cost. The position was specially warm and sheltered, open to the south, and protected by a shrubbery from all winds from other quarters. And the house being so low, it was covered with straw mats on severe nights. By these extraneous aids, and effective means of conserving heat, but little fire-heat was needed, and the results were, as already observed, strikingly successful.

Nor is the saving of fuel the chief, nor perhaps the most important saving in such cases. The reduction of the amount of heat is often of more moment. The plants are better without so much artificial heat, even if it could be had for nothing. No more mischievous fallacy was ever uttered than that heat is heat, and that all heat is alike good, whatever its source. This is just about the opposite of the truth; and it would be equally or more true to affirm that all artificial heat was but a necessary evil, and the less of it used the better for the plants. It is not only different, but inferior to natural heat, its effects on vegetable life and growth being widely different. Hence a degree of natural heat, husbanded or saved, by improved form or structure of plant-stoves and Orchid-houses, or more perfect glazing, or more efficient shelter above or below, is not only a degree gained, but equivalent in growing force, and strengthening transforming power, to two or more degrees. Hence the husbanding of natural heat is to be strenuously advocated, not only on the ground of economy, but as an aid to culture and a source of strength.

Importance of Mating Light with Heat.—Heat without light stimulates plants into weakness. It is most essential to have this in view in the culture of stove-plants and tropical Orchids. The preservation of these in health, their successful cultivation, demands a high temperature. Until, however, we can match the heat with the electric light, which seems almost identical with solar light, it is needful to moderate the amount of heat used, so as to make it run more nearly abreast, as it were, with the supplies of light. The exact structural form of house best adapted for husbanding to the full the natural and artificial heat applied, as well as utilising to the uttermost the light of our climate, has probably yet to be devised. Nearly a century ago an ingenious horticulturist designed a tropical house that revolved on its base, and presented the best absorbing angle to the sun at every hour throughout the day. The experiment was so far successful; but of course the expense proved prohibitory of others on a larger scale, and it is merely mentioned here as an illustration of the thought and care devoted to the vital matter of utilising natural light to the very uttermost. The latter is in fact the difficulty of cultivators. Their cry, like that of the dying Goethe, is "Light, more light!" Heat of some sort is quite within their control, but light is a sadly limited quantity, and of very mixed quality in our climate. Hence the importance of selecting houses of the best form for conducting light, and for offering as little resistance to its passage as possible, by reason of the opacity of their framework, as is consistent with the requisite strength; choosing glass of the best and most transparent quality, and placing the plants as near to it as is consistent with safety.

Light Framework.—Whatever the system of glazing adopted, of those to be hereafter described, some sort of strong and durable framework is needful. The stronger the material used, the lighter the ribs may be. The desire to reduce the opacity of rafters and sash-bars to the uttermost, led to the adoption of metallic roofs; and there is no doubt that metal occupies far less space than wood. It is also very generally used, though the idea so prevalent on its first introduction that it would supersede wood for hot-house building has long been laid aside. Hot-houses increase so rapidly that there is abundant scope for both wood and metal in the erection of the framework of their roof. The lightness of metal is undoubted; but it has many other drawbacks, such as its tendency to corrosion, its expansion and contraction under sudden alternations of temperature, and the prejudice against it of being colder than wood. For these and other reasons wood is still very extensively employed, and as the laws of solid principles of building, and the theory and practice of bracing have become better understood, wooden roofs contain barely a third of the timber that used to be put into them. In fact, so much has the actual proportion of timber to glass been reduced, that not a few wooden houses—as they are called—would run the iron ones pretty closely in this matter. The demand for more light to tropical plants has succeeded in reducing the opacity of roofs to the smallest dimensions consistent with sufficient strength and the appearance of perfect security. In not a few plant-stoves and Orchid-houses the latter has been lost sight of, or not sufficiently cared for, and the plants *appear* in danger of being turned out of doors by the fall of the house at the approach of the first storm. But sufficient strength and stability to look safe are quite compatible with such a degree of lightness as shall supply the needs of the plants.

Transparent Glass.—This is of equal or more importance than light framework. All is not gold that glitters, nor is all glass transparent that looks so. Experimental tests of the translucency of glass would prove of the greatest practical importance. There should be some simple method of testing the transparency of glass as there is of measuring the luminosity of gas-light, and the glass should be sold by a transmitting standard. Not a few of the cheaper horticultural glasses are probably not more than half translucent—that is, they only transmit about fifty out of every hundred per cent. that falls on their surface. The question of angles of high or low transmission has been discussed under the head of Conservatories. But these points, important as they are, are as nothing to the glazing of plant-stoves or Orchid-houses with clear glass to start with.

Glass of fair price and good quality is mostly clear. It is the cheap bargains so often offered at clearance sales, or in answer to low-priced advertisements, that are to be dreaded, and altogether avoided. A penny saved in such matters as the glass for stoves and Orchid-houses, is a penny—it may be pounds—lost; and there is nothing pays so well in produce and satisfaction to all concerned as good glass for hot-houses—say, for superior sorts of houses, 26 oz. to the foot, or even heavier.

Having secured good glass, it is most important to keep it clean by annual or more frequent washings. Nothing is more improvident of the most valuable of all natural forces, light, than to allow dust and soot, crumbling putty from laps, and mortar out of brick walls, to foul the glass, and shut out solar light from plants that have been accustomed to double, treble, or even ten times as much of it in a state of nature as it is possible to provide for them in our climate, do what we may. Deep and dirty laps, again, are a most preposterous contrivance to make glass roofs opaque. What with the actual width varying at times from a quarter of an inch to an inch, and the residuum that flows from and stains the bottoms of these collectors and distributors of pollution, a third of the glass is not unfrequently obscured by laps.

The tendency of all improvements in glazing, as will be gathered from subsequent details, is to reduce the number and contract the size of laps. Still, as they exist now, they are often a great means of shutting out the light and lessening the transparency of glass roofs.

Bringing the Roofs down Closer to the Plants.—Another method of accentuating as it were the energy of the light, consists in either bringing down the roofs into closer proximity to the plants, or lifting the plants up nearer to the light. Doubtless, were roofs perfectly transparent, the mere matter of distance from the glass would be a matter of little moment; but as they are, the light appears to lose more force the further it passes through them. Hence, in practice, and notably among Orchids, it is found that the nearer in reason the plants can be placed to the glass, the more potential the light in strengthening and maturing growth. Short of contact with the glass—and this is to be condemned on many grounds—not a few plants thrive best as near to it as possible. Actual touch leads to scalding, freezing, and other evils, but the best place for many stove-plants and Orchids will be found within the distance enclosed within six inches and a yard of the glass.

Hence, where plants on stages or shelves are the main consideration, few or no climbers should be introduced or trained on the roofs. Few have the courage to suppress beautiful climbers sufficiently to prevent their injuring the plants below them by their shade, and hence it is better not to plant, or to confine them to the front, back, and side walls, or roof-pillars. In many cases, however, a roof wreathed and festooned with climbers is far more beautiful than any or all the plants grown in pots or planted out in beds in the centre or sides of the house. But such climbers inevitably injure by their shade most of the other plants, and if disappointment is to be avoided, this should be well understood beforehand. Some contend that light is of far less moment than is mostly assumed, and cite in proof the necessity and constant practice of artificial shading. But the shading is not used as against light, but heat. The term shade is quite misleading. They should be called anti-scorchers. We have *never enough* light for tropical plants in our climate. We may often, in the highly artificial conditions of our glass-houses, have an excess of heat. Fierce sunshine striking on to plants after a long spell of dull weather, or obscure light, both of which render the tissues of plants soft and flaccid, burns up and scorches such tissues. Had the light been more intense, the heat would probably have done them no harm, so that actually the necessity for blinds arises from the obscurity of our light.

No doubt, too, shading is wonderfully overdone; it is invariably practised on the side of excess, and for this reason. A sudden scorch becomes at once visible, its evil and loss are all too prominently apparent; but the evils of over-shading are slowly revealed, and it even needs special knowledge and training to note them at sight, and whole months, maybe, after the evil is done. It should be laid down as an unalterable law, never to shade unless when the sun is shining, and to withdraw it the moment it is overcast by clouds. To facilitate the carrying out of this law, all shading material should be moved on rollers, so geared that they can be moved up or down with the utmost ease and despatch. If they are otherwise, they are sure to be either let down too early or too late, and, worse almost than either, left on far too long. It is seldom needful to shade before 11 a.m., nor to leave it on after 3 p.m., though conditions of plants, aspect of houses, &c., largely determine such matters. But little harm will result from any necessary shading, once it is thoroughly understood that it is used solely as against excessive heat, and never with the intention of moderating the energy of solar light, which is mostly all too weak for tropical plants under our semi-leaden skies.

Size of Plant-stoves and Orchid-houses.—This has been incidentally referred to as of little or no moment. But as very exaggerated ideas prevail to the contrary, it may be well to state that some of the finest stove-plants and Orchids have been grown in the smallest houses. For example, one of the healthiest collections of Phalænopsis to be found in the country, has been grown for the last ten years in a house about thirty feet long, ten wide, and eight high. The form is a hip-span, and it furnishes such a feast of Phalænopsis to its owner every year, that good and large growers make many a pilgrimage to see it. It is also important to do away with the notion that plant-stoves and Orchid-houses are beyond the reach of amateurs and those with small means. On the contrary, few plants can be grown with less cost than Orchids and many of the choicer stove-plants. Even the cost of purchasing them is daily becoming less; the enormous imports, innumerable auctions, the competition of trade firms, and last, but by no means least, the liberality of many of our largest growers, who treat amateurs in the most liberal and fraternal way in regard to cost of collections, have brought Orchids within reach of all classes; and almost any house that will grow green-house plants well, will, with a little more heating force, grow Orchids equally well or better. And even the additional heat is not essential for some of the most beautiful of all Orchids. Such as Odontoglots, Masdevallias, Stanhopeas, Lycastes, and many of the Cypripediums, forming magnificent collections in themselves, may be grown in warm conservatories; and small houses may be readily warmed up to a temperature of from 65° to 75°, which will suffice to grow the heat-loving Orchids. It is to be hoped that neither the size of the house supposed to be needful, nor the cost of keeping it warm, nor the comprehensive lists that we have given of plants which we have wished to popularise, will prevent our readers from trying Orchids. Stove-plants are yet cheaper and more easily grown, and those amateurs who have not yet tried a small stove can have little idea of the amount of pleasure that may be reaped from such a house at a small cost. Orchid-houses may be found varying as widely in size as from ten feet wide to fifty, and from six feet high to fifteen or twenty feet, with lengths of every possible number of feet to suit the pockets or plants of their owners. Lengths of fifty feet, breadths of twenty feet, and heights of ten to twelve feet, are also comparatively common. Some of the largest houses are twenty feet broad and eleven feet high, with side shelves thirty inches wide and a yard high; then follows a path a yard wide all round, leaving a stage eleven feet wide in the centre. But the tendency of the present day is towards small houses for cultural purposes, alike for the cultivation of Orchids and of stove-plants.

Forms of Plant-stoves and Orchid-houses.—Any of those forms already illustrated or described as suitable for conservatories will also answer for plant-stoves and Orchid-houses. Curvilinear and regular, or irregular, that is, hip-spanned roofed houses, are, however, specially adapted for such purposes. These admit more light than lean-to's, even should the latter have front and end lights. Still, as we have already seen, mere glass roofs spanning any handy distance between two walls will suffice, though they would be cried down by many as far behind the times. But the times are sufficiently catholic in knowledge and taste to welcome all practicable good from the past, and all possible improvements from the present and the future. Besides, many who can afford a mere glass roof, cannot afford expensive houses.

No house can be too good for the growth and display of stove-plants and Orchids; none can be too simple and cheap, if such will render their culture possible to those who cannot otherwise afford to grow such charming plants. The chief conditions that command success are a sufficiency of heat, light, moisture, and shade, as against sun-scorching, and these are almost as much or more under control in small houses than in large ones. Glazed with glass of good quality, and the surface kept scrupulously clean afterwards, it is astonishing how much pure light can be passed through a mere glass roof; often far more is thus brought to bear directly on the plants than in larger structures in which inferior glass is used, and little regard paid to keeping it clean afterwards.

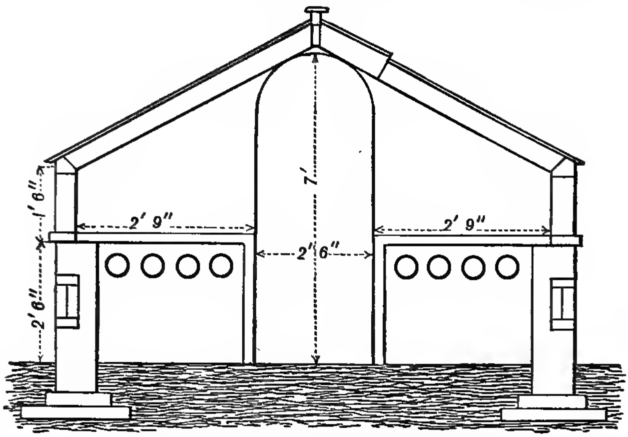


Fig. 28.—Section of Mr. Bull's Orchid-houses.

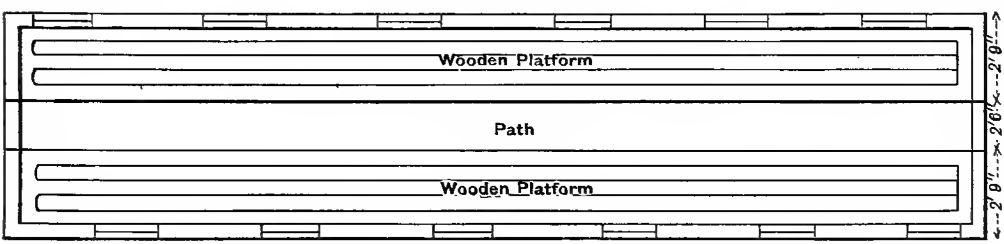


Fig. 29.—Ground-plan at Level of Platform. (The lines show the pipes.)

Still, span-roofed, domed, curvilinear, or ridge-and-furrow houses are among the most suitable for stove-plants and Orchids. Such forms on the whole, under the greatest variety of circumstances, afford the most direct and clearest light to the plants. Figs. 28 and 29 show a section and plan of Mr. Bull's series of eighteen houses, sixty feet long, eleven feet wide, and seven feet high at the apex, the brick wall at the side being two feet six inches, and the small glass side lights one foot six inches, as seen at the Ashburnham Nursery, King's Road, Chelsea. In passing through such magnificent collections of Odontoglossums, Masdevallias, and other cool Orchids as are to be found in thousands and tens of thousands at Mr. Bull's, Messrs. Veitch's, Williams and Sons', Henderson's, and other trade and private growers, it is gratifying to note that a winter temperature of from 45° to 50° is all that is needful for their well-being. Another point that powerfully impresses the amateur is the effect of large masses of one particular family or species of plants. *O. vexillarium* is so varied in colour that it constitutes a fine collection of Orchids within the compass of a single species; and the same might almost be said of *O. Crispum*, and other fine species.

For single amateur houses a very usual size is about thirty to thirty-six feet long, twelve feet wide and six and a half or seven feet high to the eaves. Generally houses of this form and width have a path down the centre, and a wide shelf or stage about four and a half feet wide down either side. A shelf is also frequently carried along within a foot or eighteen inches, or two feet, of the ridge, and this proves an excellent situation for small plants, where they are fully exposed to light and air. In other cases climbers are carried along in the apex of the span immediately over the path. Here the climbers are not only seen to most advantage, but they can be grown without injury to the plants. Of more ambitious and showy houses we give an illustration in Fig. 30, which has been engraved from a fine design by Messrs. J. Weeks and Co. This house is intended to be at least thirty feet in width, and lofty in proportion, with a ventilating ridge as well as side apparatus. The walls are represented solid, but may also be partially glazed. The stages consist of slate slabs, and under the centre stage runs a large open tank, with four hot-water pipes passing through it for purposes already explained. Four four-inch pipes are also carried under each side. This house is shown as furnished with a mixed collection of stove-plants, Orchids, and climbers, for all of which there is ample space and light in so large an erection; and such houses, well furnished, are perhaps among the choicest delights of high-class gardening. Nevertheless, let not what has been said about humbler structures be forgotten.

Internal Arrangements.—In all the illustrations we have given the plants have been in pots, and the pots arranged on shelves and stages. For commercial purposes this is inevitable. And the value of individual plants, the special culture needed by many, and other causes, have combined to continue the pot-and-stage modes of culture and arrangement in most private collections. But one has only to enter the large tropical houses at Kew, Chatsworth, or Trentham, the Botanic Gardens at Regent's Park, or Glasgow, and many other noble public and private collections, to note the immense improvement of the planting-out system. It is hardly too much to affirm that the latter is essential to the full development of tropical vegetation in its true character. By planting out different families in groups, or even considerable masses of one family—such as, for example, the Crotons and Dracænas—such families would grow as it were in dignity and magnitude beyond any possible idea of their decorative capabilities as estimated by the pot-and-stage mode of culture and arrangement. While, as for the grouping of Orchids in masses, freed from the degrading mercantile ideas of pot-portability, and instant conversion into pounds sterling under the hammer, the effect would surpass anything that has yet been attempted in plant-grouping. Such groupings have been at times successfully attempted for great decorations at festivals and public events, where all the pots were hidden, and only glowing Orchids waved over a sea of verdure. But a tropical rock garden furnished, the pocketed walls filled, the roof-rafters draped with drooping Orchids in permanency and in bulk! Such sights may become the rich cream of the permanent decorative floriculture of our near future. As Orchids grow into bulk and multiply, and our imports, already so enormous, also increase, possibly a hundredfold, housefuls of permanent Orchids planted out in groups will probably become almost as common as Ferneries are to-day.

But such brilliant displays and masterly combinations of beauty *en masse* will never supersede the present methods of pot-culture. These will always be needful to keep stock, and preserve many of the species in health, that might probably suffer, or even succumb, to the wider, and hence perhaps less careful, culture of massed-out Orchids.

Meanwhile much of the gorgeous effect of planting out is now obtained in large plant-stoves by massing the Orchids in flower at any given time into large vases, baskets, troughs, or on shelves or stages with ornamental sides of Minton tiles, china, iron-stone, or other ornamental substances. These hide the Orchid-pots and pans, and the surface may be filled in with moss, Lycopodiums, or other prostrate verdant plants, so that only beauty of colour, freshness of verdure, and sweetness of perfume may be seen and enjoyed.

No doubt there are formidable objections to the plan of grouping Orchids. The first and chief is the cost of procuring sufficient plants. Cheap as Orchids have become relatively to what they once were, it absorbs a good deal of capital to purchase them in bulk, though that is really the cheapest way to purchase them; and, of course, it is only those who have a considerable number that could plant them out in groups. Many Orchids would probably, however, grow far more rapidly, and multiply faster, if grown in this more natural way, than when cribbed, cabined, and confined in pots and baskets.

As to insects, all the base-lines, soil, and plants used should be thoroughly clean at starting, and then the probability is that they would continue so. Then as to the surface verdure, it would be quite as useful as a trap, or for a blind. The insects would lie at ease and with a sense of security under it, and the cultivator taking advantage of these facts could the more readily find, and give a good account of, most of them.

Stove-plants and Orchids Mixed, or Each Separately.—No doubt the general tendency is to grow these two classes of plants separately, and even different families of plants belonging to each section also by themselves. Yet it is quite possible to grow stove and Orchids mixed, or indeed either, in houses not specially devoted to one or both. For example, not a few of the finest specimens of Aerides, Cattleyas, and Dendrobiums ever seen by the writer were grown under the shade of Vines. True, the Vines were turned out of doors for about three months, from October to January, which enabled a temperature of about 60° to be maintained during that period. The Aerides were suspended on blocks at a distance of two feet from the roof, and were very fine examples of high cultivation. Such cases, however, are cited more to encourage those who may probably

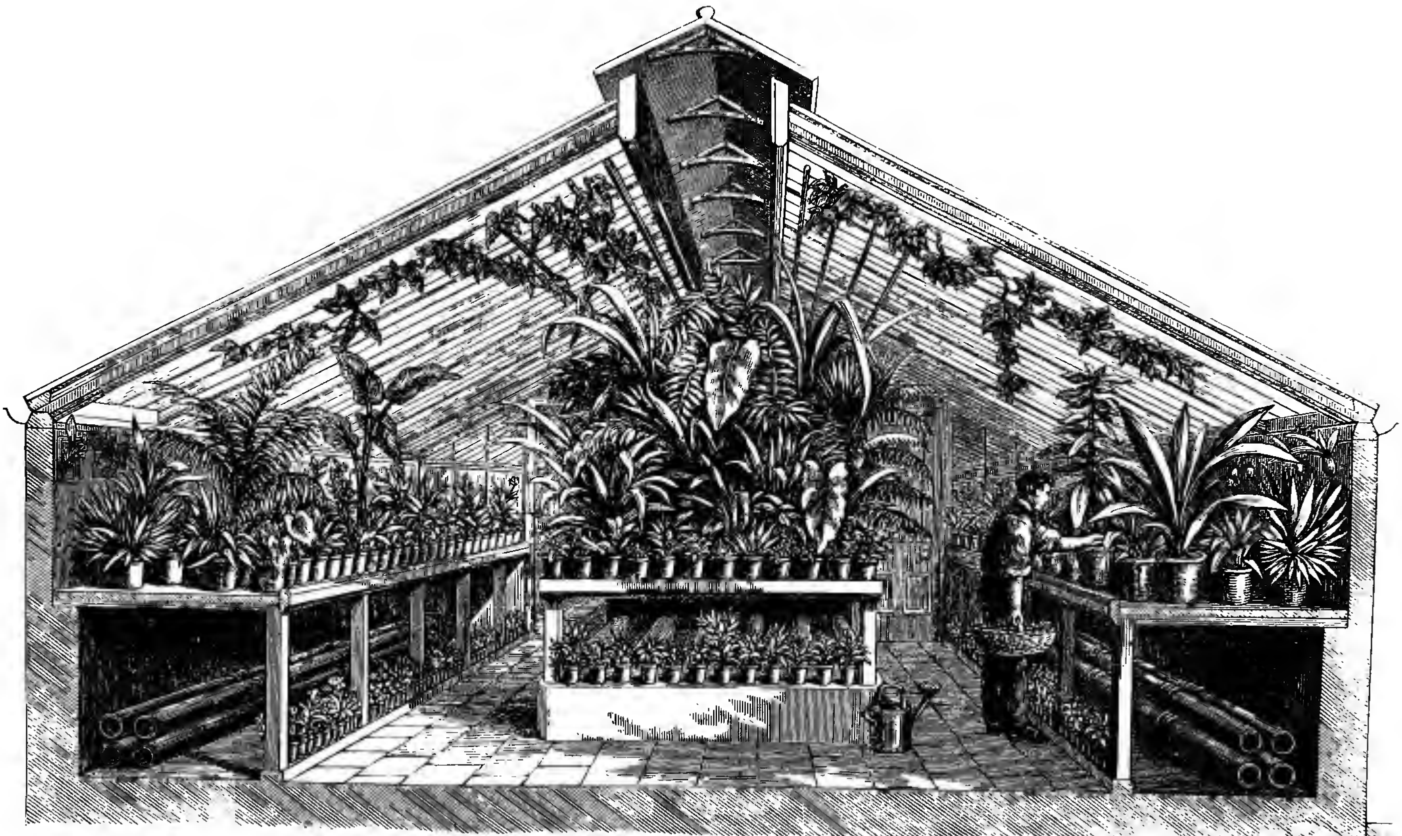


Fig. 30. · Large Tropical Plant and Orchid House, with Open Heated Tank in Centre.

only have one mixed house, than to suggest the general growth of Orchids in Vineries, Peach-houses, or others devoted to fruit-culture.

But no doubt quantities of Orchids may be well grown in plant-stoves, either suspended from the roof or in other places on the stage or shelves, intermixed with foliage or other flowering plants. Doubtless at times a compromise must be struck between the different classes of plants; in all such cases the more valuable, and that will generally be the Orchids, should have the preference. But really the compromises will be fewer than might be expected. Take for example the vital factor of temperature, there is but little difference between the plant-stove and the Indian or tropical Orchid-house. And so also of moisture when the plants are all in growing condition.

Most of the cool Orchids will agree equally well with the main treatment accorded to not a few flowering plants in the conservatory, and to the somewhat close, rather warmer, and semi-saturation system adopted with such plants as Azaleas and Camellias after blooming. And thus it comes to pass that it is often possible to grow cool Orchids in the warm conservatory, and tropical Orchids in the plant-stove, almost, if not equally, as well as in houses specially devoted to either.

Hence, while those with large collections will doubtless continue to separate stove-plants and Orchids into separate and distinct houses, there is nothing to hinder amateurs, or others, with only one cool, and another tropical plant-house, growing very good mixed collections of both stove-plants and Orchids in one or, at most, two houses. Whatever specialists may think of those mixed collections, there can be no doubt that the system brings Orchids within reach of many who otherwise could have never cultivated nor enjoyed them.

By the use of Wardian cases, or simply partitioning off small portions of common conservatories, and heating the enclosed areas with some of the many forms of gas-stoves, or a coil of hot-water pipes from the kitchen or other fire, a compartment for Orchids may even be introduced with rather startling effect among cool ferns or a general collection of conservatory plants. In arranging such pleasing surprises, it is by no means needful to exhibit the pipes or other means of warming; they may be hidden in so many and such obvious ways as need no mention here. Tastefully posted, and well filled, few arrangements are more satisfactory to their owners or more gratifying to visitors. The coil grates of various makers, which are just like others in external appearance, but are provided with a coil of pipes at the back of the grate, enable this to be done at a very trifling cost.

ROCK, ALPINE, FERN, AND WILD GARDENING.

THE HARDY FERNERY.

By James Sheppard.

SINCE the publication of the "Fern Paradise," now some years ago, the desire for hardy ferneries has become almost universal. Fortunately there is nothing to prevent this growing demand from being met. Ferns are almost innumerable in a state of nature, and few plants can be multiplied so rapidly by art. Mr. Britten's series of papers must have made this plain to every reader. The same excellent authority also points out how most of the more popular ferns may be propagated and cultivated. But fortunately in many parts of this country even this trouble is unnecessary. A day's leisure, and a fern-hunt of an hour or two's duration, will be rewarded with sufficient finds to furnish a small hardy fernery.

Nor will the plants prove the only or chief prizes in such hunts. Invaluable lessons will be taught concerning the habits, wants, and natural beauties of the plants. Besides, it is impossible to go fern-hunting in hedge-rows, coppices, or woods without having our love of nature in general, and of ferns in particular, vastly increased and intensified.

Fortunately for fern-hunters, the plants cling very much to roadsides and hedge-rows, and are thus exposed to the view, and become the common property of all observers. Permission may also be obtained at certain seasons of the year—after the pheasant-shooting is over—to have a fern-hunt in most woods and coppices. Fortunately, too, there are still a few commons and open spaces left on which the wild ferns grow, and to scamper over these, basket and trowel in hand, no man daring to make the fern-hunter afraid, is a high and satisfying pleasure. Wandering down the lanes, and by the banks of flowing streams, ferns of many sorts, and all sizes, may be found. In some districts the common Golden Polypody almost overmasters the Ivy in draping the trees, while the Bracken, the Hart's Tongue, the Male, Lady, Royal, Buckler, and Shield Ferns monopolise the land, even to the destruction of rushes and grass.

A few fern-hunts over such grounds—and they abound in Devonshire and many other counties, not excluding the arid clime of East Anglia—convert the hunter into a fervid admirer of ferns as long as life lasts. It fosters an enthusiasm and a love for these green children of nature which will never die out. Fern-hunts are also the best teachers of all about ferns. More may be learned of their forms, character, habits, culture, and beauty in one good hunt and successful finds of ferns than from reading a dozen books. Therefore our advice is to every one that would have a fernery, and grow them well, to have a few fern-hunts first, and mark their natural surroundings well. We may not be able to reproduce them, but the nearer we can approach to their natural conditions, the more beautiful the fernery will become.

What Ferns Need.—Ferns in their native haunts mostly find four favourable conditions for their growth. These are shelter, shadow, humidity, and rich root-runs; yet, how often do we see brand-new ferneries set full in the eye of the sun, amid the glitter and glare of red or white brick, stone, or composite! That they will live at all under such conditions, proves the tenacity with which they cling to life, and their marvellous power of adapting themselves to circumstances. True, there are ferns, such as the several species of the Spleenworts, and more notably the Wall Rue, as it is commonly called, the *Asplenium Ruta-muraria*, that prefer the crumbling ruins, sun-baked wall, or hard rock, to any other home. But such ferns are almost as exceptional at one end of the scale as the filmy ones are at the other. The latter cannot live in the sunlight, and are so impatient of drought, that they can only grow in a saturated atmosphere, with their leaves enveloped in a perpetual vapour-bath.

Many ferns, however, can endure a fair share of sunshine, of which we have a notable example in the common Bracken (*Pteris aquilina*), which will live and thrive on commons so hot, dry, and poor, that they cannot support any tree or shrub to afford shade or shelter; yet to see the Bracken in its vigorous character of the giant towering above all ferns, you must find it in shaded woods, and with rich and deep root-runs. The same holds good of the *Scolopendrum* or Hart's Tongues, the Lady Fern, and Male Fern (*Athyrium Filix-fœmina* and *Lastrea Filix-mas*); Polypods, Polystichum, and others. But these ferns mostly reach to a loftier stature and a fuller development when partially shaded.

Shelter for most ferns is, however, as indispensable as shade. The winds make sad havoc with the stately fronds of most of our finer ferns. The *Osmunda regalis*, for example, the noblest of all native ferns, can hardly stand up against high winds. It is either wrecked, or if planted in windy places, so stunted that the wind has little power on its dwarfed fronds; and it is so, in degree, with other ferns. Shelter is also grateful to ferns, and favours their full and rapid development, and that perfect verdure which is the perfection of beauty in ferndom. Moisture at root and top is of equal or more importance. Even those ferns, such as the Rue Spleenwort, as seem to thrive in absolute dryness, are often far more moist at root than it seems. In the deep crannies and crevices of rock, in the mortar joints of old walls, hugging the under edges of moss-clad porous copings, the roots find unseen and inexhaustible stores of moisture. But larger ferns, with thinner and more porous fronds, need larger supplies; and, indeed, on porous bases it is difficult if not impossible to over-water the majority of ferns in the open air in our climate. Good supplies of suitable food are also essential to success in fern-growing.

It is quite a popular error to assume that ferns feed chiefly or only on peat, earth, and water. The majority of them, on the contrary, revel in vegetable *débris* and fibry loam, the former forming the warp and the latter the woof of their daily fare. Dead leaves, the decomposed stems of grasses, and the faded fronds of the ferns themselves, constitute their favourite root-pabulum. Hence, on the whole, a compost of equal parts of good peat, turfy loam, and leaf-mould, with a liberal dash of sharp, clean, and when practicable, silver sand, will grow almost any or all ferns to perfection. But one of the lessons the hunter for ferns in their native haunts learns is the very useful and practical one that, other conditions being favourable, ferns are by no means particular about soil. They may be found in fair condition in almost all soils—from loams stiffening into clays, and peats running into sheer sands. In a word, all the conditions of fern-culture in the open air, and the plants themselves, are within reach of every one who cares to grow them. Even those who cannot go fern-hunting may purchase them cheaply from growers or professional collectors at about a penny a-piece. Much as this class are and have been abused, and worthless as are at times the products they offer, those who have knowledge enough to examine into their state, and insist on having plants with good roots, may find many treasures brought to their doors for a mere trifle. Our object in giving such prominence to these facts is to show how ferns and fern-culture may be brought within reach of all. Even those who have no gardens but their areas and back or front yards, a few feet square, may grow ferns, while no plants equal them for house-tops, balconies, and shady windows. The very facts of their enjoying close shelter, and thriving best in the shade, enable them to be grown in those very places almost too dark and dank for the common Ivy. Planted in such soils as we have indicated, liberally washed over-head, and watered at the root with pure and, if possible, soft water, ferns will bear up their verdant fronds bravely among the dust and dirt of great cities, and bring much of the grandest greenery of rural life into the most pent-up courts, areas, and gardens of crowded streets. Even the bare, black, gaunt walls of towns may be clothed with ferns. Semi-circular, plain, or rustic, and highly artistic pots may now be purchased at cheap rates, and suspended by one or more nails to the walls. These may be so distributed and arranged that when planted with ferns the whole wall may be so clothed as to become a thing of beauty and a joy for ever.

Though ferns thrive well in such rockeries as have been already described, it is quite a mistake to suppose that ferns will not thrive unless on rockeries. Such grand ferns as the Polystichums, Lastreas, Hart's Tongue, the Bracken, the Royal, and many others thrive best planted in the ground like other plants. The Bracken alone, though somewhat difficult to transplant, when once established will fill a whole yard, or climb up a wall eight or even ten feet high, with its glorious greenery. The simplest way to establish this most useful fern is to dig up a barrow or cart-load of its roots in as large masses as possible, and deposit it in the mass where it is wanted to establish the Brackens. This wholesale mode of procedure never fails.

Of course ferns may be made to look more artistic if planted in or against rocks. But for their mere cultivation the rocks often prove a hindrance rather than a help, and as a matter of fact nearly all ferns are grown in the solid earth, and not on rocks at all.

Many of the confined courts and narrow gardens of towns are admirably adapted for fern-culture. These provide shelter and shade, and wherever there is a water-main near, a shower-bath to cleanse the fronds from soot and dust is easily provided. Where the walls run north and south in small gardens, and afford scant shade at noon when it is most needed, few things can be easier than to provide the needful amount by the growth of such fast-growing climbers as Ivy, Honeysuckle, Jasmines, and Roses, or the Virgin's Bowers, the Clematis, of which there are now almost any quantity of all shapes, colours, and sizes. Or, in very small gardens, an artificial shade of canvas or bunting might be cast over the fernery a few hours on either side of noon.

There are ferns enough and to spare in the lists we have given of the different genera or species to furnish any sized fernery. Or ferns may be mixed with Alpine and herbaceous plants, and succulent or semi-wild plants, such as Honesty and Foxgloves, both of which thrive and look well among ferns. The glimpse of a group of Foxgloves in an open space with a Honeysuckle overhead in many a fern lane, are suggestive indications of very much that genius and art may accomplish in the artistic disposition of grave and gay colours in the fernery. And all this is often done as well or better on the smallest as on the largest scale. Be the size what it may, shade, shelter, food, moisture, skill and taste are all that are needful to grow and arrange ferns to the highest perfection. Of course on larger scale the moisture may expand into waterfalls, lakes, streams, or even rivers. But the splash of water, and the sweet sounds of tinkling drops and tiny rivulets, are also within reach of the small fernery, and may in their way and to their extent prove equally satisfying.

No garden of any extent is complete without a hardy fernery; as, when formed in a suitable situation, it not only gives great scope for growing plants that would not succeed except under shade, but it may be made one of the most delightful retreats, where a lover of nature may enjoy quiet study to the full, and admire the many varied forms such vegetation as is only there to be met with affords.

The most suitable situation for a fernery is in some low, damp part of the grounds, and if well broken up by lying naturally irregular, and there is suitable shade, the place will be perfect; but if not, it may be made so by a little digging and delving, so as to raise any mounds still higher, and sink lower any depressions. In doing this, the object to be aimed at should be to get rid of formality in the lines or curves, and to hide one part from the other as much as possible, as then, although the space may be limited, it gives one the idea of extent, and there are fresh surprises at every turn, and new features to see. One thing to avoid is, not to have the distance between the banks or mounds contracted, but let them be wide and open, and the bends and turns at such intervals that it will not be possible to place one foot on "zig" and the other on "zag." If the soil is not light and good, it must be made so by digging well into and mixing up with the face of the banks plenty of peat or leaf-mould, or both, in which ferns delight. If running water can be had, that will be a most valuable addition, as it may be led down the rock into miniature ponds, in which *Carex paniculata*, Callas, Lilies, and other aquatic or semi-aquatic plants, may be grown; or, in case there is not enough water for a pond, any little may be utilised by running it in channels or over prepared ground where *Osmunda regalis* may be planted and grown in the highest state of perfection.

Another fern that is fond of a similar wet position is the *Athyrium felix-fœmina*, of which there are many varieties, some being beautifully crested and of fine divisional appearance. It should be borne in mind, in arranging for these and other plants of a similar nature, that, though they like and require plenty of water, they hate stagnant moisture, and it is necessary therefore to provide for the water passing through or over the soil and getting freely away.

Unfortunately, in the generality of cases, when ferneries are attempted, they are mere mounds or stone-heaps; but it is to be hoped that these are things of the past, as, now that the Pulhamite rock has been seen in so many places, no one will be satisfied without having some of this work carried out; for, besides being bold, picturesque, and grand, ferns look more at home in the nooks, crannies, and fissures than they do anywhere else.

One of the finest examples of these artificial rock-made ferneries is at Danesbury, where a most suitable spot has been chosen in a dell-like valley under the shade of overhanging trees. Here the ferns and other plants flourish amazingly, as, besides being in a most suitable situation, their wants are cared for in the way of soil, and they are planted in well-defined or distinct groups, arranged in which way they have a bold and striking appearance. The erection was superintended by a lady artist of most cultured and refined taste, and its planting and cultivation were for many years under the care of one of the best practical gardeners, Mr. Parsons. The fernery lies on a gentle slope, and has, as may be seen by the engraving, a rich background of tall trees and masses of Ivy. The latter, if kept in due subjection, not only associates well with ferns, but forms one of the richest backgrounds possible to the groups and masses of artificial rock that are introduced with great taste, as in the front of our engraving, and lose themselves in the Ivy and wood at the back. Some of the taller and hardier ferns are also carried far back into the wood, and thrive luxuriantly under the shade of the trees, or hold their own among the Ivy which is beautiful at all seasons, but specially so when clustered with golden blossoms or alive with the hum of wasps, through October, or, when mild,

ROCK FERNERY AT DANESBURY.

well through November. Later on, too, the Ivy loses nothing of its richness, when each bunch of flowers grows into a round-headed group of dark berries, that show up well above the rich and far-reaching spread of fine foliage that distinguishes the Irish Ivy.

The fernery is so arranged as to afford a rich and extensive variety of sites and soil; and the bold system of massing the different families in groups has been adopted to a great extent. At considerable elevations on the slope, where the ground is comparatively dry, grand masses of the Male Fern (*Lastrea Filix-mas*), Polystichums, Diplaziums, Polypodium, &c., abound. Lower down, in more moist and sheltering nooks and corners, choice groups of such ferns as the finer varieties of Blechnums, Cyrtomiums, Cystopteris, Allosorus, Onoclea, Struthiopteris, &c.; while in the lowest parts of all, where the soil is rich and moist, large masses of the Royal Fern (*Osmunda regalis*) find a congenial home, and rise to a great height. This, as well as most of the more choice species, are planted in a mixture of equal parts of peat and loam, and thrive admirably.

Every provision is, however, made at Danesbury for copious over-head waterings in dry weather. This not only drenches the roots, but cleanses and thoroughly refreshes the tops.

Though the foreground of this fine fernery is mostly furnished with ferns in groups in a manner, yet a good many Saxifrages and other plants are used with them, while the rocks themselves at many points are enriched with the smaller and more choice of the rock ferns. The sheltering and densely-shaded dells are also admirably adapted for the successful cultivation of such shade and moisture-loving subjects as the Trichomanes and Hymenophyllums, the most delicate of all the ferns that can be grown in the open air—or rather in sheltered caverns in our climate.

Another noteworthy fernery is that at Woolverstone, where some steep banks of a cliff, dipping north, have been seized on, and paths made to run winding under and about to get at the various parts, some of which are planted mostly with ferns, and others with plants having fine foliage or a tropical look. One of the most useful of these is *Polygonum Sieboldii*, which, though by some considered common, is well adapted for semi-wild places, as it will thrive almost anywhere and in any kind of soil, the roots running quickly under ground, and sending up strong hollow shoots, that grow at a great rate, reaching a height of from five feet to eight feet in a few weeks, and dying away again in the autumn. The leaves, besides being large, are of an elegant shape and a lively light green colour; and the flowers, which are creamy-white, resemble the Lily of the Valley in form, and are borne in the greatest profusion. Another plant that shows up conspicuously is the Giant Cow Parsnip (*Heracleum giganteum*), which has huge spreading leaves, and very tall flower-stems that bear large umbelliferous heads, a foot or more across, which seed freely and soon stock a place. One of the most graceful-habited plants that can be introduced into the hardy fernery is the *Arundinaria falcata*, or Neilgherry Bamboo, which is very suitable for planting near the margin of water, as it likes a moist situation, and when its long slender rods, with light foliage, droop over, as they soon do, it forms a most beautiful object, and one that is sure to attract notice even from the most casual observer. *Chamærops Fortunii*, the Chinese Palm, is also grand for associating with ferns; and, being of a bold type and very tropical-looking, it should have a prominent position by placing it so as to stand out in the foreground where it meets the eye. By using it in this way, it gives character, and becomes a striking object when it attains size and age.

A fine colony of ferns at Woolverstone are the *Struthiopteris germanica*, called by some the Shuttlecock Fern, and by others the Ostrich Fern, the arrangement of the fronds being like those of the feathers of a shuttlecock, and their form and handsome appearance resembling ostrich-feathers, which similarity is enough to recommend the plant as a very desirable one—as really it is, being one of the most distinct and striking among all hardy ferns.

Another that cannot be too highly spoken of is the *Woodwardia radicans*, which, though generally grown in a green-house, is sufficiently hardy to stand out in the open with a little protection, the best being fresh-fallen leaves or cocoa-nut fibre, as these lie light and are capital non-conductors, keeping off a good deal of frost. As the *Woodwardia radicans* has very long, gracefully-arching fronds, it should be planted well up, where they can have plenty of room to spread and droop without touching the ground. *Lomaria chilensis* is likewise a noble fern, requiring about the same care as the *Woodwardia* during the winter.

For other hardy ferns see Mr. Britten's lists in the series of Fern articles.

Other Plants that Associate well with Ferns.—Besides those already named the following are very striking:—

Gunnera scabra is a grand-leaved plant that likes a wet spot, and deep rich soil; but, as it is not quite hardy, it needs some protection, which is easily afforded by throwing a bushel or so of leaf-mould over the crown. *Funkia Sieboldii* is particularly striking, as it has noble foliage of a rich glaucous blue-green. *Aralia Sieboldii* (correct name *Fatsia japonica*), too, must not be forgotten, as it is quite hardy in sheltered places, and has splendid foliage which is very distinct in appearance. *A. papyrifera* (correct name *Fatsia papyrifera*) is even more noble, but, as it is not hardy, plants should be taken up in the autumn and wintered in a cold house or shed. The New Zealand Flax (*Phormium tenax*) is also a fine plant for the hardy fernery, and there are many others that may be used with good effect; while as to ferns beyond those mentioned, their name is legion, and, as they cost but little to collect or purchase, any one may soon start with a good stock of some of the principal sorts. The best time to do this is early in the spring, just before the young fronds start, when they not only bear up-rooting without suffering much injury, but they may be split apart and divided, and so increased, the only limit to this being the number of separate crowns, each one of which, if carefully removed, will soon form fresh roots and grow. Some kinds being more tender than others, it is necessary to afford protection against spring frosts, and keen cutting winds, especially if the fernery is not naturally well sheltered, as when the fronds are just forming and unfolding they are easily injured, and if damaged then, are disfigured for the rest of the season. The easiest way of protecting ferns, and perhaps the most effectual, is to stick in a few Laurel or other evergreen branches around the north-east sides of each plant, and leave them there till all danger is over, when they should be cleared away and the surface of the ground cleaned by being freed from weeds, and then mulched by placing a good layer of leaf-soil over the roots of the ferns. This will act very beneficially, as, besides affording much extra food for the plants, it will also assist most materially in keeping the earth moist, as, being of a non-conducting nature, it prevents evaporation, and therefore when water is given it tells.

What ferns much like is damping over-head, which is the best way to apply the water, and if it can be done frequently during the summer, at any time in the evening, the plants will keep in luxuriant health. What injures them and makes them shabby sooner than anything else is the red spider, a tiny insidious insect that makes its appearance in dry weather; but if water is resorted to, and administered in the manner mentioned, the damping will prevent the red spider doing much harm, as it keeps the insect on the move, breaks up its web, and thus stops its increase.

Many growers of ferns clear off the fronds in the winter; but that should not be done, as, by disrobing the plants then, they are left naked at a time when they most need their natural covering. Instead of removing the old dress, it is far better and wiser to add to it by placing over the crowns a few fresh-fallen leaves, cocoa-nut fibre, or common Bracken, which should remain till the young growth pushes its way through in the spring, when the general clear-up may begin.

MANURING IN THEORY AND PRACTICE.

BY JOHN J. WILLIS.

How Soils become Fertile.—Many investigations have been made during recent years as to the mode in which nitrification takes place, because ammonia, as such, cannot exist for any length of time in the soil. It rapidly becomes converted into nitric acid, in which form it is most invaluable to the gardener as a plant-food; and the loss of nitrates by drainage is one of the most serious difficulties with which the tiller of the soil has to contend.

What, then, are the sources of the nitrogen of vegetation? Are they the same for all descriptions of plants? Are they to be sought entirely in the soil or entirely in the atmosphere, or partly in the one and partly in the other?

These are some of the questions which Lawes and Gilbert have endeavoured to solve by a series of investigations extending over a period of forty years, and in which they are still engaged; for, although their researches have thrown much light on these questions, they involve great difficulties, and a vast field of scientific inquiry is still left open; and, no doubt, much laborious work has yet to be accomplished before these questions can be satisfactorily answered in all their bearings.

From the experiments already made it appears that the bodies yielding nitric acid in the soil are—first, the various nitrogenous organic substances which arise from the decay of vegetable or animal matter; and, secondly, ammonium salts, either produced in small quantity during the decay of organic matter and carried to the soil by rain, or, in some cases, applied intentionally as manure. A further source of the nitrates contained in the soil is to be found, according to some writers, in the free nitrogen of the atmosphere; but of any supply from this source, other than the ready-formed nitrates contained in rain, there is at present no substantial proof.

The Atmosphere as a Source of Plant-food.—The combined nitrogen coming down in the aqueous deposits of rain, hail, snow, mist, fog, and dew, part of which is the return from previously existing generations of plants or animals elsewhere, and part the product of new formation, does undoubtedly contribute materially to the annual yield of plant-food; and, being a source comparatively easily estimated, it has been the subject of a good deal of experimental investigation.

From the Rothamsted researches, which have been published in the *Journal of the Royal Agricultural Society*,* we find that the annual rainfall at this station varied during thirty-four years (1853 to 1886) from 18·56 inches in 1864 to 36·13 inches in 1879, the average being 28·64 inches.

From 152 analyses of rain, snow, dew, and hoar-frost, representing the daily collections from June 22, 1881, to January 5, 1882, we find an average of 0·248 of nitrogen as ammonia per million of water, the extremes observed being 5·491 and 0·043. The variations in analysis of the rain-water are dependent on the richness of the atmosphere in ammonia and on the quantity of the rainfall, the smaller deposits always containing the larger proportion of plant-food. A heavy rainfall descending in a short time is found to be poorer in ammonia than the rains of light showers distributed over a considerable period, the former rains having come in contact with a relatively smaller volume of air than the latter.

The influence of the quality of the rain on the proportion of ammonia it contains will be plainly seen from the author's arrangement of thirty-nine monthly analyses of rain-water according to the amount of rainfall in each month, as illustrated by the following table:—

	Average Rainfall in Inches.	Nitrogsn as Ammonia per Million.
Rainfalls below 1 inch	0·624	1·06
„ between 1 and 2 inches	1·530	1·17
„ between 2 snd 3 inchee	2·473	0·91
„ above 3 inches	4·727	0 82

The amount of nitrogen, or plant-food, annually carried to the soil by rain varies considerably in different years and in different localities. Mr. Warington says, in his "Chemistry of the Farm," that the average of many experiments on the Continent gives 10·23 lbs. of nitrogen per acre; while the following table by Lawes and Gilbert shows that at Rothamsted, in Hertfordshire, on an average of three years, with a mean rainfall of 28½ inches, there was scarcely 7 lbs. per acre carried to the soil by rain and the minor deposits.

* Vol. xvii. (1881), and Vol. xix., ss. Part II.

Table showing the Amount of Nitrogen, as Ammonia and Nitric Acid, in the Rainfall of Three Years at Rothamsted, in Pounds per Acre.

Years.	Rainfall.	Nitrogen per Acre, as		
		Ammonia.	Nitric Acid.	Total Nitrogen.
	Inches.	lbs.	lbs.	lbs.
1853-4	29·01	5·20	[0·74]	5·94
1855	29·17	5·82	0·72	6·58
1856	27·22	7·28	0·76	8·00
Mean . .	28·47	6·10	0·74	6·84

It is seen that the available combined nitrogen so estimated is computed to supply but a small proportion of that annually removed from the soil by the different crops grown.

Thus on an average of three years 6·1 lbs. of nitrogen as ammonia only are supplied to the soil per acre each year, and, in addition, on an average of two years 0·74 lbs. of nitrogen in the form of nitric acid, giving a total of 6·84 lbs. of nitrogen. If, however, we only regard the two years in which the nitric acid was actually determined, the total nitrogen becomes 7·29 lbs. per acre, equivalent to 46½ lbs. of ordinary nitrate of sodium.

The amount of ammonia supplied to the soil by rain does not, of course, represent the whole quantity furnished by the atmosphere; we have also to take into account the direct absorption by the soil itself, which, in a moist soil, would doubtless be considerable.

Boussingault, to whose patient investigations the horticulturist owes much, has given the following analyses of rain, dew, and fog, from samples collected at Paris and Liebfrauenberg, in Alsace, during the year 1853:—

Table showing the Combined Nitrogen in Rain, Dew, and Fog, in Grains per Imperial Gallon.

			As Ammonia.	As Nitric Acid.	Total Nitrogen.
Rain	Paris		0·2100	0·0708	0·2808
	Liebfrauenberg		0·0350	0·0140	0·0490
Dew	Liebfrauenberg	Maximum	0·4340	0·0785	0·5125
		Minimum	0·0714	0·0030	0·0744
Fog	Paris		9·6000	0·7092	10.3092
	Liebfrauenberg		0·1790	0·0718	0·2508

It thus appears that in Paris the quantity of nitrogen brought down in rain is six times as great as it is in the open country of Alsace, a result no doubt due to the ammonia evolved during the combustion of fuel and to animal exhalations. To the same cause the large quantity contained in the moisture of the fogs of Paris may also be attributed. We also observe that dew is much richer in plant-food than rain, which may serve to some extent to explain its remarkably invigorating effect on vegetation.

Again, in the valuable publication previously referred to, are given the following analyses of rain, dew, and hoar-frost, made by Dr. Frankland from samples collected at Rothamsted, Hertfordshire :—

TABLE SHOWING THE MAXIMUM, MINIMUM, AND MEAN AMOUNTS OF CERTAIN CONSTITUENTS IN SIXTY-NINE SAMPLES OF RAIN-WATER IN PARTS PER MILLION.

	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as Organic Matter.	Nitrogen as Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Nitrogen.	Chlorine.	Hardness.*
Highest proportion .	85·8	3·72	0·66	1·28	0·44	1·94	16·5	16·0
Lowest proportion .	6·2	0·21	0·03	0·04	0·01	0·13	0·0	0·0
Mean, 69 samples .	33·1	0·90	0·19	0·37	0·14†	0·70	3·1	4·7

Turning to the analyses of dew and hoar-frost, the samples examined embraced many distinct deposits :—

TABLE SHOWING THE MAXIMUM, MINIMUM, AND MEAN AMOUNTS OF CERTAIN CONSTITUENTS IN SEVEN SAMPLES OF DEW AND HOAR-FROST IN PARTS PER MILLION.

	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as Organic Matter.	Nitrogen as Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Nitrogen.	Chlorine.	Hardness.
Highest proportion .	80·0	4·50	1·96	2·31	0·50	4·55	8·0	25·0
Lowest proportion .	26 4	1·95	0·26	1·07	0·28	1·66	3·5	13·0
Mean, 7 samples .	48·7	2·64	0·76	1·63	0·40‡	2·79	5·3	19·0

These small deposits condensed from the lower stratum of the atmosphere contain on an average three or four times the amount of organic carbon, organic nitrogen, ammonia, and nitric acid, found in heavier falls of rain-water.

The total quantity of solid matter and the amount of chlorine and sulphuric acid is also larger.

* By "hardness" is understood the total lime and magnesia in a water, expressed in parts of carbonate of calcium. † The mean of thirty-four analyses only.
‡ The mean of four analyses only.

Arranging the analyses of the Rothamsted rain-waters, according to the quantity of the rainfall and according to the various seasons of the year, we obtain the following valuable results :—

TABLE SHOWING THE AVERAGE AMOUNT OF NITROGEN AS AMMONIA IN MONTHLY RAINFALLS OF DIFFERENT QUANTITY, IN SUMMER, WINTER, AND THE WHOLE YEAR.

Groups of Rainfall.	Summer Months.				Winter Months.				Whole Year.			
	Examples.	Mean Rainfall.	Nitrogen as Ammonia. Per million.	Nitrogen as Ammonia. Lbs. per acre.	Examples.	Mean Rainfall.	Nitrogen as Ammonia. Per million.	Nitrogen as Ammonia. Lbs. per acre.	Examples.	Mean Rainfall.	Nitrogen as Ammonia. Per million.	Nitrogen as Ammonia. Lbs. per acre.
		in.		lb.		in.		lb.		in.		lb.
Below 1 inch	2	0·87	·890	·175	5	0·81	·750	·137	7	0·83	·792	·148
1 to 2 inches	7	1·65	·527	·197	5	1·32	·468	·139	12	1·51	·506	·173
2 to 3 inches	7	2·23	·537	·272	3	2·59	·278	·163	10	2·34	·451	·239
3 to 4 inches	4	3·62	·410	·335	8	3·44	·263	·205	12	3·50	·314	·248
Above 4 ins.	5	5·32	·287	·346	4	5·30	·206	·247	9	5·31	·251	·302
	25	2·80	·423	·268	25	2·69	·296	·180	50	2·74	·361	·224

The gradual decrease in the proportion of ammonia per million of rain, as the rainfall of the month becomes greater, is plainly shown by these figures; the quantity of ammonia brought down per acre, nevertheless, rises with each increase in the quantity of rainfall; but, taking the figures for the whole year, it requires the rainfall to be increased about six-fold in order to double the quantity of ammonia contributed to an acre of land.

Determinations of chlorine in monthly mixtures of rain-water have been carried out in the Rothamsted Laboratory since June, 1877. In the next table the determinations in seventy-two monthly rainfalls are grouped according to the amount of the rainfall and to the season of the year :—

TABLE SHOWING THE AVERAGE AMOUNT OF CHLORINE IN MONTHLY RAINFALLS OF DIFFERENT QUANTITY, IN SUMMER, WINTER, AND THE WHOLE YEAR.

Groups of Rainfall.	Summer Months.				Winter Months.				Whole Year.			
	Examples.	Mean Rainfall.	Chlorine. Per million.	Chlorine. Lbs. per acre.	Examples.	Mean Rainfall.	Chlorine. Per million.	Chlorine. Lbs. per acre.	Examples.	Mean Rainfall.	Chlorine. Per million.	Chlorine. Lbs. per acre.
		in.		lb.		in.		lb.		in.		lb.
Below 1 inch	3	0·80	3·58	0·65	6	0·81	5·76	1·06	9	0·81	5·04	0·92
1 to 2 inches	10	1·56	1·74	0·61	9	1·52	3·46	1·19	19	1·54	2·55	0·89
2 to 3 inches	9	2·30	1·40	0·73	7	2·59	2·65	1·55	16	2·43	1·98	1·09
3 to 4 inches	5	3·55	1·25	1·01	8	3·44	2·82	2·20	13	3·48	2·20	1·74
Above 4 ins.	9	5·26	0·81	0·96	6	5·15	2·23	2·59	15	5·22	1·37	1·61
	36	2·88	1·21	0·79	36	2·64	2·84	1·70	72	2·76	1·99	1·24

From these results it would appear that in summer the supply of chlorides is very limited; for a large increase in the rainfall is attended with but little rise in the quantity of chlorine brought upon the land. In winter, on the other hand, the supply of chlorides in the atmosphere is so constantly renewed from the combustion of fuel, that an increased rainfall results in a considerable addition to the supply of this constituent to the soil.

The amount of chlorine annually contributed by the rain of Rothamsted to the land has amounted to 14·4 lbs. per acre on an average of nine years, 1877–86.

This amount is equal to 24 lbs. of pure common salt, an amount of chlorides greater than that which is contained in most garden crops.

Determinations of sulphuric acid in the rain have given a mean of 2·41 per million, or 18·5 lbs. per acre per annum.

The following are approximate determinations made in forty monthly mixtures of rain-water collected at Rothamsted, and made by Dr. W. J. Russell, who is investigating the chemistry of rain:—

TABLE SHOWING THE AMOUNT OF SULPHURIC ACID IN THE RAINFALL OF THE SIX SUMMER AND SIX WINTER MONTHS OF TWO YEARS, 1881-3.

Period of Collection.	Rainfall in Inches.	Sulphuric Acid.	
		Per Million of Rain.	In lbs. per Acre.
April to September, 1881 .	13·76	2·61	8·2
October to March, 1881-2 .	15·86	2·29	8·2
April to September, 1882 .	16·37	2·67	9·9
October to March, 1882-3 .	21·78	2·15	10·6
Average per annum .	33·89	2·41	18·5

A part of the sulphuric acid in these rain-waters would be due to coal-smoke, and a still smaller portion is derived from sea-spray.

The considerable amount of sulphuric acid found in the summer rain points, however, to a further source most active during high temperatures—namely, the products of the decay of animal and vegetable matter, which naturally takes place much more rapidly in the warmer months.

The quantity of sulphuric acid would appear to be about sufficient for the demands of ordinary cereal crops of the farm, though unequal to the requirements of Turnips, Potatoes, and some other garden products. And it may here be mentioned that the drier atmosphere and smaller rainfall in the Southern and Eastern districts of England accounts for the fact that, under equal conditions of manuring, the Turnip crops are not so large as they are in the North of England and of Scotland.

Yield of Nitrogen by Crops. — If we divide the constituents which exist in the various Plants of the garden into two sections, and assume that carbon and water are obtained from the atmosphere, while the nitrogen and mineral substances are derived from the soil, it will be necessary in the next place to consider what is the amount of nitrogen annually obtained over a given area in different crops when they are grown without any supply of it in manure.

This point may be illustrated by some results obtained in the field experiments of Sir J. B. Lawes at Rothamsted. The following table shows the yield of nitrogen per acre per annum, in Wheat, in Barley, and in root-crops, each grown for many years in succession on the same land, either without any manure, or with a mineral manure supplying no nitrogen:—

YIELD OF NITROGEN PER ACRE PER ANNUM IN WHEAT, BARLEY, AND ROOT-CROPS AT ROTHAMSTED.

Crops.	Condition of Manuring.	Duration of Experiment.	Average Nitrogen per Acre per Annum.
			lbs.
Wheat	Unmanured	32 years, 1844-75 .	20·7
	Mineral Manure .	24 years, 1852-75 . .	22·1
Barley	Unmanured	24 years, 1852-75 . .	18·3
	Mineral Manure	24 years, 1852-75 . .	22·4
Root-crops	Complex Mineral Manure .	Turnips, 8 years, 1845-52 .	42·0
		Barley, 3 years, 1853-55 .	24·3
		Turnips, 15 years, 1856-70 .	18·5
		Sugar Beet, 5 years, 1871-75	13·1
		Mangel Wurzel, 5 years, 1876-80	15·5
		Total, 36 years, 1845-80 .	25·2

Bearing in mind what has already been said as to the amount of plant-food annually deposited from the atmosphere to the soil of the garden, the above figures have great interest and significance.

It may be observed that the annual use of a mineral manure, supplying potash, soda, magnesia, and phosphate of lime, but very slightly increases the yield of nitrogen beyond what may be termed the inherent fertility of the soil, and it would appear that the increase of crop is derived from the accumulation within the soil of organic nitrogen, derived from the *débris* of pre-existing vegetation.

In considering the yield of nitrogen by Turnips of the order *Cruciferæ*, and Sugar Beet of the order *Chenopodiaceæ*, we again find a marked decline in the stock of fertility during the thirty-six years that these experiments have been carried on; and from analyses of the soil made at different periods, it has been ascertained that not only has there been a decline of organic nitrogen in the soil, but of potash and phosphoric acid also.

It follows, therefore, that although the fertility of a rich garden soil may be sufficient to grow crops of vegetables, or fruit or flowers, for a very long period without further manuring, yet true economy in horticulture is not to be attained by a simple lessening of expenditure in the matter of manuring, but by studying and applying the proper nourishment to plants, and so obtaining the greatest production with the maximum amount of profit.

It may further be observed that those who maintain that the atmosphere is an important source of the nitrogen of our crops, assume that many descriptions of plants, if provided with a small quantity of nitrogenous manure to favour their early development, will obtain the remainder of their food-supply from the atmosphere. How far this is the case may be illustrated by the following results, which are the average produce of fifteen years' successive growth of Swedish Turnips, and five years of Mangel Wurzel, all grown on the same land, and in each case with the same manure year after year.

Average produce per acre of Swedish Turnips, fifteen years, 1856–70:—

Manures applied.	Roots.		Leaves.	
	Tons.	Cwts.	Tons.	Cwts.
1. Superphosphate of Lime and Sulphate of Potash .	2	7	0	7
2. As No. 1, and 36½ lbs. Ammonium salts . .	2	12	0	7
3. As No. 1, and 400 lbs. Ammonium salts . . .	4	5	0	13

Average produce per acre of Mangel Wurzel, four years, 1881-84:—

Manures applied.	Roots.		Leaves.	
	Tons.	Cwts.	Tons.	Cwts.
1. Superphosphate of Lime and Sulphate of Potash .	4	15	0	15
2. As No. 1, and 36½ lbs. Ammonium salts . .	6	12	1	0
3. As No. 1, and 400 lbs. Ammonium salts . .	14	8	2	16

Thus the annual application of about 8 lbs. of nitrogen as ammonia salts increased the crop of Swedish Turnips by only 5 cwts. per acre per annum. And the same amount applied to Mangel Wurzel increased the growth of roots by 33 cwts. per acre, with an excess of 5 cwts. of leaves per acre also. An application of 400 lbs. of ammonium salts nearly doubled the Swedish Turnip crop, and increased the produce of Mangel Wurzel roots from 6 to 14 tons, and the leaves from 20 cwts. to 56 cwts. per acre per annum.

It is obvious, therefore, that a small quantity of nitrogen applied as manure does not enable plants to obtain much, if any, nourishment from atmospheric sources, and that a further direct supply of plant-food becomes necessary. These results also afford confirmation of the view, that it is the reduction of the available supply of organic nitrogen within the soil, that is the cause of the decline in the annual produce of a garden.

It is not in the difference of the capacity of certain plants for taking up nitrogen from the atmosphere, that the gardener must look for an explanation of the distinctive function of different crops. The explanation is rather to be found in variation of character, and length of life of different plants; in the nature of their roots in regard to number, range and size, and to their aptitude to derive more of their food and moisture from the surface or from the sub-soil; finally, in the greater capacity of some plants for liberating and assimilating food not available to others, or for arresting nutritive matters which would otherwise be washed out of the soil by heavy rains.

Evidence further shows that the so-called "root-crops," which may include Potatoes, Beet, Onions, &c., exhaust the superficial layers of a soil of its available supply of fertility more completely than do deep-rooted plants, whose main *feeding-ground* is the sub-soil.

It is well known among agricultural chemists that the growth and removal of a highly nitrogenous crop of either Beans, Peas, or Clover, is one of the best possible preparations for the growth of Cereal crops, which characteristically require luxurious manuring. And notwithstanding the fact of the large amount of organic nitrogen, and of potash, lime, magnesia, and phosphoric acid removed from the land by the growth of leguminous crops, yet these plants actually leave the surface soil richer in nitrogenous plant-food than it was before.

Plants of one family will often grow luxuriantly where other plants fail, and *vice versâ*. For a long time it was supposed that certain substances were given off from the roots of plants, which in time accumulated in the soil, and so poisoned the plant which had excreted them. These explanations have, however, been long exploded. We now know that failure does not arise from anything left in the soil, but from the absence of what has been taken out of it.

Applying these facts to the garden, it follows that crops of the same general character, and requiring almost the same manurial constituents for their development, should not succeed each other too rapidly; a sufficient time being allowed to elapse between the growth of similar crops to enable the soil to recover from its exhaustion, whether it be of minerals, or of nitrogenous organic plant-food.

Most garden crops have two great advantages over those grown on the farm, from the fact that the period of their growth takes place at a time of year which is not only more favourable for active nitrification, but also when the soil is less exposed to loss of the soluble nitric acid by excess of rain. Garden crops have still one other advantage over those of the farm; nitric acid contains an immense amount of oxygen, and as it is only those particles of carbon which are close to the surface of the soil that can have access to oxygen, the constant stirring which the soil receives during the growth of most vegetables is doubtless the means of continually exposing fresh surfaces to the action of the atmosphere.

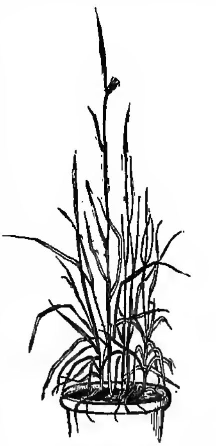


Fig. 1.—Wheat.

Fig. 3.—Oats.

Fig. 2.—Barley.

Assimilation of Nitrogen by Plants.—Having so far considered the amount of plant-food derived from rain, and the minor aqueous deposits, and the amount of nitrogen which various plants are able to take up or assimilate from the atmosphere and soil combined, when grown without any manure at all, or with a supply of the ash constituents of plants only, we may briefly consider the question whether plants assimilate the free nitrogen of the air, which is such an obvious and easy way out of so many difficulties in connection with vegetable economy, that this assumption has from time to time been freely made. As about four-fifths of the atmosphere which surrounds growing plants consists of nitrogen, it is an important question, why should not this be a source to them of the nitrogen they evidently require?

It has most abundantly been established, as we shall have cause to show, that ammonia in its compounds is appropriated by plants as food, and that ammonium salts applied as manure, in actual practice have produced the most striking results. Further, by watering potted plants with very dilute solutions of ammonia, their luxuriance is made to surpass in a most surprising manner similar plants placed in precisely the same conditions, save that they are simply supplied with common water.

Ville has stated that vegetation in conservatories may be remarkably promoted by impregnating the air with gaseous carbonate of ammonia. For this purpose lumps of solid ammonia salt are so disposed in the heating apparatus of the green-house as to gradually vaporise; or vessels containing a mixture of two parts quicklime and one part sal-ammoniac may be employed. Care, however, must be taken that the air does not contain too much ammonia vapour, otherwise the foliage of tender plants is injured.

Although such facts indicate very clearly that ammonia is directly absorbed by plants, they most decidedly fail to prove that the soil is not the medium through which the absorption really takes place.

Again, it is considered an essential part of good tillage to break up and loosen the soil, in order that the air may have access to the decaying vegetable matter, as well as to the living roots which descend to considerable depths beneath the surface of the soil. When air is thus admitted to the roots, it is not impossible that some of the nitrogen of the atmosphere, as well as its oxygen, may be directly absorbed and appropriated by the plant.

In order to test the fact whether plants do assimilate the free nitrogen of the air or not, Lawes, Gilbert, and Pugh arranged an elaborate series of experiments at Rothamsted to determine the question.

The enclosing apparatus consisted of a large glass shade, resting in a groove filled with mercury in an earthenware stand, upon which the pan, with the pot of prepared soil, was placed. The atmosphere supplied to the plants was washed free from ammonia by passing through sulphuric acid, and then through a solution of carbonate of soda. These conditions were proved to be adapted for healthy growth by growing plants under exactly the same circumstances, but in a garden soil.

The prepared soil was also shown to be suitable for the purpose by the fact that plants grown in such soil, and in the artificial condition of atmosphere, developed luxuriantly, if only manured with substances supplying nitrogenous food.

The accompanying diagrams show the character and extent of growth attained under the conditions in question, with Wheat, Barley, and Oats.

Figs. 1, 2, and 3 represent plants of Wheat, Barley, and Oats grown in prepared soil, supplied with no combined nitrogen beyond that contained in the seed sown.


Fig. 4.—Wheat.


Fig. 6.—Oats.


Fig. 5.—Barley.

Figs. 4, 5, and 6 represent plants of Wheat, Barley, and Oats grown in prepared soil, and supplied with a known quantity of combined nitrogen beyond that contained in the seed sown.

Figs. 4, 5, and 6 show the development of the three graminaceous plants, with an extraneous supply of combined nitrogen, corresponding to the three plants preceding them without any such supply. The vigour and degree of growth attained may be taken as sufficient evidence that the conditions of soil, atmosphere, temperature, &c., were consistent with active and healthy growth.

The data obtained from these experiments clearly proved that there was no assimilation of free nitrogen from the atmosphere, by the plants.

They had vegetated, however, and in most cases more than trebled the amount of carbon in the seed, but had obviously been limited in their growth for want of a supply of available nitrogen. During several months the plants were surrounded by an atmosphere containing abundance of free nitrogen, and the cells in which they grew were penetrated by fluid saturated with that element. The diagrams show that Nos. 4, 5, and 6 formed glumes and paleæ for seed when provided with assimilable manure; but Nos. 1, 2, and 3 barely reached that stage of development, having to depend for their food upon that supplied in the seed sown only.

Some experiments in seed-germination made at Rothamsted at this period, showed how completely plants are able to appropriate the nitrogen of the seed sown, leaving only traces of nitrates in the soil in which the growth had taken place. Further, it has been proved conclusively that potash, phosphate, or any other manure, provided that it contains no nitrogen, may be supplied to the soil, but all in vain; little or no increase of crop will be obtained. We thus arrive at the conclusion that plants of all descriptions, whether in the open garden or in the closed conservatory, are unable to make use of the stock of minerals in the soil if there be an insufficient supply of available nitrogen.

It is true that the soil liberates more nitrates than are contained in most garden crops, but being of such a soluble nature, they are very liable to waste before they can be appropriated by the growing plant; hence considerable amounts of that substance have been found in the drainage water collected from the experimental fields at Rothamsted. But it is quite certain that healthy plants make great efforts to get hold of all food that is within reach of their roots. Consequently, to be fertile, a soil must be firm enough to afford a proper degree of support to the plants which grow in it, and yet loose enough to allow the delicate fibres of the rootlets to extend themselves in all directions.

THE LIFE-HISTORY OF PLANTS.

BY DR. MAXWELL T. MASTERS, F.R.S.

REPRODUCTION.

HITHERTO we have seen the plant feeding, breathing, moving, building. We have seen how within certain limits it may be cut into fragments, each of which will, under favourable circumstances, extend and multiply the parent stock. We were about to write, reproduce it; but, for the sake of accuracy, we must limit the term "reproduction" to that absolutely new formation which takes place as the result of fertilisation. That new formation is the embryo plant wrapped up in the husk of the ripe seed, or nestling within its perisperm. (See *ante*, Vol. I., page 21.)

In ordinary language, generally too vague for application to scientific purposes, the seed is looked on as the product of fertilisation, but the seed exists (in a rudimentary state, it is true) prior to that operation. In any case it is the mere casket and food-store in which the embryo plant is packed up.

A bud is an outgrowth from a parent branch or stem, enabling it to extend in length, or, as we have seen, to multiply it when detached. An embryo is something more than an outgrowth or offset; it is an entirely new formation, compounded of two elements derived from two distinct sources. Even as every man is a descendant from two parents, so every plant has a similar origin. In a few cases, indeed, the sexes of plants have not hitherto been traced, but their presence has now been ascertained in so vast a proportion of the vegetable kingdom that there can be no reasonable doubt of their practically universal occurrence. A general sketch of the mode in which the embryo is formed is then essential for our purpose.

The conditions under which reproduction and the production of flowers are effected are in some sense the opposite of those requisite for growth.

The object now is rather to utilise what has been obtained, to change it chemically, and develop it morphologically. It is hence requisite, speaking generally, that the work of accumulation and reserve be over, and that the vegetative growth be checked, so as to allow of the development of the previously formed flower-bud. Presuming that the plant is well developed, and in good health, the supply of food, and especially of water, may be diminished, while, at the same time, a higher temperature is requisite than for mere vegetative growth. Many plants grow well enough in this country, but refuse to flower, owing to a deficient amount of heat. But it is here assumed that the flower-buds are already formed in embryo. It is not absolutely proved that a reduced supply of water, greater heat, or the devices practised by the gardener, will positively bring about the formation of flowers where no germ of them pre-existed, though it is probable that this may happen.

Reduced to its simplest and most elementary stage fertilisation consists merely in the commingling (perhaps the mere contact) of two hitherto separate portions of protoplasm. So far as we can see at present there is no difference in appearance between these two atoms; nevertheless, the one, stimulant, promotes growth; the other, receptive, grows—"useless each without the other."

Fungi and Algæ, Mosses and Liverworts we may pass over, not that they are unimportant by any means, but they lie for the most part outside the domain of practical cultivation, and the object of the gardener is rather to get rid of than to foster them. Speaking generally, they form no exception to the general rule above stated, and so far from being "cryptogamous," as they were thought to be in Linnæus's time, these so-called Cryptogams have contributed in these later times the largest share to our knowledge of the process of reproduction. Ferns and flowering plants, however, are more especially the objects of the gardener's attention, and therefore a knowledge of their mode of reproduction is essential.

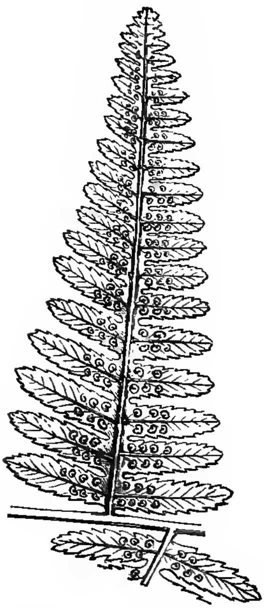


Fig. 58.—Lower surface of portion of the Frond, Male Fern, showing the clusters of spore-cases, covered by the kidney-shaped membrane.

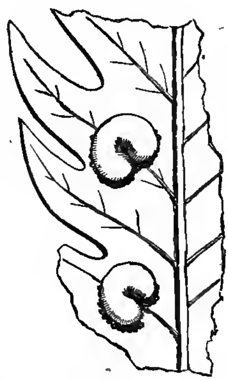


Fig. 59.—Portion of lower surface of Frond of Fern, showing the clusters of spore-cases covered by the kidney-shaped membrane (magnified).

Fig. 60.—One Spore-case of the Male Fern (magnified).

Fig. 61.—Spore-case splitting to set free the spores.

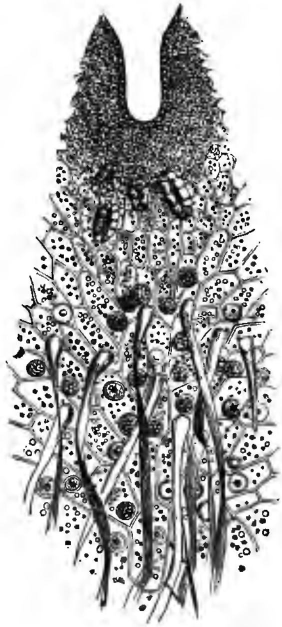


Fig. 62.—Portion of Prothallus of *Pteris serrulata* (highly magnified) showing globose antheridia and cylindrical archegonia.

Reproduction of Ferns. — And first as to Ferns. Any one who has cultivated Ferns in a damp house must have noticed the small green plates which cover the walls, line the chinks or crannies, or cover the surface of the pots where undisturbed. Very probably these green scales, if thought of at all, have been set down as "Liverwort" or "Moss," something objectionable, or at least unworthy of attention. These green plates, however, form one stage in the process of reproduction of Ferns, and one of immense physiological interest, because it supplies a clue to the ancient history and genealogy of vegetation in different geological epochs from that in which we live, and furnishes links that knit together, in one continuous series, groups of plants such as the Pines and Cycads, formerly considered as having no relationship to Ferns or Lycopods, and which link on in their turn to the flowering plants proper; serving to show that the vegetable world, like the animal, is not so much made up of myriads of detached independent fragments as of one vast group of mutually related elements.

Every one who knows Ferns, is familiar with the brown spots on the under surface of the leaves, or fronds, as they are called. Shake the frond, and a brownish dust falls out. The brown spots (Figs. 58, 59) may, by the aid of a magnifying-glass, be seen to be aggregations of very small helmet-like capsules (Figs. 60, 61), often covered by a kidney-shaped membrane, and which split and liberate the contents, the dust aforesaid.

When looked at with a pocket lens, this dust is seen to be made up of fine grains or cells, which are called "spores." When these spores fall on to a damp surface, after a time they germinate, so that they are frequently mistaken for seeds. Instead, however, of immediately producing a seedling plant as a seed does, each spore produces a flat green plate or "prothallus." (See Figs. 1, 2, p. 49, Vol. I.) These plates are not, as is usually thought, the seedling Ferns, but correspond more nearly to the flower-stalk of any ordinary plant, because, as a matter of fact, they bear the true flowers of the Fern on their under surface. To see these, a compound microscope is essential, and with this aid, two different kinds of "flowers," so to speak, may be seen, both made up of cells, the one globular in form, the other tubular, and resembling a chimney or hollow cylinder (Fig. 62). In the globular bodies, which are called "antheridia" (Fig. 63), are formed very minute fragments of protoplasm, coiled up spirally, and provided at one end with two bristles of extreme tenuity. These are the "antherozoids" (Fig. 64). At the bottom of the tubular flowers, called "archegonia," is a cell called the "central cell," and containing the mass of protoplasm or "oosphere," which will develop after fertilisation into the young Fern (Fig. 65). The process of fertilisation is effected by the passage of the antherozoid from the male flower into the cavity of the female flower, where it comes into contact with the central cell, and either directly or indirectly with the "oosphere" in its interior.

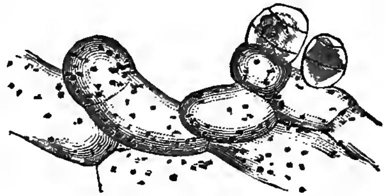


Fig. 63.—Antheridia (highly magnified).

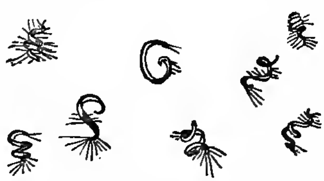


Fig. 64.—Antherozoids (highly magnified).

This latter, thus stimulated into action, becomes invested by a cell-wall, divides, subdivides, and ultimately forms a new plant, the true seedling Fern. The chimney-shaped "flowers" are thus the females, the globular ones are the males, and both as a rule occur on the same prothallus. The prothallus we have seen issues from the spore, and may be likened to a detached bud which extends into a shoot bearing flowers. Here, then, we have the process of true reproduction, consisting of the union of one mass of protoplasm (the spermatozoid) with another (the "oosphere"), and as a result, the development of the latter into a new plant.

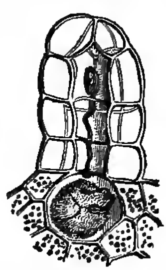


Fig. 65.—Single Archegonia (highly magnified), showing passage of the antherozoids.

The Reproduction of Flowering Plants.—The process of reproduction in the so-called "flowering plants" is in many points essentially similar to that of the Fern above mentioned. The antherozoids are represented by the pollen-grains of the flower contained in the anther; the "oosphere" contained within the embyro sac of the ovule is strictly correspondent with the oosphere of the Fern, and when acted upon by the pollen, it divides, subdivides, grows, and develops into a new plant, the embryo plant. But the flowers of flowering plants are borne on ordinary branches, and not on separately formed prothalli. The prothallus stage then, which is so marked a feature of Ferns and of the higher Cryptogams, generally, is absent in the flowering plants, and is only visible in the form of rudiment in the Pines and Cycads.

Flowers and their Uses.—The word "flower" has hitherto been used in its proper meaning as applied to the true reproductive organs and the cases in which they are enveloped. But this is not the popular signification of the word flower. In fact, in most flowers there are some parts that are essential, and these are of course the organs of reproduction; and other parts that are mere accessories, not essential, though not without their use, as we shall hereafter see. In most books it is the custom to speak of the accessories first, and inasmuch as they are only modifications and adaptations of the leaves, which pass more or less gradually into them, there are good grounds for so doing; but from our present point of view it may be desirable to begin with the essential, and to postpone the consideration of the accessory organs.

Every one knows and admires the infinite variety in the shape and appearance of flowers, and it might seem at first sight a hopeless task to attempt to reduce all these varied forms to a few simple arrangements, and find a use and a purpose for all these seemingly capricious and endless permutations. Nevertheless in no department of Natural History are order, method, and adaptation to purpose more strikingly exemplified than in the case of flowers. The botanist has the clue to the seeming mystery; he unravels its history in the past, pursues its course in the present, divines the why and the wherefore, and lays the knowledge he has gained before the practical man, for him to turn to good account, in so far as his requirements are concerned. In this place we must confine ourselves to one or two examples which must serve to illustrate the rest. Let us take as an example the White Lily; its flowers are large and their parts conspicuous; any other Lily will do provided it be a true Lily, and not one or other of the half-hundred things which are Lilies in name only.

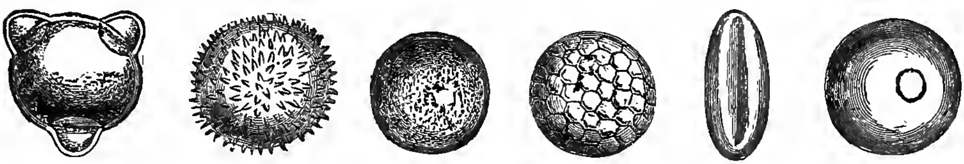
In the centre of a Lily flower (Fig. 66) may be seen six white threads projecting from the flower, each with an oblong top, generally covered with yellow dust. These are the "stamens," and they surround a central column with a thick three-lobed knob at the top, and an oblong swollen portion at the bottom; this latter is the "pistil."

Fig. 66.—Flower of the White Lily.

Fig. 67.—Stamens of Iris.

Fig. 68.—Stamen of Solanum.

Fig. 69.—Stamen of Amaryllis.



Evening Primrose. Hollyhock. Hollyhock with external envelope removed. Phlox. Garlic. Wheat.

Fig. 70.—Pollen-grains (highly magnified).

The stamens (of which examples are given in Figs. 67, 68, 69) consist of a longish thread analogous to the stalk of the leaf, and called the filament. It supports a case at the top, the "anther," in which are contained the "pollen-cells" or microspores, and which escape by the bursting of the anther, either by long slits (Fig. 67), by holes or pores (Fig. 68), or by valves or trap-doors.

The pollen-cells are very varied in different plants, the forms having reference to their mode of transit, whether by the wind or by insects, as hereafter to be explained. In Fig. 70 are shown various forms of pollen-grains.

The pistil of the Lily, below, is shown in Fig. 71, and consists of an "ovary," the thickened green portion which is prolonged above into a column, which is the "style," on the top of which is the three-lobed knob or "stigma." Within the ovary at the base are the "ovules" or rudimentary seeds, in this case contained within three compartments, as may be seen by cutting the ovary across. These parts may also be seen plainly in the Primrose (Fig. 72), in which however the ovary has no compartments, but only a single cavity. In Fig. 73 may be seen the essential parts of the flower of the Vine after the removal of the petals. Here are seen the five stamens, each with its anther at the top, surrounding the pistil, which in this case consists of the ovary and a stigma at the top without any intermediate style, or with a very short one.

At Fig. 74 are represented the six stamens of a Wallflower surrounding the central pistil, and of which two are shorter than the other four (the mark of the order *Cruciferæ*, to which the Wallflower, like the Cabbage, belongs).

The same parts are seen in the Foxglove flower, and in the Fuchsia flower seen cut down lengthwise (Figs. 75, 76). These figures are sufficient to exemplify the general nature of the stamens and pistils. Their form and arrangement differ from flower to flower, but the essentials remain with little or no change. Thus in the Orchids we have a complicated and elaborate arrangement, in the Lilies we have a "flower" of six pieces outside the stamens and pistils, in the Foxglove a sleeve-shaped flower, while in the Willow (Figs. 77, 78) we have simply

Lily, although it by no means follows that the pollen of these so-called "hermaphrodite" flowers really fertilises the germs in the pistil of the same flower. Very frequently, in order to secure adequate fertility and robust seedlings, the pollen from one flower has to be conveyed to the stigma of quite a different flower, but one of the same species, and although close fertilisation may in some cases be the rule, yet an occasional cross is found to be advantageous in maintaining the health of the seedlings. In

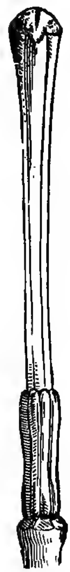


Fig. 71.—Pistil of the Lily, with ovary, style and stigma.

Fig. 72.—Pistil of Chinese Primula, with ovary, style and stigma.

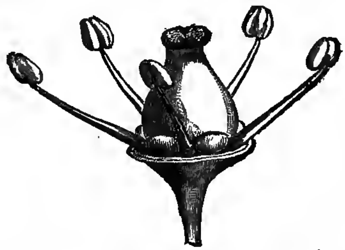


Fig. 73.—Reproductive Organs of the Vine. The stamens have filaments and anthers, the pistil has an ovary and a stigma, and a very short style.

Fig. 74.—Stamens and Pistil of the Wallflower.

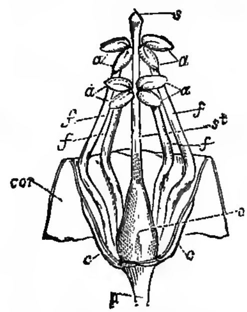


Fig. 75.—Section of Flower of the Foxglove. *cor*, corolla turned back; *f*, filament; *a*, anther; *s*, stigma; *o*, ovary.

Fig. 76.—Section of Flower of the Fuchsia, showing ovary and ovules, tubular calyx ending in sepals reflexed, two petals, stamens and style.

one tiny scale from whose axil proceed, in some cases, two or three stamens, and in other instances one pistil without any stamens. Such cases are illustrations of very simple flowers, though from the fact of their being aggregated together they appear more complicated, or rather the whole mass of flowers, "the inflorescence," is commonly taken for the flower. In the case of the Willow and Poplar the stamen-bearing flowers (Fig. 79) are on one plant, the pistil-bearing flowers on another (Fig. 80). In the Hazel-nut, or Melon, stamen-bearing flowers and pistil-bearing flowers are on the same plant. In many cases the flowers contain within the same envelopes both male and female organs, as in the

cases like that of the Willow this is an obvious necessity, as the pollen is on one plant, the pistil on another. But the same thing is equally marked, though perhaps less obvious, in other cases; for instance, the "blindness," as gardeners call it, of strawberries is due to the fact that the pollen and the stigma are not ripe and do not mature at the same time, and hence, although both may be present in the same flower, yet, as the one is ready and the other is not, no fruit is formed and the flower becomes "blind." But if the pollen could be conveyed from the one flower to another where the stigma was developed, fertilisation would ensue. The "setting" of Grapes depends on like causes; if the pollen and stigma are both ripe at the same time, setting will happen; but if joint action be impossible from any cause, the berries will not set.

Transfer of Pollen.—So then, it is a vital necessity that the pollen be conveyed to the stigma, through whose medium it acts on the germ within the ovules. The next point demanding consideration naturally is, how this conveyance is effected? A gardener often does it with a camel's-hair brush, with which he removes the pollen from the anther to place it on the stigma of the same, or of another flower; or, more roughly, he will shake the pollen out from his Peach-trees by giving the stems a knock with his

But in Linnæus's time the process was supposed to be confined to "flowering plants," so called because they alone were supposed to be endowed with sexes, and it is only within the last quarter of a century or so that the same processes have been detected in so many of the so-called Cryptogams. Now the process is, as before said, considered to be practically universal in its occurrence; and it has been shown how the essence of it is the same in widely differing orders of plants. We must next consider that actual bringing together of the two sexual elements, which is known by the name of Fertilisation; such then will be the subject of our next chapter.

Fig. 77.—Male Flower of the Willow, consisting of a scale with two stamens (magnified).

Fig. 78.—Female Flower of the Willow, consisting of a scale and stalked pistil (magnified).

Fig. 79.—Male Catkin of the Willow, consisting of groups of male flowers as in Fig. 77.

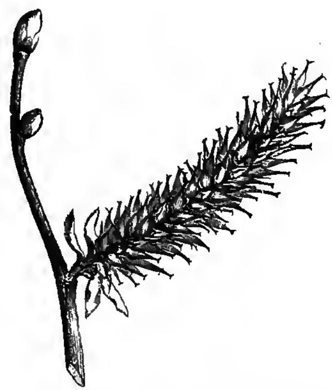


Fig. 80.—Female Catkin of the Willow, made up of numerous female flowers like Fig. 78.

stick, or by shaking a branch with pollen-bearing flowers over the female flowers, as was done by the Arabs ages before the German Camerarius, the Italian Cæsalpinus, or the English Nehemiah Grew,* had formulated the doctrine of sexuality in flowers. Linnæus adopted that doctrine, brought forward numerous new proofs in support of it, and, as we all know, based his system of classification upon it.

* Grew in his "Anatomy of Plants," published in 1682, says, at p. 173:—"In discourse hereof [relating to the use of the "attire" or stamens] with our learned Savilian Professor, Sir Thomas Millington, he told me, he conceived that the attire doth serve as the male for the generation of the seed. I immediately replied that I was of the same opinion; and gave him some reasons for it, and answered some objections which might oppose them." Grew then goes on to express his views in detail, some of which are wholly untenable in the light of the present day, but in which, nevertheless, the doctrine 'that the same plant is both male and female' is clearly laid down, and from his point of view correctly so, although the statement is now known only to be correct so far as structure is concerned, and not always equally so as to function.

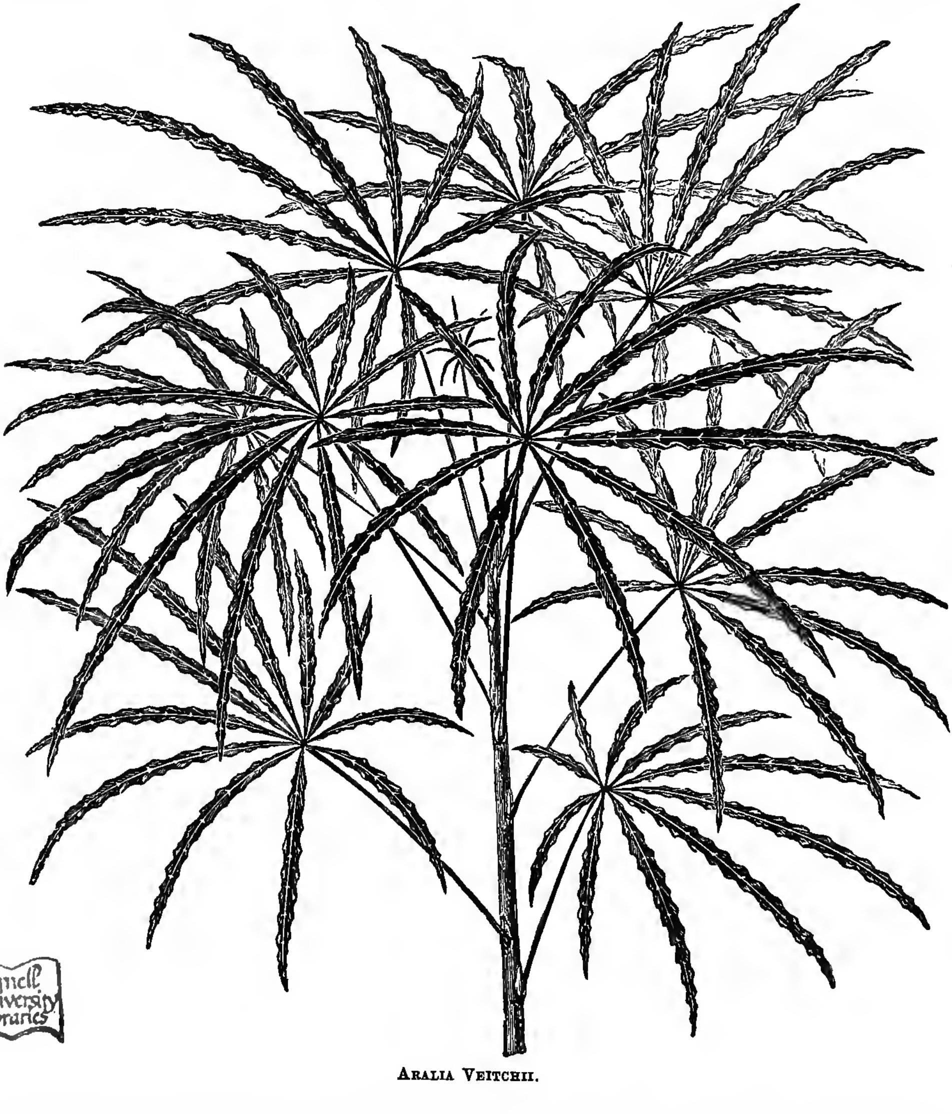
HOT-HOUSE OR STOVE PLANTS.

By William Hugh Gower.

Aphelandra.—From *apheles*, "simple," and *aner*, "a male"; in allusion to these plants having one-celled anthers. They belong to the order *Acanthaceæ*, which contains a host of beautiful flowering plants, although some species of Aphelandras have not only beautiful flowers, but fine variegated leaves as well; formerly they were included in the genus *Justicia*, to which they are very nearly allied. These plants are very free in growth, yet require some attention to keep them well furnished with leaves, and presentable; when neglected they soon lose their foliage, and have a very wretched appearance. Pot them in loam and peat, in the proportion of two parts of the former to one of the latter, with the addition of some sharp sand; drain the pots well, and give them plenty of water; after flowering it will be found advantageous to withhold the water-supply to a great extent, and place them in a somewhat lower temperature. Before they start into fresh growth the young wood should be cut back to within a few eyes of the place they previously started from, and after some few leaves are made the points of the shoots should be pinched out in order to produce a greater number of growths; when, as before remarked, care and attention is required to develop handsome specimens. Aphelandras are mostly winter-blooming plants, and are therefore doubly valuable, as their brilliant flowers serve to maintain a display at just the season of the year when the surroundings are dull and gloomy.

A. acutifolia.—Stems quadrangular; leaves oblong-ovate, and acuminate, some six to eight inches long, rich glossy green on the upper side, paler beneath; flower-spike terminal, as long as the leaves; bracts large, green, tinged with purple; flowers intense deep red. Autumn and winter months. Widely distributed in South America.

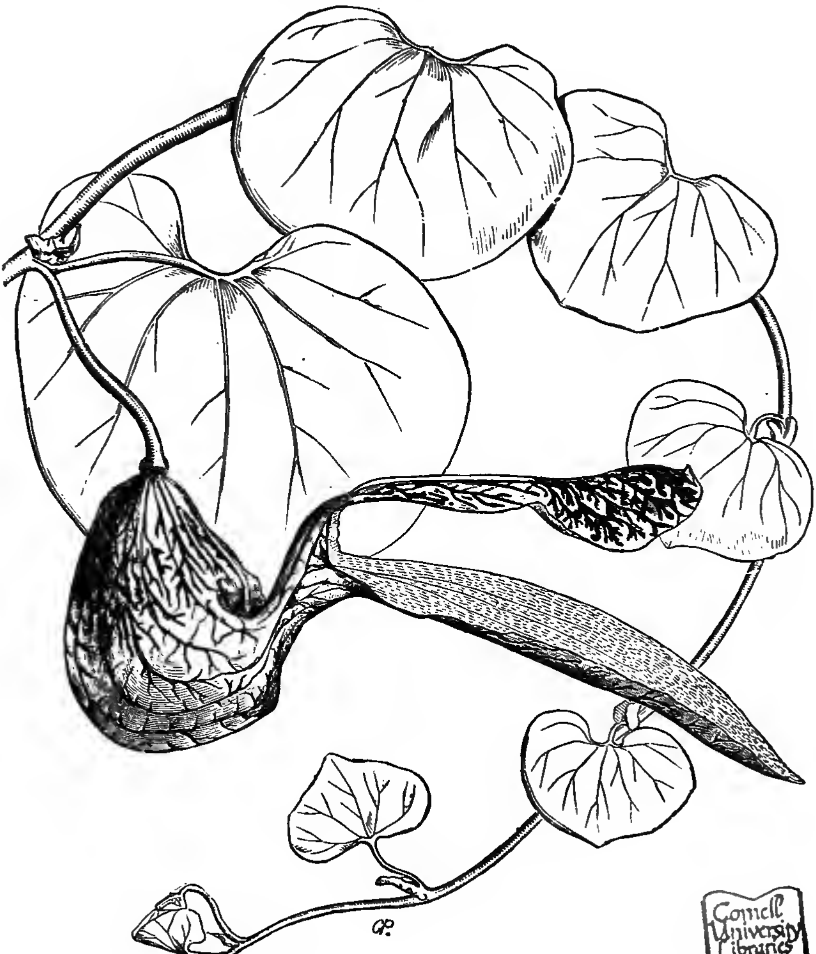
A. aurantiaca.—Leaves broadly-ovate, and of a



Aralia Veitchii.

uniform deep green; flowers in a terminal spike six to eight inches long, rich orange-scarlet. Winter months. South America.

A. aurantiaca, var. *Roezli*.—Leaves oblong acuminate, deep green, suffused with a silvery film; waved at the edges, deep green on the upper side, the midrib and primary veins margined with silvery-white, under side port-wine colour; flowers much exserted, with a large spreading limb of a uniform rich vermilion. Winter months. South America.



ARISTOLOCHIA RINGENS.

flower-spikes erect, tubes pale red, the spreading limb deep orange-scarlet. Winter months. Mexico.

A. cristata.—Leaves broadly-ovate acuminate, and deep glossy green; flower-spikes erect, with several small lateral ones, rich brilliant scarlet. Autumn and winter months.

A. fascinator.—Leaves oblong-lanceolate, slightly

A. Leopoldii.—Leaves broadly-ovate, tapering at each end, deep green, the opposite primary veins pure white; flower-spike six to eight inches long, rich yellow. Autumn and winter months. Brazil.

A. Liboniana. — Leaves ovate-lanceolate acuminate, upwards of six inches long, deep green, the midrib pure white; flower-spikes longer than the leaves; the large bracts are deep orange-yellow, tubes yellow, the limb rich scarlet. Winter and early spring months. Brazil.

A. nitens.—Leaves ovate-acute, thick and fleshy in texture, about six inches long, rich bright green above, port-wine colour beneath; spikes as long as the leaves; bracts large, pale green; flowers brilliant scarlet. Spring months. New Grenada.

A. pumila.—Leaves ovate, or oblong-ovate, deep shining green, with a pale green band along the centre; bracts dull brown; flowers brilliant red. Winter months. Brazil.

A. punctata.—Leaves bluntly-oblong, deep green, the midrib and veins margined with silvery-white, and the margins dotted with white; bracts yellow, tipped with green; flowers bright yellow. Winter and spring months. South America.

A. Sinitzini.—A bold and handsome plant, with large, broad, ovate-lanceolate acuminate leaves, which are dark glossy green above, midrib reddish-brown, and this with the primary veins are margined white, the under side purplish-violet; flower-spike long and dense, sometimes having lateral branches; bracts red, flowers intense scarlet. Winter months. Peru.

A. sulphurea.—Leaves broadly-ovate acute, some eight or nine inches long, bright shining green on the upper side, paler below; spikes longer than the leaves; bracts green, veined and tipped with brown; flowers golden-yellow, with a small red spot in the throat. Winter months. Guayaquil.

Aralia.—A genus of very dissimilar-looking plants, which includes the common Ivy; its derivation is of unknown origin, although it gives its name to the order (*Araliaceæ*), none of them are possessed of showy flowers, but all the kinds here enumerated are very ornamental-foliaged plants. Aralias should be potted in sandy loam, with the addition of some vegetable mould; some species are temperate plants already noticed in the Green-house section of this work, but the kinds here enumerated all luxuriate in strong heat and moisture.

A. elegantissima.—This handsome plant has an erect stem and long slender petioles, very dark green speckled with ivory-white; the leaves are palmate, divided into narrow segments down to the petiole; these segments are pendulous, serrate at the edges, deep green speckled with white, under side reddish-brown. South Sea Islands.

A. Guilfoylei.—The leaves of this species are pinnate, made up of five or seven large oblong-obtuse, dark green leaflets, which are broadly margined with creamy-white, and serrate at the edges. South Sea Islands.

A. Veitchii.—The leaves palmately divided into narrow segments, which are slightly serrate at the edges, bronzy-green above, deep reddish beneath. No description can give an adequate idea of the beauty of this species. New Caledonia.

A. Veitchii, var. *gracillima.*—Narrow and elegant as are the divisions of the leaf in the last-named plant, the variety here named is infinitely more slender, whilst its colour and markings are the same. New Caledonia.

Aristolochia.—A genus of bold-growing plants, the majority of which are climbers; they give their name to the order, and are popularly called Birthworts. Aristolochias form magnificent objects upon the roof, or upon pillars in a large plant-house; the flowers are not brilliantly coloured, but their extraordinary forms, and large handsome cordate leaves, render them very attractive. Pot in loam, peat, and sand; and in the autumn when the flowering season is past, cut the shoots of the climbing species back to within a few eyes of the old wood.

A. Duchartrei.—A somewhat slender species for a climber of this genus. The leaves broadly-cordate acuminate; dark green on the upper side, paler below; flowers produced from the old wood; tube about an inch long, thin, narrow, and contracted, ultimately expanding into a large funnel-shaped limb, some three inches across; outside of perianth yellowish-white, and reticulated with reddish-brown lines; interior or funnel creamy-white, irregularly blotched with blackish-purple. Winter months. Upper Amazon.

A. gigas.—This is a strong climber, with cordate-acuminate leaves of a deep green; flowers solitary in long peduncles, flowers when young and before opening clothed with a dense tomentum of woolly hairs; tubular at the base, expanding into a large spreading limb upwards of eighteen inches in diameter, with a tail nearly a foot long; ground-colour yellowish-white, beautifully reticulated with purplish-brown. Summer months. Guatemala.

A. Goldieana. — This is the largest-flowered species known, and unfortunately its disagreeable odour is in proportion to its size; it is a climbing species, with large and smooth, ovate-cordate acuminate leaves. Flowers very large; upwards of two feet long, and nearly a foot across its funnel-shaped limb; tube greenish-yellow; the end bent back and contracted, suddenly expanding into a large campanulate three-lobed limb, which is furnished with three slender tail-like points; on the outside it is pale greenish-yellow, with broad longitudinal lines of reddish-brown, which are filled in transversely with finer lines of the same colour; interior of the limb dull orange-yellow, profusely barred and reticulated with purplish-brown. Summer months. Sierra Leone, and in forests at the mouth of the Old Calabar River, West Africa.

A. labiosa.—A strong-growing climber, having large uniform cordate leaves; the flowers are furnished with a short sac at the base, and a large spreading limb; ground-colour yellowish-green, reticulated with purple lines. Summer months. Brazil.

A. odoratissima.—Similar to the preceding in habit, but leaves less uniform. Flowers very large, with a large speading lip, upwards of six inches across; ground-colour yellowish, reticulated with flowers solitary, springing from the joints and supported on bright red peduncles; the tube pale and curved, and spreading upwards into an open limb more than an inch across, which on the lower part is split into three long tails, some four inches or more long; limb dull red outside, deep purplish-red inside. Summer months. Chiapas, Eastern Mexico.

A. trilobata.—A most singular flower, though not brilliantly coloured; it is of scandent habit, with small three-lobed leaves, which are of a deep shining

ASPARAGUS PLUMOSUS NANUS.

purple. This fine species is agreeably perfumed. Summer months. Jamaica.

A. ringens.—A somewhat slender-growing scandent plant, to be found in some collections under the name of *A. grandiflora*. The roots of this species are in much repute as a cure for the bite of venomous snakes. The whole plant is smooth, with large reniform, on nearly round leaves, which have a broad depression between the lobes; they are light green on the upper side, glaucous beneath. Flowers six to nine inches long, yellowish-green, beautifully tessellated with deep purple. Summer and autumn months. New Grenada.

A. tricaudata.—This is not a scandent but an arborescent plant, with thick-jointed zig-zag stems; leaves oblong-acute, some eight inches long; deep green above, paler and strongly nerved beneath; green above, but paler and strongly nerved below; flowers solitary, supported on long peduncles; tubular, the base much inflated, then suddenly contracted and bent straight upwards, terminating with the lid to the mouth of the tube, which is arched over, and lengthened into a long tail of striking character, the whole flower resembling one of the green Nepenthes; the inside yellowish-white, profusely spotted with reddish-purple; outside pale green, the inside spotting showing through. Summer months. South America.

Artocarpus.—The name comes from two Greek words signifying Bread-fruit, and the history of its introduction has been recently vividly brought to mind by a visit to the colony founded by the crew of the *Bounty*, commanded by Capt. Bligh, who mutinied and thus frustrated the first attempts to introduce the plant into the West Indian Islands. The true Bread-fruit is the fruit of *Artocarpus incisa*, which attains the dimensions of a moderate forest tree, with large deeply-sinuate leaves, but is not sufficiently ornamental to find a place in these pages. The genus does, however, furnish us with some species of small growth and ornamental foliage. These plants should be potted in sandy loam, with the addition of a little vegetable mould; they enjoy a very moist atmosphere and strong heat.

A. Cannonii, or *Ficus Cannoni*.—A showy plant with leaves of a variable form, but mostly pinnatifid in shape; the lobes deeply divided and serrate at the edges; upper surface deep crimson with a bronzy tinge, under side port-wine colour. Society Islands, Pacific Ocean.

ATACCIA CRISTATA.

A. eburnea.—The leaves of this species are obovate and acuminate, cordate at the base, about twelve inches long and six broad, of a deep rich green colour, the midrib and primary veins being white. A native of the South Sea Islands.

Asparagus.—A group of the order *Liliaceæ;* the name is familiar to every one from the species *A. officinale*, so largely grown as a culinary vegetable in all European countries. The plants here enumerated, however, are of scandent habit, and the very finely divided leaves, combined with their brilliant shades of green, render them general favourites. The plants bearing different names are very similar in appearance, and may be only variations of the same species. Pot in rich sandy loam, with a little vegetable mould added; supply moderately with water to the roots, but avoid syringing overhead.

A. consanguineus.—"A very slender climbing plant of exceedingly graceful habit, throwing up much-branched stems. The ultimate branchlets bear brilliant green needle-like leaves, thickly set and spread all round, presenting an elegant feathery appearance." South Africa.

A. plumosus.—"An elegant evergreen climber with slender stems, smooth and numerous spreading branches of a vivid rich green." It is extremely useful for mixing with cut flowers, the embellishment of a lady's hair, or, indeed, any other purpose where elegant foliage is required. South Africa.

A. plumosus, var. *nanus*.—Although this is called *nanus*, it appears to be equally as tall-growing as the species; it, however, is a very handsome kind, with dense feathery, vivid green branches. South Africa.

Astrapæa.—The name comes from *astrape*, "lightning," on account of the brilliancy of the flowers; they belong to the order *Byttneriaceæ*, and form large, soft-wooded, evergreen shrubs of great beauty. Pot in a mixture of peat and loam in equal parts, with the addition of a little sand, drain well, and water freely during the summer months.

A. Wallichii.—There are several species in the genus, but this is by far the most beautiful; it is a large-growing plant with alternate cordate acuminate leaves, from twelve to eighteen inches long and a foot broad, furnished with large stipules at the base. The flowers are borne in large pendulous umbels. These are very large and brilliant red. Summer months. Madagascar.

Ataccia.—This is the Malay name for a very peculiar family, which certainly are not possessed of any gorgeous beauty, but their singular structure will commend them to all lovers of plants. Pot in peat and loam, and provide a liberal supply of heat and moisture.

A. cristata.—This is a very singular plant, sometimes found under the erroneous name of *Tacca integrifolia;* it is of dwarf habit, with an underground rhizome; the petioles are purplish-black, bearing large oblong-acuminate leaves, which are wrinkled on the surface, and purplish-green. Scape a little longer than the leaves, and like the petioles dark purple, terminating in a four-leaved large involucre of a blackish-purple hue; within this involucre are numerous dark purplish flowers furnished with long tail-like beards. Summer months. Malay Islands.

THE ORCHARD-HOUSE.

By William Coleman.

MANAGEMENT OF PEACHES AND NECTARINES IN THE SECOND YEAR.

ALTHOUGH fruit-trees of all kinds are grown in the orchard-house, there is but little doubt that the Peach and Nectarine stand first in point of interest and value, and on this account their treatment during their first fruiting season must receive our earliest attention.

Housing.—Not later than the end of January let all the trees be taken into the house. Wash the pots and examine the drainage to ascertain that it has not been clogged by worms; then lay the trees on their sides, and with a soft brush wash every shoot and stem with warm soap-water, to cleanse them from accumulations and the larvæ of insects. If scale or spider have been detected, wash a second time, always working the brush outwards from the base to the points of the shoots, so that the buds may not be injured in the performance of the operation. Give each tree a thorough soaking with clear water, and if the house is not otherwise occupied, place them at once in position in the order named in directions for the first year's management.

Pruning.—The experienced gardener who can distinguish wood-buds from flower-buds will perform this trifling operation either before the trees are taken under glass, or as soon as they are washed; but the amateur who cannot distinguish them at a glance will do well to defer pruning until they begin to swell, otherwise he may commit an irreparable error by cutting away the only wood-bud contained on a blossom-bearing shoot, when the shoot will die back to the wood-bud at the base. It may here be necessary to remind the novice who thinks he must commence cultivation by cutting away two-thirds of every shoot, that properly pinched pyramids and bushes require very little pruning indeed, and that it is better to defer cutting into shape until the blossoms are well advanced, than to risk the loss of his best fruit-bearing shoots by cutting away the terminal, which is always a wood-bud, at random. In order to prevent the possibility of a mistake the sketch (Fig. 8) will show at a glance the character of the different kinds of buds: *aa*, are wood-buds; *ee*, blossom-buds; *b*, a triple bud, in which the centre is almost invariably a wood or shoot-producing bud, while those on either side of it are flower-buds, as shown. It is generally, but not always, safe to prune to these; but, all things taken into consideration, deferred pruning of Peaches and Nectarines is the safest course for all cultivators to pursue.

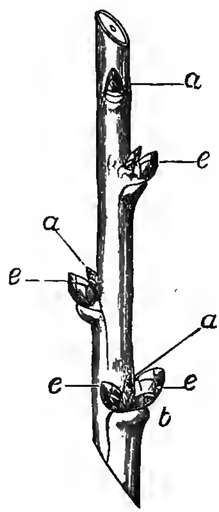


Fig. 8.—Fruit and Wood Buds.

Having arranged the trees belonging to the different sections—all of them, we may assume, well furnished with flower-buds—keep the house as cool as possible by ample ventilation, both by day and night, but do not let the soil in the pots approach dryness. Towards the end of February will be quite early enough to commence coaxing the trees into activity by shutting up the house in the afternoon, and perhaps throughout the night, that is, provided artificial heat can be supplied in the event of frost or damp dull days setting in when the blossoms begin to open. If this provision has not been made, endeavour to escape danger by abundant ventilation, whenever the elements are favourable. When the earliest flowers begin to show colour, fumigate the house once or twice on calm days with tobacco-paper to destroy aphis, which may have been introduced with the Strawberries, and syringe with tepid water the following morning. If properly performed, two smokings should destroy every fly, when the trees will be safe from this pest until after the fruit is set. If neglected until after the flowers open the crop will be endangered; as fumigation that will kill the fly will ruin the delicate organs of the flowers before they have time to perform their office of fertilisation.

Temperature.—The Orchard-house in the general acceptation of the term is not a forcing house;

therefore, if it be put to its legitimate use, the certainty of a maximum crop of fruit at the least possible cost, is a point which must not be lost sight of. From this remark, it must not be inferred that Peaches and Nectarines in pots cannot be forced, as many people, to save their permanently-planted trees, invariably obtain their earliest crops from pyramids and bushes thoroughly established in pots, tubs, or boxes. Where this is the object, detailed directions such as will be given for the management of the early Peach-house will apply. In order to attain the more legitimate end, the trees should be retarded by abundant ventilation until they approach the flowering stage, when fire-heat should only be applied when there is danger of severe morning frosts running the temperature down to, or near, the freezing point. When trees are brought on in this way, and a dry bracing air is kept in constant circulation through the house, it is astonishing how vigorously the blossoms of the Peach expand, well in advance of the wood-buds, and how freely the fruit sets in a temperature that is equally favourable to the Cherry, the Pear, and the Plum. In mild, dry seasons, all stone-fruit trees set their fruit freely on the open wall; in the dry, airy orchard-house, they will do the same often without the aid of fire-heat at all; but there are times and certain conditions of the atmosphere which are more fatal to fertilisation than actual frost itself. If, for instance, the sun is obscured for days together, and the atmosphere is charged with cold, stagnant moisture, the pipes should be steadily warmed, and the apex lights opened when the temperature touches 40°. When the trees are in full flower, they must be kept progressing in a dry temperature ranging from 40° at night to 50° or 55° by day, when a circulation of air will greatly facilitate the setting process, provided it can be secured without creating a cold cutting draught. After the fruit is set, and if mild genial weather prevails, 45° to 50° may be taken as the minimum, and 55° to 60° as the maximum; but higher than this the mixed orchard-house should not be allowed to rise, at least until after the stoning process is complete, when fire-heat will no longer be needed, but time, apparently lost during the early stages, can be regained by closing early with solar heat on fine sunny afternoons. Some growers have advised setting and keeping open all the ventilators by day and night; but why the genial afternoon warmth from bottled-up sun-heat through April and May should be ignored, it is difficult to imagine. One result in cold fickle seasons is certain to follow, and that is crippled foliage, subject to the attacks of black and green fly, mildew, and a tendency on the part of weakly trees to cast their fruit at stoning-time.

Ventilation.—From the preceding remarks the amateur will have gathered that fire-heat must be sparingly used as a necessary agent when the weather is unfavourable, and a circulation of air cannot be secured without it. Through the first stage, that is from the starting to the flowering period, the ventilators should be kept constantly more or less open, also during the setting process. After the fruit is set and swelling, plenty of air through the early part of the day is an important matter, otherwise the young growths will be weak, long-jointed, and watery. When fine summer weather sets in, the ventilators may be opened as early as six o'clock in the morning, and left open until five in the afternoon, when closing with copious syringing will greatly assist the swelling of the fruit. When the latter begins to colour, throw every ventilator wide open, and close or leave them open at night, according to the state of the weather, and the period at which the fruit is wanted for use.

Watering.—It is difficult to advise the amateur upon this important point, as an excess of water when the trees are at comparative rest, is almost as bad as the want of it when they are in activity. Fruit-trees, however, should never be allowed to become dry from the time they are re-potted in the autumn, until the succeeding year's wood is ripe, and the leaves are ready to fall. During this period partial dryness may do no harm, but care should be taken that they are in a satisfactory state at the time they are turned out, reduced, and re-potted.

Immediately after this operation has been performed, say in October, new roots will commence the slow but sure process of working in the fresh compost, and gradually filling up the blossom-buds for the succeeding year. Therefore, whether they are plunged in the open air or in the orchard-house, a regular system of watering should from this time be carefully carried on. If well plunged throughout the dormant season, very little water will of course suffice; but if once allowed to receive a check, they will most likely cast many of their flower-buds in the spring. When the fruit is set and the trees are in free growth, it is not easy to water a properly-drained and potted tree too liberally. The operation should, however, always be entrusted to one reliable person, as owing to the surface moisture, which is produced by constant syringing, it is difficult for a strange hand to judge from appearances. Early morning is the best time to water until the trees are in full leaf; but when rapid growth has set in, copious supplies should be given every evening, as the roots then have the benefit of a cool, refreshing bath, extending throughout the night. In very hot weather it may be necessary to water twice a day, and it is during this period that the duplicate pots for slipping the trees into are of so much service in protecting the delicate roots from the rays of a July sun. If the trees are kept well mulched from the setting up to the ripening of the fruit, such a covering of rich compost will be found a great protection to the surface roots, independently of its stimulating virtues. Stimulating liquids of various kinds will of course be applied during the heavy strain. These should always be given when the soil is in a good growing state, and on no account should they be applied strong.

Syringing.—Notwithstanding the fact that the Peach is a moisture-loving plant, and many failures may be traced to the want of water at certain periods of its growth, all good fruit-growers agree that copious and incessant syringing from the time the trees are started until they begin to open their flowers is a mistake. In the first place, incessant syringing has a tendency to bring the foliage in advance of the flowers, when the fruit rarely sets or swells away so freely as it does when the wood-buds are kept in check, not by starvation at the roots, as they must never be allowed to get dry, but by damping the paths and floors in preference to the direct syringing of the trees. Therefore, in order to prevent the wood-buds from getting too forward, or the flower-buds from being injured by cold water hanging about them, let direct syringing be confined to bright mornings after cold nights, when extra fire-heat has been applied, and keep the atmosphere properly charged with moisture by damping the paths, walls, and all available spaces, during the time the ventilators are open, and again after they are closed in the evening. As soon as the fruit is set, apply the syringe vigorously every fine morning when the temperature begins to rise, and again after the house is closed with solar heat. Always use clean water at the mean temperature of the house, and apply it with considerable force to the under sides of the leaves, where spider and fly are most likely to find their first foot-hold. Syringing whenever the weather is fine should be continued in this way until the fruit is ripening, when it must be given up, otherwise the fruit will be soft and deficient in flavour. The Peach, when carrying a heavy crop of fruit, being so subject to spider, may be syringed as early as six o'clock in the morning through the summer months, as the foliage will then have time to revel in its bath before evaporation by increased ventilation takes place, and it may be syringed as late as five o'clock in the afternoon when shut up for the day. Later than this, it should not be syringed, as trees in cold houses are apt to get too gross when the foliage remains wet through the night. As a cleansing stimulant to the foliage, clear soot-water may be applied occasionally, either with the syringe or engine, and, as has already been said, its application to the roots will give a dark, healthy appearance to the fruit and foliage.

Fertilisation.—It is generally admitted that Peaches and Nectarines under orchard-house treatment require artificial fertilisation either with their own or, better still, with foreign pollen. Free kinds like Royal George Peach and Elruge Nectarine may, and generally do, set an abundance of fruit without this process, but many of the shy pollen-producing varieties are greatly benefited by having the brush passed over them when the pollen is ripe and fit for its office. As male parents, it is questionable if the Peach and Nectarine above named are not the best, but being rather late mid-season kinds, many of the newer early varieties are often set and swelling by the time they come into flower. The conditions most favourable to setting the fruit are a dry buoyant atmosphere, in which the pollen can ripen, and float when it is liberated, bright sunny weather to raise the temperature of the house fully to the maximum, plenty of air, and gentle fire-heat when these conditions cannot be obtained without it. Another important point is vigorous root-action in a clean well-filled pot, placed in a medium equal to the mean temperature of the house. When the trees are in full flower, and pollen flies off freely in response to a sharp rap on the stem, they are in a fit state for artificial fertilisation; then with a camel's-hair pencil, or a rabbit's tail, pass over each tree with a light and careful hand, but avoid bruising the tender organs of fructification, otherwise injury, instead of benefit, will be the result of the operation. Always commence with the most forward and prolific pollen-producing kinds, and when the brush is well charged pass it over the large-flowered section and others which do not as a rule produce pollen so freely. Repeat the operation from day to day when the temperature of the house has reached the maximum, until the petals begin to fall, when, all having gone well, the young fruits with straight bold pistils will be seen emerging from the remains of the decaying flowers. Some growers syringe their trees when in flower to set the fruit; others, often succeeding quite as well as those who take greater pains, leave them to the agency of insects, combined with a sharp blow on the stem with the hand and a free circulation of air. But experience has proved that many delicate kinds have failed through neglect of this simple and interesting operation, while many experienced Peach-growers are of opinion that this artificial aid adds weight to every fruit so fertilised, and very often prevents splitting of the stones when the Peaches begin to ripen.

Disbudding.—Contemporaneously with the setting of the fruit the wood-buds will begin to swell, and burst into fresh healthy growth. If the wood of the past year was well ripened, and the trees have been brought on steadily with plenty of air, these young growths will not be too far in advance of the fruit. If these conditions, however, have not been fulfilled, disbudding and pinching will require very early attention, otherwise, although properly set, many of the young fruit will not swell away freely. Therefore, to prevent robbers or gross breaks from carrying away the sap that should go to their support, give timely attention to pinching, disbudding, and shortening back, always bearing in mind that fruit formed near the base and on the upper sides of the shoots should be encouraged to swell on for the crop. The first point to be considered in the manipulation of a bush, pyramid, or cordon tree is a regular supply of young growths from the base of every fruit-producing shoot. These when secured may be allowed to grow to the necessary length before they are pinched, as they will be the fruit-producers in the succeeding year. The terminal growth may extend some five or six leaves where the tree is already large, when it must be pinched again and again throughout the season. All other growths between the base and the terminal, unless more wood is wanted to form the trees, must be kept closely pinched to within three or four leaves of the fruit, and some of them may be entirely removed after the crop is thinned. It is a difficult matter to give precise directions for stopping every shoot; but the practised eye will soon discover that the balance of the tree can only be maintained by the incessant pinching of all free growths near the apex, and allowing a little more licence to those which are naturally weaker near the base. Next in importance to the equal diffusion of the sap over every part of the tree is its form and freedom from crowding. These points must not be lost sight of, as neglect of the first will rob the tree of its charms, while overcrowding will lead to the production of pale, vapid, colourless fruit, which must be deficient in flavour.

Thinning the Fruit.—When the fruit has attained the size of small Marrow Peas, and copious syringing has cleared away the remains of the flowers, thinning must receive attention. The first operation will be the removal of all side fruits where triplets have been formed, and the least promising of the two where they have set in pairs. Then, provided an abundance, from which the crop can be selected, are standing on the upper sides of the shoots, remove all that have been formed on the lower sides, as they cannot be expected to colour to the apex. An interval of a few days will show which of those left are the most promising, when a second, but not the final thinning may be taken in hand. When the Peaches attain the size of Acorns, calculate the number which each tree may be allowed to carry to maturity, and again reduce the number by taking off a few more of the least-promising and worst-placed fruits. If the tree is considered capable of maturing, say thirty Peaches, thin down to forty, and then leave it until after the stoning process is complete. Well-managed pot-trees do not generally cast a large percentage of fruit at stoning-time, but they are always liable to cast some; it is, therefore, a safe plan to leave a few to be taken off after this process is complete. It may be mentioned that this mode of thinning applies to all kinds of fruit under orchard-house culture, as it is by timely attention to all these details that superior quality is obtained. In course of time the trees attain a large size, and become one mass of spurs and blossom, bearing shoots which set hundreds of fruit, and independently of age always carry a heavy crop to maturity; but timely and continuous thinning must never be neglected, otherwise that left will ripen prematurely when it ought to be commencing the last swelling.

How long a well-managed pot or tub-tree will last, is a question which might have been answered by such veterans as the late Mr. Pearson or Mr. Rivers; but it is only doing bare justice to the system to say that trees at Eastnor, which were potted more than twenty years ago, still require considerable thinning, and still produce fruit good enough to take the premier prizes at the best shows in the kingdom.

Top-dressing.—A very important feature in pot-culture is top-dressing, that is, keeping the surface roots constantly supplied with rich compost during the time the trees are carrying and maturing a crop of fruit. Some growers place their trees on the borders, and allow the roots to strike into the surface; but this is not a good system, as the liberal supplies of water, which carry down much rich stimulating matter, soon draw them away from home, when the compost in the pots becomes little better than a medium. Large trees are soon produced, and all goes well until the fruiting year, when the border roots having been cut off, the few feeble feeders contained in the pots are unable to supply the requisite food. The trees flag, water *ad lib.* is given to them, the rich compost, quite innocent of active roots, becomes sour, water-logged, and pasty, and pot-culture is pronounced a failure. But let the tree be placed on bricks or tiles, apply rich mulching to the surface of the pot, and thousands of hungry feeders will take possession of every bit of turf, bone, and manure. Stimulating top-dressings are prepared in various ways. Some use dried cow-dung, others apply rich loam and water with diluted liquid; but a very good material for this purpose consists of equal parts of fresh horse-droppings and rich turfy loam, to which may be added twenty per cent. of bone-dust. These should be thoroughly mixed in a dry shed some time before the dressing is required for use, and should be frequently turned to prevent heating. Newly-potted trees do not require top-dressing the first season, but when they begin to bear fruit a small quantity of this material may be applied once a fortnight from the time the fruit is thinned until within three weeks of the time of ripening. When this stage is reached, discontinue all strong stimulants, and keep the trees regularly supplied with pure water.

Mr. Douglas, a very successful cultivator of fruit-trees in pots, recommends a dressing composed of equal parts of loam, fresh horse-droppings, and malt dust. This is a most powerful stimulant, but is subject to violent fermentation, when its quality deteriorates, and it throws off a disagreeable stench, which renders the house anything but pleasant.

Gathering the Fruit.—Early morning, when the fruit is cool and dry, is the best time to gather Peaches and Nectarines; and they should be under rather than over-ripe, particularly if they have to be kept for a few days before they are required for use. An experienced person can judge by the appearance of the fruit when it is in a fit state for gathering; but the tyro may at first find it necessary to test it by slight pressure near the stalk, when if it yields to the touch it is in a fit state for removal. With this exception Peaches should never be touched by the fingers, as the slightest pressure forms a bruise, which ferments and deteriorates the flavour. When a tree of fruit approaches ripening, withhold water, but do not allow the foliage to droop, or the least forward fruit will ripen prematurely, and be deficient in flavour. Assuming then that the first gathering is about to be made, take shallow, flat-bottomed baskets, pad them well with soft moss or wadding, over which place a sheet of silver paper; then, with a pad of wadding in the palm of the left hand, and a pair of Grape scissors in the right, grasp the fruit lightly, and detach it with the points of the scissors, place each fruit on a square of silver paper, and lay them close together in the basket. Remove to a cool, airy, Grape or fruit room, where they may remain until wanted for use.

Gathering for Market.—When Peaches are intended for the fruiterer, and have to be packed for transit by rail, many growers detach them as soon as they are well-coloured and have attained their full size, but before they begin to soften. Each Peach is then folded in a square of silver paper and packed in shallow boxes some four and a half inches deep. Soft, well-beaten moss, where it can be obtained, answers best, as it is elastic and cheap. For detailed directions on this important part of the fruit-grower's management, see the articles on PEACHES UNDER GLASS in future pages. Many people can grow good fruit, but through lack of experience suffer in pocket by allowing it to soften before they gather it and send it away. The fruiterer does not care how hard a Peach is when sent in, provided it is well-coloured; as he has ways and means of ripening it up without bruise or blemish; and it is for such consignments that the highest prices are given to the producer.

VARIETIES OF PEACHES AND NECTARINES, AND HOW TO DISTINGUISH THEM.

When it is borne in mind that thousands of Peaches and Nectarines are propagated from trees which nurserymen never see in bearing, it is not surprising that fruit-growers find many of them incorrectly named. Many of our finest varieties of Peaches so closely resemble each other as to render it difficult for the amateur to distinguish them when growing on the trees, and the experienced often fall into mistakes when they take upon themselves to name them after they are gathered. And yet there are a few simple rules, or simple forms of structure, by which any observant man can soon learn to name many kinds—certainly to say the tree sold him for such a variety is not true to name, as the features do not agree with Dr. Hogg's description contained in his "Fruit Manual." All who grow fruits or flowers like to know them by their names; but Peaches and Nectarines are less known than any other fruit which comes under the British fruit-grower's management.

In the first place, it must be explained that Peaches and Nectarines are divided into two classes by their blooms, which may be large, light-coloured and handsome, or small, dark and inconspicuous. The fruit may be found rich and to separate freely from the stone, or tough and to adhere closely to it. The first are called Melting Peaches, the second are Clingstones. The leaves, a most infallible guide in all the old varieties, but not so much so in some of Rivers' seedlings, will be found serrated on the edge and without glands, as in Fig. 9; crenated, with globose glands, as in Fig. 10; or crenated, with reniforme glands, as in Fig. 11. Now, assuming that the amateur has purchased and potted, say twenty varieties of Peaches, and he wishes to ascertain with as little delay as possible whether they are true to name, the best thing he can do will be to obtain a book and rule each page into four columns. The first will be for the number, the second for the name, the third for the size of the flowers, and the fourth for the formation of the leaves, in this way:—

Number.	Name.	Flowers.	Leaves.	Remarks.
1.	Royal George.	Small.	Serrated, without glands.	
2.	Abec.	Large.	Glands globose.	

The first examination, made when the trees come into flower, will enable the grower to fill in the third column. The second, when the foliage is fully developed, will enable him to fill in the fourth; and the size, colour, quality, and earliness of the fruit will enable him to enter his remarks at the end of the first fruit-bearing season.

By way of illustration we will refer to our amateur's notes on No. 1. His notes in March show the flowers to be small, which is quite correct; but when we come to the next column we find the leaves have round glands, and we know at once that our tree is not Royal George, as Dr. Hogg says the leaves are without glands. In No. 2 we find all the characters correct. The fruit, a little higher on one side than on the other, having a pointed nipple or beak at the apex, in every way agrees with the description, and we conclude that the name is correct.

In this way all trees with false names can be picked out the first year, and copious remarks on time of ripening, size, and character of the fruit will, in most cases, enable the grower to correct the nurseryman's mistakes.

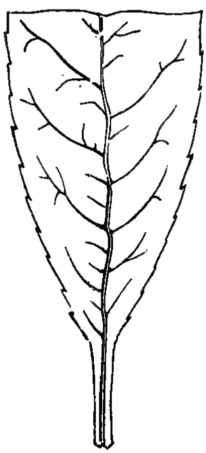


Fig. 9.—Without Glands.

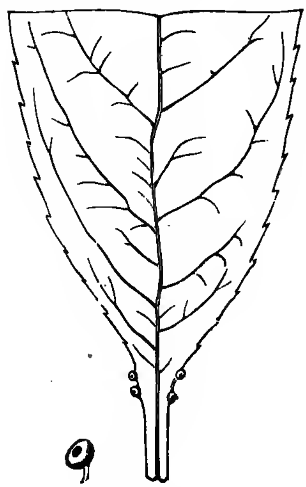


Fig. 10.—Glands Round.

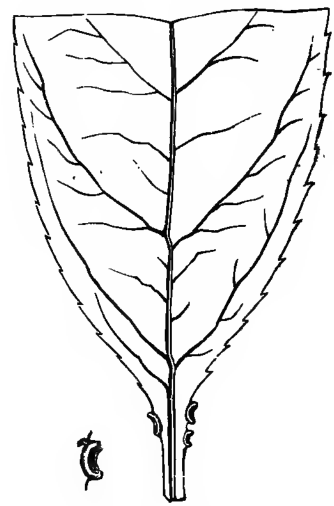


Fig. 11.—Glands Reniform.

EARLY PEACHES.

1. *Early York* (Rivers').—Medium size, marbled with red; flesh melting; flowers large.

2. *Early Silver*.—Medium size; skin dark maroon next sun; flesh melting and luscious; flowers large.

3. *Hale's Early*.—Medium size; skin suffused with crimson; flesh pale yellow and melting; flowers large.

4. *Early Grosse Mignonne*.—Medium size; skin pale red, covered with crimson dots; flesh white, veined with red; flowers large. One of the best.

5. *Abec*.—Fruit large, uneven; skin bright crimson next the sun, pale lemon in the shade; flesh tender and melting; flowers large. This and the preceding are two of the best in cultivation.

6. *Doctor Hogg*.—Fruit above medium size; skin crimson; flesh firm but melting, deeply stained with red at the stone; flowers large.

7. *Alexandra Noblesse*.—Fruit large; skin pale, flushed with pink; flesh white, rich, and melting, flowers large. Hardy, not subject to mildew.

8. *Large Early Mignonne* (Rivers').—Fruit large; skin pale lemon with crimson cheek; flesh melting, tender, and rich; flowers large; leaves with round glands.

9. *Condor*.—A large Peach raised by Rivers from Early Silver. Colour bright crimson; flavour rich and good. Early, prolific, and forces well.

10. *Waterloo.*—Very handsome and early, ripening with Alexander. Colour brilliant; flesh inclined to be tenacious.

EXTRA EARLY PEACHES.

Earliness being their chief recommendation, for description see the catalogue of any good nurseryman.

1. *Early Alfred*
2. *Early Beatrice*
3. *Early Louise*
4. *Early Rivers*
5. *Early Victoria*
6. *Early Leopold*

The drawback to these is want of size, thin watery flesh, and a tendency to revert to the clingstone character of the parents.

MID-SEASON PEACHES.

1. *Grosse Mignonne.*—Fruit large, melting, and excellent; skin greenish-yellow, mottled with red and covered with fine soft down; stone small and rough; flowers large; leaves with round glands. Excellent.

2. *Belle Beauce.*—Fruit large and flattened; skin thin, covered with fine down, highly coloured with deep red; rich and excellent; flowers large and handsome; leaves with round glands; rather shy when forced early.

3. *Dymond.*—Fruit large and handsome; skin bright crimson; flesh melting, rich, and delicious; flowers large; leaves with round glands. One of the best, and very handsome.

4. *Bellegarde.*—Fruit large, flattened, depressed at summit; skin deep purple; flesh pale yellow, rich, vinous, and juicy; flowers small; leaves with round glands. One of the best; fine for exhibition.

5. *Violette Hative.*—Fruit above medium size, round, slightly depressed; skin dark red, almost purple; flesh melting and excellent; flowers small; leaves with round glands. One of the best.

6. *Royal George.*—Fruit large, round, and depressed; skin pale in the shade, marbled with deep crimson next the sun; suture deep and broad; flesh yellowish-white, red at the stone; flowers small; leaves glandless. A grand old Peach.

7. *Stirling Castle.*—Fruit large, round, depressed; skin deep crimson; flesh white, tinged with red at the stone; flowers small; leaves with round glands. A variety of the preceding, and by some preferred, as the tree is not subject to mildew.

8. *Crimson Galande.*—Fruit large, round, and handsome; skin pale straw in shade, crimson next the sun; flesh white, tender, and melting, very red at the stone, juicy and delicious; flowers small; leaves with round glands.

9. *Magdala.*—Fruit medium-sized; skin smooth white, blotched with crimson, deep crimson next the sun; flesh green, melting, and very rich; flowers large, handsome, deeply coloured; leaves with kidney-shaped glands.

10. *Noblesse.*—Fruit large, round, with small nipple at apex; skin pale green in shade, marbled with dull red next the sun; flesh white, varied with red next the stone; flowers very large; leaves without glands.

LATE PEACHES.

1. *Barrington.*—Fruit large, round, with prominent nipple; skin downy, marbled with red next the sun; flesh firm, tinged with red at stone, rich and good; flowers large; glands round.

2. *Sea Eagle.*—Fruit very large, rather pale, high flavour, keeps a long time; succeeds Barrington; flowers large; one of the best.

3. *Nectarine Peach.*—Fruit very large, pointed at apex, nearly smooth like a Nectarine; flesh firm, rich, and melting; flowers large; one of the best.

4. *Prince of Wales.*—Fruit large and uneven; skin downy-green in shade, deep red next the sun; flesh white, tender, and rich; flowers small.

5. *Walburton, late Admirable.*—Fruit large and round; skin yellowish-green, mottled with crimson next the sun; flesh yellowish-white, juicy and rich; one of the best late Peaches.

6. *Gregory's Late.*—Fruit large, flattened; skin pale green in shade, marble with deep crimson next the sun like Royal George; flesh melting and good; flowers small, glands round.

7. *Osprey.*—Fruit very large, oblate, depressed; skin pale, tinged with crimson next the sun; flesh tender, melting, deep crimson next the stone, slightly adherent; flowers small; leaves with round glands.

8. *Desse Tardive.*—Fruit large, round, flattened; skin pale, covered with small red dots; flesh greenish-white, tinged with red next the stone, melting, juicy, and vinous; flowers small; glands globose.

9. *Raymackers.*—A large late variety, quality first-rate.

10. *Albatross* (Rivers').—Very large, and invaluable for late house. Skin pale, splashed with purple-crimson.

EARLY NECTARINES.

1. *Lord Napier.*—Fruit large; skin pale cream, mottled with red next the sun; flesh white and tender, juicy, with flavour of Stanwick; flowers large; leaves with reniforme glands; one of the best early kinds.

2. *Advance.*—Fruit medium-sized, round, with a deep suture; skin dark bronzy-green, crimson next the sun; flesh greenish-white, rich, with Stanwick flavour; flowers large; leaves without glands.

3. *Hardwicke.*—Fruit large, round; skin pale, covered with purple next the sun; flesh greenish-white, red next the stone; flowers large; glands none; a good old Nectarine.

4. *Murray.*—Fruit above medium, round, one side larger than the other; skin pale green, dark red where exposed; flesh white, rich, and melting; flowers small; an excellent variety.

5. *Downton, Improved.*—Fruit large, roundish-oval; skin pale green, crimson next the sun; flesh green, red at the stone, melting and juicy, with Stanwick flavour; flowers small; glands reniforme.

MID-SEASON NECTARINES.

1. *Elruge.*—Fruit medium-sized; skin pale, dark red next the sun; flesh pale, juicy, and rich, paler next the stone; flowers small.

2. *Stanwick Elruge.*—Fruit very large; skin green in shade, deep red when fully exposed; flesh rich and melting, with Stanwick flavour; flowers small.

3. *Violette Hative.* — Fruit large, ovate; skin yellowish-green, bright red next the sun; flesh yellowish-green, bright red next the stone; melting and very rich; flowers small.

4. *Pitmaston Orange.*—Fruit large, ovate, pointed apex; skin bright orange, brown-red next the sun; flesh deep yellow, red at the stone, juicy, rich, and excellent; flowers large; glands round; excellent.

5. *Pine-apple.*—A seedling from the above; has the same yellow flesh, and by some is considered an improvement; flowers large.

6. *Balgowan.* — Fruit very large, roundish-ovate; skin mottled with red; flesh veined with red, melting, rich and highly flavoured; flowers small; glands reniforme; a good free variety.

7. *Byron.*—Fruit large, roundish-ovate, resembling Pine-apple; skin rich orange, marked with crimson; flesh orange, rich red at the stone, and highly flavoured; flowers very large; glands reniforme.

8. *Humboldt.*—Fruit large, round, pointed at the apex; skin bright orange, slightly streaked with crimson; flesh orange, tender and juicy.

LATE NECTARINES.

1. *Albert Victor.*—Fruit very large, flattened at the crown; skin pale green in shade, mottled with red when fully exposed; flesh greenish-yellow, juicy, tender, and rich, very red next the stone; flowers small; glands round; a very fine Stanwick-flavoured Nectarine; should be well thinned.

2. *Victoria.*—Fruit large, like Stanwick, one of its parents, but is a month earlier and does not crack; skin pale green in the shade, reddish-purple where exposed; flesh white, melting, and delicious; flowers large; glands reniforme.

The following late Nectarines, imbued with the piquant Stanwick flavour, raised by Rivers, have been tested, and can be strongly recommended for the orchard house :—

1. *Chaucer*	4. *Dryden*	6. *Newton*
2. *Dante*	5. *Milton*	7. *Spenser*
3. *Darwin*		

PEACHES REMARKABLE FOR THEIR SIZE.

1. *Albatross*
2. *Lady Palmerston*
3. *Lord Palmerston*
4. *Osprey*
5. *Princess of Wales*
6. *Exquisite*
7. *Stump the World*
8. *Salwey*

As these varieties grow to an immense size, and are very handsome, they are well adapted for exhibition; but with one or two exceptions they do not come up to the mid-season kinds in quality; No. 7 has been grown 22 ounces in weight.

AQUATIC PLANTS.

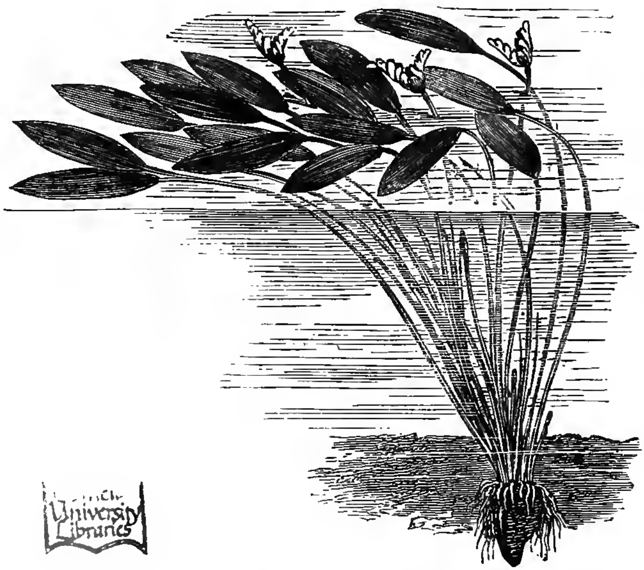
By R. Irwin Lynch.

THE OUT-DOOR AQUARIUM AND BOG-GARDEN.

THOUGH tropical aquatics are the most magnificent, the occupants of this department hold a good second place, and while yielding nothing in point of interest, have the advantage of costing considerably less. Wherever water is at command some of the most beautiful may be cultivated, and we shall show how it may be accomplished with very modest means. But with the conveniences we shall first describe, the result is much more delightful. We should provide such conditions that it is possible to suit every kind, from those which merely love constant moisture to those that flourish, as many do, just at the water's edge, and we should have water in depth from two or three inches to two feet. Deeper water is not necessary. Common garden soil will suit the majority, but it is important to have peat in different degrees of moisture. Then it is desirable to have a spongy swamp in which sphagnum will grow, and for that the free percolation of water must be secured. If sphagnum can be made to grow, there will be no trouble with some of the choicest that are sometimes troublesome. It is perhaps easiest to convey the information we wish by describing some of the best bog-gardens, pointing out at the same time their advantages.

At Kew there is a large collection of hardy aquatics. They are grown in pots, which stand as required, at various depths, in a large brick tank of water. This manner of culture is so simple that little need be said about it. Every kind is easily supplied with the soil it needs, and the right degree of moisture, or depth of water; and as the plants are confined in pots, a large collection may be grown in a small space. But there is this disadvantage, that the plants from the confinement do not so easily attain a fine development as when planted out, and there is the expense of pots, and labour of necessary shifting. The sides of the tank are raised above the ground-level, but for the sake of appearance we should prefer such a tank to be sunk in the ground.

It admits of no doubt, that where possible this class of plants, like every other, should be grown in the natural style, with room for root-development. A very fine effect may be produced, and we have seen nothing to equal the arrangement in the garden belonging to Mr. T. D. Hoey, of Newry. He has a large pond, generally oblong, but of irregular outline, into which there is a constant and large supply of clear water. All around there is every condition from mountain side to marsh, and the varied vegetation so skilfully placed renders this glen a garden paradise. Fortunately a large quantity of stone has been available, and it has been used all around where water touches, so that there is no trouble with the washing or settling down of soil, which happens more or less when there is no support. Rockwork has been carried up in various directions in order to avoid a monotonous level, and good spaces have been provided for large colonies of choice kinds just at the level that sustains the requisite amount of moisture. A path encircles this pond and its boggy sides, while against the slopes of the glen, on the other side of the path, more rockwork is continued, furnishing splendid sites for Bamboos, choice Coniferæ, and fine-flowering climbers, such as the Ayrshire Rose and Clematis. In the pond are several small islets, and one of these with *Spiræa Ulmaria fl. pl.* in flower was very fine indeed. A large Heath bed is one of the features, and among the Heather many choice plants flourish on account of the protection it affords. Many plants commonly grown on the ordinary border, were here particularly fine with an extra amount of moisture: such were *Polygonum Sieboldi*, *Hemerocallis fulva*, and *Funkia Fortunei*. Although this aquatic and bog garden is wonderfully interesting and complete, still further extension of culture has been made in another part of the establishment, and with the introduction of a new plan. In a low part of the garden is a pond, and in it islands have been formed, and peninsulas have been thrown out, of soil perhaps a foot above the water, for the culture of *Iris Kæmpferi*, *Gunnera*, and various other ornamental bog plants. In this case, the soil is confined by piles of moderate-sized tree-stems which are driven into the mud of the pond. This obviates the use of stone.



Aponogeton distachyon.

In the Cambridge Botanic Garden is an arrangement which avoids entirely the use of pots, costs little in construction, and is at the same time natural in effect. It has been found to require but little attention, as the majority when once planted take care of themselves. Once in the spring the pond and mounds are thoroughly cleaned and set in order, and afterwards an occasional weeding only is necessary. Plants are put in at almost any time except during winter. There is a pond of water sixty-four feet long, averaging twenty feet in width and two feet deep in the centre. Around the pond is a belt of grass, kept short for walking upon. In the pond are two mounds of soil, reaching to nearly the top of the water, made especially for *Pontederia cordata* and its variety *angustifolia*. Against the sides of the pond are mounds of soil, some of peat, others of loam, from nine to ten feet long, and from two to four feet wide, with a height above the water of from six to nine inches. Between the ends of the mounds, the slopes down from the edge give depths of about one foot of water, easily within reach, which are very convenient for planting small submerged aquatics, and young specimens. All around the edge of the pond, between the mounds and the turf, is a narrow space of shallow water, which forms a neat margin and a very convenient place for small floating aquatics—as, for instance, Azolla—during summer. At the further end of the pond, beyond the belt of grass, is a bed of peat, kept constantly moist by pipes. In this bed Sarracenias, Parnassias, and Pinguiculas appear to flourish well, but it has not been long established. Behind against the bank, tree-stumps have been laid, and the spaces filled in with peat, which receives a certain amount of moisture by absorption from the wet below. Here at last is a position where Ourisia takes care of itself. Soldanellas grow well, and some Primulas make surprising growth. Tree-stumps are not generally advisable for the immediate neighbourhood of choice plants; but there are some—as, for instance, *Mitchella repens*—which flourish in rotten *débris*, and this is an especial adaptation. Inside the gate is a bed of Equisetums, which grow strongly in the moist soil, but are prevented from interlacing by slate partitions. Against the fence on the inside is a border where Bamboos and Spiræas flourish, also because of the moist position. There is also a marsh bed where *Orchis latifolia* is established, and other fen plants are quite at home. This garden is surrounded by a bank, high at the farther end, sloping down to the ends in front. The washing down of soil from the mounds has not been troublesome, as the roots of the plants generally keep it up, but after four years it was found necessary to mend in some places. It may be remarked that the inlet and outlet are close together. This was unavoidable, on account of the banks, but has not been attended by any inconvenience. Conferva at first was troublesome, but a few fish—two carp and about forty silver dace—were put in as an experiment, and since then the water has been perfectly clear.

In the Botanic Garden at St. Petersburg is a very natural and satisfactory bog-garden. It is formed in a long narrow dell, prettily over-arched here and there by Birch and other trees. At one end is a series of wet beds, divided by slightly-raised paths. The water percolates from one end to the other, and ponds are formed for submerged and floating aquatics. Rustic bridges of Birch with the natural bark cross at intervals, and have an ornamental appearance. This garden may have been formed from a broad ditch, and it suggests a useful adaptation.

Lastly, we have to mention the cheapest method of culture, and one that may be adopted when there is a small supply of water, or when there is no possibility of making a pond or bog. We have our example from the Rev. H. T. Ellacombe, of Topsham, who, with little convenience, has made a speciality of these plants. He grows them in tubs, made by cutting a wine-cask in two. Paraffin-casks are very cheap, and they answer perfectly. It is safest to burn them out with a wisp of straw, though it does not seem to be absolutely necessary to do so. The manner of planting need scarcely be described. The depth of water for Nymphæas and Nuphars need not be great, as the leaves will rise above the surface instead of floating upon it. There are other good bog-gardens, for the description of which we have no space, but the methods of culture adopted are similar to those we have mentioned.

A caution is not unnecessary with regard to the introduction of plants that would become weeds, and prove difficult to eradicate.

Polygonum amphibium is an extremely pretty plant, with rosy spikes of flowers, but it spreads extensively, and should only be grown where it can be effectually confined. It will grow in water two feet deep, and upon the driest ground.

Anacharis Alsinastrum, or Water-thyme, the American weed, that has spread over the country in streams and ditches, should be omitted.

Potamogeton lucens has proved difficult of eradication, and other kinds may be equally troublesome.

Glyceria aquatica is scarcely ornamental, and as it spreads rapidly, should only be tolerated under the roughest circumstances.

Water-lilies and Typhas, indeed everything that grows strongly, should be kept within bounds immediately they have reached the desired extension. The best way is to lower the water and dig them out.

In giving a list of plants, it will be convenient to group them into two divisions: the first consisting of plants that require ponds, aquaria, or actual water surface to grow in; the second comprising those plants which thrive in bog or marshy ground. Nearly all which will be given have been successfully grown in the Cambridge collection.

OUT-DOOR AQUATIC PLANTS.

Aponogeton distachyon (the Cape Pond-weed).—So beautiful and curious as this plant is, possessing withal a delightful fragrance, it has a most indisputable claim to the praise it so often receives. It has a perennial root-stock, from which a number of floating oblong leaves arise, and among them numerous flower-stems, bearing a forked inflorescence. The flowers themselves are inconspicuous, but they have black anthers, and these contrast with the charming white bracts, which are ranged in two rows on each fork. It has the advantage of flowering in winter, and during mild weather is continually in flower. It has nowhere flourished better than in the water from an artesian well in Mr. Parker's nursery, but it is perfectly hardy, and is safe in water about eighteen inches deep. Seeds grow freely, and soon produce a large stock. A strong tuber planted in an inverted bell-glass produces a delightful result in the green-house. Mice are said to devour the roots, but this is not a common trouble. It appears to grow well in any soil. It is figured in the *Gardeners' Chronicle*, Vol. VIII., N.S., p. 649, and in Paxton's *Flower Garden*.

Another species recently cultivated is *A. spathaceum*, var. *junceum*, which is figured in the *Botanical Magazine*, t. 6399. It is much less showy, and is said to grow among grass. Figured also in the "English Flower Garden." *Naiadaceæ*.

Butomus umbellatus (the Flowering Rush).—A select water or marsh plant, commonly found in England, and quite worthy of introducing to the garden. It has three-cornered leaves, three or four feet high, and the round flower-stem bears an umbel of many reddish or rose flowers. A position open to the full sun is best, and it generally grows in a few inches of water. Europe and some parts of Asia. Flowers in June and July. *Alismaceæ*.

Calla palustris (Bog-arum).—An extremely pretty plant, with creeping stems, roundly heart-shaped leaves, and many white spathes, much like those of the Arum Lily, but smaller. It likes to be planted at the level of the water, when the stems spread in all directions, extending on the water, and creeping up the bank upon which it grows. The white spathes are very bright-looking among foliage, and the plant is an excellent one for clothing ground. As the genus is now constituted this is the only species. The plant, cultivated as *Calla occulta*, is a form of *Peltandra virginica*. Flowers in summer. Native of Europe, Siberia, and North America. *Aroideæ*. A small cut is given in the "English Flower Garden."

Comarum palustre = *Potentilla Comarum*.

Hottonia palustris (the Water-violet).—A lovely British plant, growing in ponds and ditches, which it enlivens during May and June by the most attractive display of lilac flowers, each with a yellow eye. The leaves are whorled, divided into narrow segments, and the appearance of the flower-stem rising above the water, with successive whorls of flowers, reminds one of *Primula Japonica*. It is always submerged, and sometimes grows from a considerable depth, producing candelabra-like branches of the most graceful leaves from below the flower-stems. It is found through most of Europe and West Siberia. Flowers in May and June. *Primulaceæ*.

Hydrocharis Morsus-Ranæ (the Frog-bit).—A floating water-plant, with roundly heart-shaped leaves and white flowers, appearing above the water of our ponds and ditches during the autumn months. It is a small and pretty plant, the leaves dark green or brownish in colour, and flowers nearly one inch across. The winter-buds are easily seen when they commence to grow, and they are then easily transferred to the garden. It is found in Europe and Siberia. Flowers during July and August. *Hydrocharideæ*.

Jussiæa grandiflora.—This is a fine plant where space can be afforded. The stems extend many feet, and float on the water, bearing oblong-lanceolate leaves, and large golden flowers with five petals. It is a native of Georgia and Carolina, and as it is not perhaps hardy in severe winters, some rooted pieces should be planted in pots, the hole in the bottom being stopped with clay, so that they can be kept in the green-house. (*Botanical Magazine*, t. 2122.) This plant is probably grown sometimes as *J. natans*, which differs from it, according to De Candolle, in having white flowers. Flowers in autumn. *Onagraceæ*.

Limnanthemum nymphæoides (the Fringed Buck-bean).—One of the most ornamental of British water-plants, known also as Villarsia. In Britain it is not common, but where it grows the water is sheeted with pretty foliage and bright yellow flowers. It is a perennial, and the stems rise to the surface, bearing leaves in form like those of a small Water-lily, and dappled with brown. The flowers are funnel-shaped, about an inch across, appearing in July and August. It requires no care when once established, and, indeed, often spreads considerably. In Holland the canals are often covered with its leaves and flowers. Native of Europe and Asia. Flowers in July and August. *Gentianeæ*.

Lobelia Dortmanna.—A British species, more interesting to the botanist than the horticulturist. It grows submerged in mountain lakes, with gravelly bottom. The leaves are two or three inches long, in tufts; a flower-stem twelve or eighteen inches long raises the pale lilac flowers slightly above the water. It apparently requires perfectly clear water to grow in, as the sediment deposited on the leaves in the pond of the bog-garden at Cambridge seems to prove fatal after some time. It is cultivated, however, in pots in a green-house, the hole at the bottom being stopped with clay, and with this treatment it is not difficult to manage. It is a native of Europe and North America. Flowers in July and August. *Lobeliaceæ*.

Menyanthes trifoliata (the Marsh-trefoil, or Bog-bean).—This is perhaps the most popular of British marsh-plants, its beauty and fragrance have ever been regarded with admiration, and it is one not to be omitted. The stems are stout and creeping, and when planted near water they grow down into it, and creep also on the wet ground of the bank; the leaves reach upwards about six inches, and are composed of three leaflets. The flowers are produced in racemes, and vary from white to pink. They are elegantly leaved in a manner which affords much beauty. Pieces of stem, with roots, grow easily. It is widely spread, growing in North-west India and America. Figured in the "English Flower Garden," and several botanical works. Flowers from May to July. *Gentianeæ.*

Nuphar.—The species of this genus are known as "Yellow Water-lilies," but it must be observed that there is a true Yellow Water-lily, *Nymphæa flava.* They are fine plants, and *N. advena* and *N. lutea* are splendid for the adornment of lakes and ponds, where, in company with the common Water-lily, they are almost indispensable. With the exception of *N. Kalmianum*, all are easily grown, and in planting require only that the rhizomes be firmly fixed to the bottom. Flowers are produced in summer. *Nymphæaceæ.*

N. advena.—This North American species is the finest of all. It most nearly resembles the *N. lutea* of our own waters, but the leaves are larger and with more spreading basal lobes. The flowers also are larger, though paler, but they have the advantage of orange-red stamens. It is known easily from other kinds, except *polysepalum*, by having six instead of five sepals. The leaves are massive, and of dark green hue, and as they grow out of the water a fine clump possesses a noble appearance.

N. luteum.—The more common and the handsomer of our two British species. The leaves are rotund, and grow out of the water when the plants are crowded; the flowers are two and a half inches across, with the perfume of brandy, hence probably the popular name, "Brandy-bottle;" the stamens are of the same colour as the petals, and the stigma has from ten to twenty rays, which do not extend to the margin. The variety *minor*, which grows in Chartner's Lough, Northumberland, has flowers one and a half inches across, with a wavy-margined stigma. Seedlings spring up freely, but are easily drawn out with a rake where they are not required. Europe, Asia, and North America.

N. pumilum.—This is a much smaller plant than the last. The leaves are oblong, and deeply heart-shaped with distant lobes; the flowers small, with two-edged petiole; the stigma has eight to ten rays, which extend to the margin and form sharp teeth. Europe (Britain) and North Asia.

N. Kalmianum.—Like a miniature *N. lutea.* It is the rarest of all, probably because of its liability to perish. The flowers are little more than an inch across; the petals do not exceed ten; the rays of the stigma are white, generally eight, but sometimes twelve. Mr. H. T. Ellacombe, of Clyst St. George, is the most successful cultivator of this kind. He grows it in a tub, as he does the rest of his collection. Native of North America.

Nuphar polysepalum has been introduced, and it is probably a desirable kind. The flowers are very large, and the sepals numerous. It occurs in the far West of the North United States. *N. sagittifolium*, from North Carolina southwards, must have a distinct appearance, as it has long and narrow leaves. According to Professor A. Gray, both these, perhaps, run into *N. advena.* A kind that might be obtained without difficulty is *N. sericeum*, a native of Hungary, which has the flower-stalk clothed with silvery silky hair.

Nymphæa alba.—One of the most lovely of our indigenous plants, never failing to be attractive whether wild or cultivated, and of our native water-plants it is the undisputed queen. There is more than one form wild in Britain, but the typical one is probably unsurpassed. Of the exotic varieties *candidissima* and *rubra* are the principal. The first is truly magnificent; it has flowers which even exceed a foot in diameter, and they are produced very freely. It is probably a native of Bohemia. At Chatsworth it is said to be well grown under glass, and it has been remarked that a finer development is attained in-doors; but it is perfectly hardy, and it is difficult to believe that it can be finer than we have seen it in the open air. The variety *rubra* has become famous during the last few years, and its distinctive beauty rests in the rosy colour. It was discovered in 1856 in the north-west of Oster-Gothland, Sweden, where Lake Fagertärn is the only known locality. M. Froebel finds the plant to come true from seed, but others have not been so fortunate. This is a magnificent plant, and we can scarcely say too much in its favour, and probably it may be much improved by careful selection. Other names that have been given are *N. alba*, var. *rosea*; *N. sphærocarpa*, var. *rubra*; and *N. Caspary.* A beautiful figure, truthfully coloured, is given in the *Botanical Magazine* for 1884, tab. 6736. Other varieties of *N. alba* are *intermedia* and *minor*, both natives of Germany. Ranked as distinct species and figured in the *Flora Germanica* are *N. biradiata* and *N. candida.* Both probably might be placed as varieties of *N. alba.* The first, a native of Austria, is in cultivation quite rare; the latter is a native of Bohemia, and should be found in some collections, though nothing has been heard of it for some years. *N. alba* flowers from June to August, the variety *candidissima* still later.

N. odorata.—To the qualities of *N. alba* is added in this species a delicious perfume, though the demerit that it does not flower so freely must be mentioned. The flowers open early in the morning, and close in the afternoon. The foliage is quite as beautiful as of any other hardy kind; the leaves of established plants are raised above the water, and they are light green in colour, of a shape quite distinct from its congeners, the apex of each lobe being turned slightly in the form of a sickle. It flowers in July. There is a small variety of this, called *minor*, of which there is a pretty rose-coloured form, *N. odorata*, var. *minor floribus roscis*. A lovely figure of the latter is published in the *Botanical Magazine*, 1883, t. 6708. The preceding are natives of North America. *N. nitida* is said to be a variety of this species, but according to the *Botanical Magazine* its root-stock is perpendicular, not spreading horizontally as in the present case. The flowers are white, two and a half inches across, and not scented. It is probably not hardy.

N. tuberosa.—An excellent companion for our native Water-lily and *N. odorata*, both of which at first sight it resembles; it is free-flowering, and has splendid dark green foliage, which is prone to grow out of the water. There is a figure of the flower and leaf in the *Botanical Magazine*, 1881, t. 6536. Flowers in July and August. Native of the North-eastern United States. A wonderfully beautiful form of this, with yellow flowers, lately sent out by a French raiser, is called at Kew *Tuberosa flavescens*. The raiser considers it nearer *N. alba*, and calls it *Marliacea chromatella*.

Orontium aquaticum (Golden Club).—A handsome Aroid, somewhat rare, with elliptical or oblong smooth glaucous leaves, twelve or eighteen inches long, possessing a pretty spotted scape, white just below the spadix, the lower part of which is yellow. Propagated by division, but increases slowly. Flowers in summer. Native of North America.

Peltandra virginica.—This is an Aroid without any striking beauty, though the leaves are somewhat ornamental, and it grows very easily. Its height is about two feet, in habit much like a Richardia. The leaves are sagittate, and pale green in colour. It should be planted at about the level of the water. The plant sold as *Calta occulta* has been proved in the Cambridge Botanic Garden to be a narrow-leaved variety of this. Known often as *Caladium virginicum*. Flowers in July. Native of North America.

Pontederia cordata.—This is a beautiful plant about three feet high, with lance-like bright green leaves on long stalks, and dense spikes of small blue flowers. It is the only hardy species, but there is a variety of this with narrower leaves, differing slightly in shape, called *angustifolia*. The ornamental character of the one is equal to that of the other. They are adapted for the sides of a lake or bog-pond, where they should be planted a little below the level of the water. Both are natives of North America. They flower in July. *Pontederiaceæ*.

Potentilla Comarum (*Comarum palustre*), the Marsh cinquefoil.—Though not very ornamental, this plant may be grown for its curious appearance in every collection not the smallest. It has long and woody purple-brown stems, with pale green leaves, and it bears few dull purplish-brown flowers. Planted near the level of the water it grows well, but not rapidly. The root-stock is powerfully astringent, and yields a yellow dye. It is British and European, being found also in North Asia and North America. Flowers in June. *Rosaceæ*.

Ranunculus Lingua (the Greater Spear-wort).—This is well worth growing on account of its distinct and bold habit, and fine yellow flowers two inches across. The stems grow erect to a height of about three feet, and the leaves are lanceolate, six to ten inches long. It should be planted a few inches down in the water; if planted on the ground above it soon grows down to the position recommended. Native of temperate Europe and North-west Asia. It flowers from July to September.

R. Flammula (the Lesser Spear-wort) is scarcely worth popular favour, but it grows easily without becoming a nuisance, and being of low growth, a place is easily found for it. It likes a wet place, but not in water. These Spear-worts are both British. *Ranunculaceæ*.

The Ivy-leaved Ranunculus (*R. hederaceus*) may be mentioned for very shallow water on account of its pretty foliage. The flowers are small and white. Some of the varieties of *R. aquatilis* are extremely pretty as they grow wild, but for the garden they are somewhat weedy. This species grows in the water.

Richardia africana (Arum Lily).—Few are perhaps aware that this well-known plant is perfectly hardy, but it is so if planted about a foot deep in water, and it is of course highly ornamental. It does best, however, in the milder parts of the country. Probably it would perish if not planted so deeply as to be safe from frost. Commonly known as *Calla* or *Richardia Æthiopica*. Native of the Cape. Flowers out of doors in summer. *Aroideæ*.

Rumex hydrolapathum.—The finest of our British Docks, and a noble-foliaged plant for a rough corner. It grows from three to six feet high, and has leaves one to two feet long. Should be planted where its roots can reach water. *Polygoneæ*.

Sagitaria sagittifolia (Arrow-head).—An attractive plant with arrow-shaped leaves projecting out of the water, and racemes of white flowers, with petals purplish below. It is not uncommon in English ditches and canals. Far more attractive, and even a magnificent kind, is the double variety. Its flowers are of the most delicate and pure white, more double than a Rose and perhaps as lovely. This is the most desirable of the hardy kinds. It flowers from July to September. There are several others, particularly *S. heterophylla*, a North American species, which is scarcely so pretty as our own, and *S. sinensis*, reduced now to a variety of *S. sagittifolia*. *S. sinensis* is sometimes known as *S. obtusa*. The Sagittarias should be planted in water a foot deep; they increase by means of tubers. Our British kind is a native of Europe and North Asia. *Alismaceæ*.

Saururus cernuus.—This is a curious but not very ornamental plant. It grows a foot or more high; the stems are erect, bearing heart-shaped leaves and terminal spikes of small flowers, that have occasioned the popular term "Lizard's-tail." A native of North America, in marshes. *S. Loureiri* is more ornamental than the above; it has broader leaves, and the upper one, beneath the spikes of whitish flowers, is white, veined with green. Native of Northern China. Both these require to be planted at the water's edge. They flower in August and September. *Saururaceæ*.

STRATIOTES ALOIDES.

Scirpus lacustris (Bulrush).—A fine plant for lakes and ponds. The stems are round, four to eight feet high, resembling those of an immense Juncus; they are not collected in tufts, but rise from creeping rhizomes, erect or gently curved. A large group of them is very effective. Should be planted a foot or more deep in water. British, and widely spread in temperate and many tropical regions.

Scirpus Tabernæmontani, var. *zebrinus*.—This is the Banded Rush introduced a few years ago, and erroneously known until recently as *Juncus zebrinus*. It is a striking and curious plant on account of the transverse bands of white on the stem, constituting a variegation which appears to stand well. The stems, unfortunately, are often weak and bend over about the middle. The species is British, but this form came from Japan. Prefers peat. It is quite hardy. *Cyperaceæ*.

Sium latifolium (Water-parsnip).—This is one of the finest of our native Umbellifers, not common in the Fens, and found rarely elsewhere. It grows five or six feet high. The first or radical leaves are handsomely fern-like; they disappear as the stems grow up, upon which the leaves are pinnate, with leaflets four or six inches long. The flowers are white, and are very attractive to the Musk-beetle. It requires to be planted close to the water's edge. It is rarely grown, but is one of the handsomest foliage-plants in the Cambridge bog-garden. Flowers in July and August. Native of Europe, Asia, and North America.

Sparganium ramosum.—A Flag-like plant with erect leaves two to five feet high, not highly ornamental, but worth planting in rough ponds or lakes. It spreads considerably, and should only be planted where its increase is of no consequence, or where it can be confined. The globose heads of fruit are curious. *S. simplex* is rather a pretty plant in flower, much smaller than the last, and not so strong in its habit. May be safely planted. Both are British, and they flower in June and July. Natives of Europe, Asia, and North America. *Typhaceæ*.

Stratiotes aloides (Water-soldier).—The most exclusive lover of showy plants could scarcely refuse this on account of its singular character. It forms rosettes of narrow serrated olive-green leaves about a foot long, and these are anchored to the bottom by means of long roots; they rise to the surface to flower in summer, but sink again afterwards. Clear water is best for the beauty of this plant, as otherwise sediment is deposited on the leaves. In a greenhouse tank we have seen very attractive specimens. It increases itself by offsets, but is not always easy to establish, though sometimes it increases rapidly. It grows chiefly in the East of England, in fen ditches, and is a native of Europe and Siberia. The flowers are white, but not attractive. June to August. *Hydrocharideæ.*

TYPHA LATIFOLIA.

Typha (Reed-mace, Bulrush).—*T. latifolia* is the common Bulrush, of which the cylindrical brown spikes are often prized for room decoration, associated with Pampas-grass and similar dry ornaments. It is an extremely ornamental subject for ponds, where the tall waving leaves afford a distinct and pleasing effect. The leaves grow from a creeping rhizome in two opposite rows, they are an inch or more broad, and three to six feet long. The spike-bearing stems about equal the leaves in length, and the spikes are from six inches to a foot long. *T. angustifolia* is a beautiful kind not unlike this, but perhaps more graceful, being narrower in all its parts. The leaves do not exceed three-quarters of an inch in diameter. *T. minima* is an interesting kind in comparison with these on account of its diminutive size, and may be grown in complete collections. Reputedly distinct kinds are grown as *intermedia* and *stenophylla*, and lately we have received *T. Shuttleworthii*, an ally of *T. latifolia*, but distinct. All *Typhas*, except *T. minima*, grow without care; the rhizomes merely require to be fixed in the mud of a pond, in water a foot or more deep. They spread considerably, and clumps should be kept within bounds, or great masses may have to be removed at considerable expense. The rhizomes are not easily taken up without draining the pond in which they grow. The first two species are British, extending from Europe to North Africa, Asia, and North America. *Typhaceæ.*

Utricularia vulgaris (Greater Bladder-wort).—All the kinds of *Utricularia* are curious and interesting, but of those that are hardy this is the most usually cultivated. It has submerged floating stems and leaves, with flower-stalks rising above the water. The leaves are ovate, much divided into fine segments, and upon them are borne numerous shortly-stalked tiny bladders, which serve to catch minute aquatic animals, for the purpose of absorbing the products of their decay, so that this plant, like its ally the Butter-wort, is insectivorous, although by very different but extremely interesting means. The flowers are yellow and somewhat Snapdragon-like. If stems of this plant are broken and brought in from the wild, they are usually very difficult to establish. The proper plan is to raise from seeds, or to secure those hybernaculæ, or buds, which remain dormant during winter and start fresh plants in the spring. These are formed at the ends of the branches in autumn. Flowers in July and August. Native of Europe (Britain), North Africa, Siberia, and North America. *Lentibulariaceæ.*

Villarsia nymphæoides = Limnanthemum.

Zizania aquatica (Canada Rice).—This grass, when planted in or close to water, produces fine masses of bright green leaves, but it is of little ornamental worth, and is only of interest on account of its enormous value in North America, where the seeds have contributed essentially to the support of Indian tribes, and feed immense flocks of waterfowl. It has grown for several years in the Cambridge Botanic Garden, but has never flowered. Trials of its economic value have also been made in this country, but without success. Pieces of the plant are easily imported if taken up just as growth commences, packed in damp moss, and sent by post; but seeds always fail, as they lose vitality when dry.

THE ROSE AND ITS CULTURE.

By D. T. Fish.

GARDEN ROSES.

"There [in the garden] will we make our beds of Roses
And a thousand fragrant posies."

In these days, when so many Roses seem only grown for cutting, either for showing or decoration, it is refreshing to cite Shakespeare's reverence for the Rose as seen in Othello's sensible plea for its being enjoyed to the full in the garden, on the tree:

"When I have plucked the Rose,
I cannot give it vital breath again.
It needs must wither. I'll smell it on the tree."

So far as possible, then, we shall see that our garden Roses are worth smelling. Some will, perhaps, be chosen for other reasons, but fragrance shall be one of our chief grounds of selection. It may be doubted, however, whether Shakespeare's dictum—

"That which we call a Rose,
By any other name would smell as sweet,"

is quite tenable. But it is certain that a Rose without fragrance is hardly more than half a Rose at best, and about as poor as a garden without Roses, were such an anomaly possible nowadays.

Next to fragrance, age should distinguish true and real garden Roses. None need be excluded because they are new, but many may and ought to find a place because they are old. The older Roses, such as the old Moss, the Maiden's Blush, Rosa Mundi, and Village Maid, the Cabbage, the York and Lancaster, are not only brimful of fragrance, but overflowing with sentiment. How many Corisandes have had their life-history determined, their fate sealed, by the gift of one of these simple Roses! What records of fact, what fairy webs of fancy could these old-fashioned Roses unfold, could the loves as well as the wars of the Roses be faithfully chronicled! How strangely blended, how delightfully mixed, the human and floral become in the romance of the older Roses, as we read—

"Their lips were four red Roses on a stalk,
Which in their summer beauty kissed each other."
(*Richard III.*)

Vigour of constitution is the third point to be considered in the selection of veritable garden Roses. Unfortunately, as in other matters, so among Roses, quality has often been obtained at the sacrifice of constitution. Not a few of the finest show Roses are miffy growers, and have little or no fragrance. Our fathers planted Roses as they did their Apples and Oaks, once in their lives, or even for their children. We moderns have to plant them annually.

By hieing back to the older, hardier varieties as much as may be, and selecting those characterised by vigour and staying power from among the newer varieties, the lives of garden Roses may be extended to the ancient limits. It is an additional pleasure not only to be able to gather the same Roses, but to be able to enjoy them on the same plant for a series of years, or a lifetime. A judicious selection of old and new Roses of vigorous constitution for the garden, should place this pleasure within reach of every reader.

Profusion of bloom and brilliance of colour should also characterise garden Roses. In this connection, the mere perfection of single blooms is of far less moment than the broad and striking effects that result from the massing together of multitudes of smaller flowers, either single or in clusters. Not a few of the Roses selected for the garden will be almost good enough for exhibition. But even these will not be chosen on that account, but for other, and what may be conveniently called garden qualities; while the majority of those included in our rather extensive list of garden Roses, would make but poor show Roses, and prove all the more effective in the garden for that reason.

Provence and Damask Roses.—Bearing in mind these brief rules of selection, the old Cabbage or Provence Rose shall lead off our list of garden Roses. All the Rosarians will rejoice if this prominence will increase its waning popularity, and bring it back by thousands and tens of thousands to our gardens. Hardly any Rose is more full of colour or of fragrance. It is said that the fulness and form of its overlapping petals gained for it the unrose-like name of the Cabbage. One of the most popular authors on Roses delegates Cabbage—that is, the name, not the Rose—to the pigs, and gets enthusiastic over its other name, Provence, though its claim to the latter name is of almost equally doubtful origin.

Botanically this fine rosy-pink Rose forms the basis of the species *Rosa centifolia*, or Hundred-leaved, a very suitable name. Old as it is, it has not been fruitful of varieties. The Crested, or *cristata*, is rather larger and fuller than the original, and the edges of the petals are paler than the rosy centre.

Striped Unique is a variable Rose, sometimes coming almost pure white, at others broadly striped with lake.

White Provence is an old, large, pure white Rose, and may almost be called a Moss Rose in the first stage of evolution.

Adrienne de Cordoville has beautifully cupped flowers, of a deeper shade of rose than the common Cabbage.

The *York and Lancaster Rose*, though often included among Damask Roses, is evidently a semi-double variety of the Provence. This Rose is probably the oldest we have, and is well described by Shakespeare thus—

> "I have seen Roses damasked red and white,
> But no such Roses see I in her cheek."

It is one of the sweetest and most interesting of Roses. Its inconstancy greatly enhances the interest. It is generally described as white, striped with red. This is quite wrong, and should be reversed. In nineteen examples out of twenty red forms the ground-colour, and the white is splashed on irregularly. There is also a red self Provence, which is probably a reversion to the primitive type, or the original Rose from which the York and Lancaster may have sprung. Tradition, however, has it that the Rose was originally white.

Rosa mundi is a Rose so much like the York and Lancaster that it has often been confounded with it.

Belle des Jardins has conspicuous white stripes on a bright crimson ground.

George Vibert.—Purple, with white bands.

Montalembert.—White carmine bands or stripes on a lilac ground.

Meeene.—Rose stripes on a white ground.

Several of these striped Roses are mostly classed with what are called the Damask, or Gallica Roses. These, however, are so closely related to the Provence that it is hardly worth while distinguishing between them.

Perle des Panachées is one of the most delicate and chaste of all the striped Roses, having delicate blush stripes on a white ground.

Madame Soëtmans.—Creamy-white.

Village Maid is another Rose of great delicacy and beauty, the rose-coloured stripes on a white ground varying much in breadth.

Leda, or *Painted Damask.*—Bluish or lead-coloured margined with lake, very beautiful.

Parfait.—Bright red, striped with lilac and purple.

Madame Hardy.—Pure white, and a most profuse bloomer.

Blanchefleur.—White, suffused with rose.

Duchess of Orleans.—This is one of the most chaste and wax-like of all garden Roses.

Maiden's Blush.—Pale flesh with darker blush centre.

But the older Damask, Gallica, or French Roses were as unlike as can well be to these garish though beautiful varieties. They were mostly red, dark purple, almost black selfs of the *Rose du Roi* type, almost now unseen in private gardens, and unknown to the trade. It was, however, of these that Shakespeare wrote—

> "Flowers as sweet as Damask Roses,"

and—

> "For ladies masked are Roses in their buds;
> Dismasked, their damask sweet commixture shown,
> Are angels' veiling clouds, or Roses blown."

These brilliant, sweet, often little better than single, or semi-double varieties, and the Provence Roses already noted, were much valued for their brightness and fragrance, and very generally distilled into Rose-water, in those olden times when even ladies of title condescended to make their own Rose-water, and other sweets. Among the finer representatives of these Roses in the brilliancy of their colouring still surviving are such grand old sorts as—

Kean. — A rich velvety-purple Rose, with the centre glowing into crimson-scarlet.

Ohl.—Violet-purple, brightening into fiery-red in the middle.

Triomphe de Janssens.—Rich rosy-crimson, beautifully cupped.

Boule de Nanteuil.—One of the largest, fullest, and most brilliant of all Roses, rich velvety-crimson.

D'Aguesseau.—Brilliant crimson.

La Volupté.—This is among the most beautiful of all rosy-lilac Roses.

The double yellow Cabbage, or Provence Rose, should also be mentioned here. It resembles these Roses in many respects, though it is often classed by itself as *Rosa sulphurea.* This is one of the most beautiful and fragrant of all Roses, and is said to be a native of Persia, though it is as unlike as any Rose could well be to the Austrian Briars, or Persian Roses. As it, however, seldom or never opens its flowers well, or develops a perfect one, one plant will be sufficient for most gardens.

There is a class of dwarf, or miniature Provence Roses, admirably adapted for small gardens, and useful as edgings or for planting towards the sides of beds or borders in larger ones. Of these the White and Red Burgundy, De Meaux, and Spong are the best. There is also a mossed variety of the De Meaux, and a darker, equally dwarf moss, named Little Gem. These dwarf Roses are but little grown in this country. They are, however, extensively cultivated in France and other parts of the Continent, and their tiny sweet flowers bunched up into large bouquets form a striking and a novel feature in the flower-markets near the Madeleine and other parts of Paris.

Moss Roses.—Science has by no means settled the question of how the Roses got their mossy appendages. Writing broadly, Moss Roses may be described as Provence or Gallica Roses, or hybrids of these, with the mossy addition. History also has it that the Moss Roses were sports from the Crested Cabbage or White Unique, the latter of which shows a tendency to manufacture or develop moss from the semi-infinitude of its partially-suppressed prickles.

But fable comes to the aid of science in this matter, and this is one of the very few instances in which the fable is better than the science:—

> The angel of the flowers one day
> Beneath a Rose-bush sleeping lay,
> That spirit to whom charge is given
> To bathe young buds in dews of heaven.
>
> Awaking from his light repose,
> The angel whispers to the Rose,
> "Thou loveliest object of my care,
> Still fairest found where all so fair,
> For the sweet shade thou'st given me
> Ask what thou wilt, 'tis granted thee."
>
> Then said the Rose, with deeper glow,
> "On me another grace bestow."
> The angel paused in silent thought—
> "What grace is there this flower has not?"
>
> 'Twas but a moment; o'er the Rose
> A veil of moss the angel throws.
> Thus robed in Nature's simplest weed,
> Can there a flower the Rose exceed?

Scientifically, the first step towards a mossy covering may be seen in such Roses as the White Unique and the Crested Cabbage. The enlarged calyx of the latter seems a step, and a long step, towards the evolution of rudimentary mossiness. Be that, however, as it may, there can be no doubt that the moss adds a new charm to the Rose, and hence the universal popularity of Moss Roses, especially in bud, in which stage the moss is most prominent, half veiling while more sweetly revealing their exquisite beauty.

The Moss are pre-eminently garden Roses, and universally popular. The common or pink Moss is still one of the best in itself, and is held in semi-veneration by most lovers of Roses for its rich and tender associations.

The Old White Bath still holds its own as one of the best white Moss Roses, fit to run abreast of the common or pale pink Moss; though Reine Blanche, the New White Moss, and Panachée Pleine, the latter occasionally exhibiting a pink petal among the white, run the White Bath rather hard.

Moss cristata, or Crested, has a prodigality of moss, almost completely covering the buds, and heavily fringing the petioles of the leaves.

Celina is one of the best, with deeper-coloured flowers than the Cabbage.

Angélique Quetier.—Rosy-lilac, exquisite in bud.

Laneii.—Bright crimson and purple, bold buds, profusely mossed, and fine foliage, that several Moss Roses are rather deficient in. The Crimson or

THE PURPLE-STAINED LÆLIA (LÆLIA PURPURATA).

A magnificent stove Epiphyte from St. Catherine's in Brazil, belonging to the order of Orchids. The pseudobulbs are oblong, and produce at their end a narrow oblong blunt leaf, as broad at one end as the other, about eight inches long, and deeply notched at the point. In the axil of the leaf comes a compressed pale green spathe fully three inches long, and much like that of *Cattleya labiata.* The peduncle which appears from within this is stout, deep-green, and two-flowered. The flowers are rather more than six inches from the tips of the petals. Sepals and petals pure white; the former linear-lanceolate, rolled back at the edge towards the base and thus appearing unguiculate; the latter three times as broad, ovate-oblong, obtuse, wavy. The lip is three inches long, rolled round the column, with a much-rounded point from which the rounded lateral lobes are hardly distinguishable; it is yellow in the middle towards the base and streaked with crimson, but the limb is of the deepest and richest purple, diminishing in intensity towards the edge.

THE PURPLE-STAINED LÆLIA.
(LÆLIA PURPURATA.)

Damask Moss has also fine leaves, and is heavily mossed.

Baronne de Wassenaer. — Bright rose, semi-double flowering in character.

Etna.—Brilliant crimson, large and free.

Luxembourg.—Deep crimson.

Princess Royal.—Rosy-pink, large and full.

Gloire des Mousseuses.—One of the most showy and delicate, pale rose, edged with blush, well mossed.

There are many other Moss Roses, but the above form a good collection, and full representation of the best Moss Roses.

Like the Provence or Damask Roses, however, these bloom but once in the summer. The Perpetual-flowering or Hybrid Moss Roses prolong the supply through the autumnal months, and thus indefinitely extend the season of Moss Roses.

Singularly enough, few of these are so heavily clad with moss as their summer-blooming progenitors; the mixture of the Hybrid Perpetual, Bourbon, or other blood that endowed them with the power of continuous or autumnal blooming, having apparently washed off or out some of the mossiness in the process. It is much, however, to have Moss Roses in the autumn, albeit the verdant veil is thinner in most of them.

Perpetual White Moss.—This is the most heavily mossed of all the autumnal flowerers, pure white, blooming in clusters.

Salet, one of the best, is most vigorous, bright rose-coloured, with black edges.

Madame Edouard Ory.—One of the freest-flowering, large full flowers, bright crimson.

Madame William Paul.—Light rose, free-flowering, vigorous.

Eugénie Verdier.—Rich crimson, centres of flowers a deeper shade ; good form, and vigorous.

Alfred de Dalmas.—Chaste moss, blooming in clusters ; rose, petals edged with white.

James Veitch.—One of the richest dark perpetual Moss Roses; violet, shaded crimson.

Eugénie Guinnoiseau.—Cerise and violet, vigorous.

Madame Supert.—Rich red, richly mossed.

Mousseline.—Almost white, shaded puce.

Perpetual White or *Quatre Saisons Blanche.*

Sweet-briar or Eglantine.—It may seem a far leap from Moss Roses to the Sweet-briar. But the latter still holds its own as one of the most welcome and the sweetest of all the Roses in the garden. No garden, large or small, can be fully furnished with Roses unless it contains several plants or groups of Sweet-briar, or better still, when practicable, a hedge of it, to enclose and protect all the others.

The common Sweet-briar, with its light green fragrant leaves, and brilliant pink flowers, is too well known to need further description. It is, however, less generally known that there are different varieties of Sweet-briar, varying in colour from pure white to fiery-red. There are also several cultivated sorts, though rare, and among them a so-called Double Scarlet and Double White. *Splendens* is also much brighter in colour than the wild variety. *Celestial* has delicate pale pink flowers. *Purple-red* is several shades brighter than those of the common Sweet-briar, *Rosa rubiginosa.* Of this there are as many as half a dozen or more varieties, varying considerably in size of foliage, number and length of prickles, and size and colour of flowers. Among these Celestial, Splendens, Scarlet, and the Double White and Scarlet are the best.

Independently of the profusion and brilliancy of the flowers of the Sweet-briar, and the unrivalled and unequalled fragrance of its leaves, it deserves a place in every garden as one of the most brilliant-berried, or rather fruited plants. Loaded with bright coral hips, which hang for months if not destroyed by birds, the Sweet-briar lights up the garden with a glow of brightness and beauty throughout the autumn and early winter months that few other plants can equal, none excel.

Closely related to the Sweet-briar botanically, though differing widely in the nauseous scent, are the so-called Austrian Briars, or Persian Yellow Roses, *Rosea lutea.* The Single Yellow is a native of Germany, and has been sometimes called the Yellow Eglantine. The flowers are single, and of a bright primrose colour.

The Copper-coloured is of a reddish-brown hue, unique among Roses or other flowers, and closely resembles the Yellow, unless in the colour of ths flowers, and the deeper semi-chocolate hue of its wood.

The Persian Yellow is of more vigorous habit than either of these, and has large blooms of the deepest yellow.

Double Yellow (*Williams'*).—This is said to be a seedling, and is by far the best of its class, being a full, double Rose, of a bright yellow colour.

Harrisonii, though classed with these Roses, is widely different, alike in leaf and flower. It is also fragrant—a sort of soft primrose, somewhat in harmony with the fluffy and canary-like character and colour of the blooms, while the scent of the others is either *nil* or positively offensive. The growth is also weaker, the flowers smaller, and it blooms earlier, and in greater profusion. Hence, in small gardens, where there is room for but one Rose of this class, *Harrisonii* should be that one.

Scotch Roses. — Another class of garden Roses that are much neglected in England, are very generally grown in Scotland. This is well named the *Rosa* *spinosissima*, or Scotch Rose. It is a native of Scotland, and defended by thorns to an extent out of all proportion to the size and value of its individual blooms. They flower early, however, and in wonderful profusion, and as the leaves are small, the plants dwarf, the habit of the plants compact, and the tiny balls of flowers, mostly double, stand up clear of the pretty foliage, masses or hedges of them have a very attractive and unrose-like appearance, and their fragrance is almost as unique as their appearance.

As they are scarcely grown by the trade in England, those who wish to grow them, can hardly do better than order by their colours through any of the Scotch nurserymen; they can be had in red, white, purple, blush, pink, yellow, and other shades of colour almost to any extent, and are so different and distinct from all other Roses that few or many, according to area, should find a place in every garden or shrubbery. There are at least two varieties of these Roses that bloom in the autumn, and more or less throughout the year. One is the Perpetual Scotch, with pale blush, rather large double flowers for this class of Rose. The Stanwell Perpetual is, however, far superior to this. The flowers are better formed, with more of pink in them, and are deliciously fragrant. These useful varieties are obviously Hybrids, and judging by the odours—rich and full of the latter—probably from the Provence or Damask Rose. In gaining semi-perpetuity of blooming, the flowers have become larger, which is no advantage to this class of Rose. The Stanwell possesses the additional merit of being one of the very few hardy Roses that bloom in May.

Monthly or **China Roses.**—The old Monthly or China Roses, with the various additions that have been made to them, are also among the most useful and showy of all garden Roses. And the crimson, blush, and French white varieties are still among the very best, either for bed or border. The green variety is curious in foliage and general character: it is the exact counterpart of the Pink Monthly, but the whole Rose consists of an enlarged green calyx, which has the mild odour of this class of Rose.

The White or *Alba* is also comparatively rare; Clara Sylvain and Duchess being great improvements on the White Monthly China, though scarcely so hardy.

Archduke Charles is also nearly white when in bud, growing in colour as it expands, till it reaches to a semi-crimson hue, before fading.

Eugéne Hardy.—White, with pale-coloured centre.

Duchess of Kent.—Creamy-white, edged with rose.

Madame Bureau.—White, and changing to lemon in centre.

Among the more brilliant of the Chinese Roses, the following are some of the best:—

Cramoisie Supérieure does well in the open air in a warm situation; fiery-crimson; exquisite in the bud.

Fabvier.—A hardier Rose than the foregoing, of the most dazzling crimson-scarlet.

Prince Charles.—Brilliant crimson; a much fuller Rose than either of the preceding ones.

Louis Philippe.—Dark crimson, edged with white; strikingly beautiful.

Cramoisie Eblouissante—Fiery-crimson.

Henry V.—Crimson-scarlet, fringed with white.

American Banner.—A striking variety with magenta stripes, on a yellowish-white ground.

James Sprunt.—A climbing sport of *Cramoisie Supérieure*, with all the merits, and more than the vigour of that variety.

The *Lawrenceana*, or Fairy Roses, are miniature editions of the common China, rising to a stature of from six to nine inches. There are from four to six varieties in the trade, including a white, two or more shades of crimson, and several of pink. They look well in small groups or patches, but better as edgings to the dwarf, Moss, and Provence Roses, such as De Meaux, Spong, &c.

Bourbon Roses.—The great and useful class of Bourbon Roses furnishes the garden with many of its most useful autumnal-blooming varieties. Contrasted with other classes, these Roses lack sweetness, though the first five in the following list are fragrant, as well as otherwise desirable:—

Acidalie.—White and blush, full and fine form.

Bouquet de Flore.—Large, double, beautifully cupped, carmine.

Mrs. Bosanquet.—Soft white, with delicate flesh centres; very profuse bloom, distinct and beautiful.

Queen of Bourbons.—Unique and chaste, salmon, tinged with buff; most floriferous.

Souchet.—Rosy-purple, deepening into crimson; large, full, and good.

Armosa.—Rich pink; capital sort for massing.

Beauté de Seduisante.—Pink, large and fine.

Dupetit-Thours.—Brilliant crimson; it sometimes fails to open fully and freely.

Empress Eugénie.—Rosy-blush, cupped.

Madame Angelina.—A rich mixture of cream and salmon; very striking.

Baronne de Maynard.—Pure white; excellent.

Madame Desprez.—Rose and lilac, large clusters.

Marquis Balbiano.—Rose, tinged with lilac.

Paul Joseph.—Purplish-crimson.

Prince Albert.—A double crimson Rose, blooming freely in clusters.

Queen of Bedders.—Dark crimson. One of the best.

Reine Victoria.—Bright pink.

Setina.—Pink; fine.

Sir Joseph Paxton. — Bright rose, shaded with crimson.

Souvenir de Malmaison.—This is in many respects the finest and most distinct of all the Bourbon Roses. It is nearly white, with a blush of flesh-colour in the centre of the flowers; exquisite in bud, which is long, the petals being thick and full of substance. Often malformed in the early summer months, the buds and flowers grow more perfect as the season advances, until throughout the autumn and early winter it becomes one of the most useful and beautiful of Roses.

In striking contrast to this is the brilliant, rather new Bourbon Rose, Queen of Bedders, of compact habit and colour, so brilliant as to have been compared to the richest-coloured of all Roses, Charles Lefebvre.

Noisettes.—The following are among the very best for the garden:—

Aimée Vibert.—Pure white, most profuse; the gem of the garden.

Of this, there is also a variegated-leaved variety, rather rare, and a stronger grower, known in the trade as Aimée Vibert Scandens.

Céline Forestier.—Soft sulphur, flowering in clusters; beautiful in bud.

Du Luxembourg.—Large and double, lilac.

Fellenberg.—Bright crimson; one of the brightest and best of Noisette Roses.

Miss Glegg.—Pure white and flesh, in small clusters, in the way of Aimée Vibert.

Pumila alba.—Dwarf; very floriferous.

Triomphe de Ducher.—Pale rose, large clusters.

Unique Jaune.—Coppery-yellow; vigorous.

There are many other fine Noisettes, but most of them will find a place among our wall Roses, as they are somewhat tender. Some of the most valuable of garden Roses are, however, found among Hybrid Bourbons, Noisettes, and Chinese Roses.

Among those deserving a place in every garden are:—

Abbé Gerardin.—Chaste, light rose.

Baronne Gonella.—Bright rose, exquisite in form and arrangement; one of the best.

Reine Victoria.—Bright pink; a fine Rose.

Baronne de Maynard.—A pure white, perpetual-flowering Bourbon, of great excellence.

Madame Plantier. — This well-known, most floriferous, fine white Rose, is still one of the best of all for the garden.

Madeleine is another white Rose, edged with crimson.

The Rev. H. Dombrain.—Bright carmine.

Beauty of Billiard.—Brilliant scarlet; a favourite old Rose of the Hybrid Chinas.

Blairii No. 2.—Large, double, blush-pink.

Chénédolé.—Light vermilion; capital grower; one of the most showy of the old Roses.

Brennus.—Light carmine, beautifully cupped; fine foliage.

Miss Ingram.—Delicate blush-white, and globular; good.

William Allen Richardson.—Rich orange-yellow; striking.

Fulgens.—Very bright crimson.

Coupe d'Hébé.—One of the most exquisitely-formed of all pink Roses.

Chas. Duval.—Deep pink, large and full.

Paul Verdier.—Light carmine, fine form.

Madame Barriot.—Light rose, large and fine.

Vivid.—Brilliant crimson.

Paul Perras.—Rich rose; very double.

Chas. Lawson.—Almost equal to *Coupe d'Hébé*, and a good deal like it, but a darker pink.

Paul Rieaut.—Rich rosy-crimson, very full.

Among *Albas*, or White Roses, as they are called, the following are perhaps the best:—

Félicité (Parmentier).—Rosy flesh-colour with white margins.

Blush Hip.—Delicate blush, with flesh-coloured centres.

La Séduisante.—Deep rose and full.

Queen of Denmark.—Rosy-pink, with paler margins.

Several other classes of Roses, such as the Ayrshire, Evergreen, Banksia, Musk, &c., are referred to elsewhere.

Tea Roses.—Among these we find some of the most valuable of all garden Roses. First and foremost among them is *Gloire de Dijon.* This is hardier than the common China Monthly, and at once the hardiest and best of all the Tea Roses. It is also the most popular, and the most generally grown. The merest novice in gardening must be familiar with that rich mixture of yellow, buff, orange, and salmon, that sweetly glide and softly flow into each other in this beautiful and fragrant Rose. The Pink Glory, as it has been called, or more correctly *Gloire de Bordeaux*, is a stronger grower of a deep pink colour, especially in late autumn.

Maréchal Niel is not only magnificent under glass or on a warm wall, but forms a charming weeping standard in the open, and is the most magnificent and fragrant of all garden Roses.

Homere.—Blush, mottled, deeper-coloured centre; fine, especially in the autumn.

Bougere.—Light pink; very hardy.

President.—Rich rosy-salmon.

Safrano.—Bright apricot in bud, changing to fawn when open; best in bud; hardy and fine-flowering.

Vicomtesse de Cazes.—One of the oldest and hardiest of the Teas; yellow shaded with copper.

Souvenir d'un Ami.—Large and fine bright rose.

Triomphe de Guillot fils.—Large, fragrant; colour a rich mixture of fawn and salmon.

Sombreuil.—Cream fading into blush-rose.

Devoniensis.—Rich mixture of rose and creamy-white; exquisite form and delightful fragrance.

Climbing Devoniensis.—Equally good but hardier, more vigorous, and a real climber.

Comtesse de Nadaillac.—Very vigorous, fine globular form, and a rich apricot-colour.

Letty Coles.—Rosy-carmine.

Madame Furtado.—Soft sulphur.

Madame Trifle and *Madame Levet* partake to a great extent of the character and colour of Gloire de Dijon, though neither of them is better, if equal to it.

Perfection de Monplaisir.—Bright canary-yellow, soft and rich.

Madame de St. Joseph.—Rich salmon-pink.

Madame Lambard.—Bright rose.

Madame Berard.—Rich light salmon.

Madame Falcot.—Hardy, good in bud, with good perpetual-flowering properties.

Alba Rosea.—White with rose centre; very fine.

The Cheshunt Hybrid is so different from other Teas that it has formed the basis of a separate class, that of Hybrid Teas. It also stands at almost the head of the list among garden Roses. The following are excellent in this class:—

Miss May Paul.—A mixture of red and lilac; a welcome addition to the class.

Madame Supert should also be classed with these; a white seedling from Gloire de Dijon.

Cannes la Coquette.—Light salmony-pink; something in the way of La France; higher praise is impossible.

Madame Etienne Levet.—Deep crimson; flowering freely.

Reine Marie Henriette.—Deep carmine; with long pointed bud.

Reine Olga de Wurtemberg.—Round, red; very luxuriant.

Camoëns —Bright-coloured, of the China type; fine, flowering beautifully in beds.

To this section will probably be added several of Mr. Bennet's pedigree Roses, as *Her Majesty*. In form, size and substance, this Rose is all that could be desired. The colour is a waxy-pink, something like La France. It has also been described as half-way in colour between Captain Christy and Baroness Rothschild. The foliage is fine, and the habit vigorous. This hybrid is likely to take a high place alike in the garden and on the exhibition table.

Lady Mary Fitzwilliam is a soft rose-coloured novelty of free growth. This may also become a good garden variety.

Distinction.—Soft peach, rich and good.

Princess of Wales.—Delicate flesh; fine form.

There are many more Tea and other Roses seen or grown by the writer that promise well, but it will be safer to test them by experience before recommending them as garden Roses.

Hybrid Perpetuals.—The great family of Hybrid Perpetual Roses might be taken into the garden bodily to its manifest improvement. Still, not a few of those best for the garden are useless for exhibition, and to some extent *vice versâ*. Hence, while varieties may be included in the following list that may at times be found in winning stands, the majority are chiefly distinguished by vigour of constitution, profusion of flower, and effectiveness on the plants, or as cut flowers for decorative purposes.

Abbé Bramerel—deep crimson; strong.
Admiral Nelson — brilliant red.
Anna Alexieff—bright clear rose; strong grower.
Anna de Diesbach—bright rose; vigorous.
Annie Laxton—rosy-crimson; good.
Auguste Mie—soft satiny-pink.
Baronne Adolphe de Rothschild—red, very brilliant.
Baronne Prévost—probably the finest and hardiest bright rose-coloured garden perpetual Rose in existence; a vigorous grower and profuse bloomer.
Beauty of Waltham—rich rosy-carmine.
Belle de Bourg la Reine—glossy rose; vigorous.
Brightness of Cheshunt—very vivid red.
Caroline de Sansal—deep pink.
Charles Darwin—dark crimson.
Charles Margottin — brilliant carmine.
Comtesse de Mortemart—rose; very fragrant.
Dean of Windsor—rich vermilion.
Duc de Cazes—dark purple.
Duchess of Connaught—a very bright, showy, brilliant red Rose, raised by Mr. Noble, and sent out in 1880.
Duchess of Norfolk—deep crimson.
Duchess of Sutherland—soft pink
Edouard Morren — very bright rose.
Eugène Appert — velvety-crimson.
Firebrand—rich fiery-crimson.
Fisher Holmes — brilliant red.
Géant des Batailles — still one of the most brilliant and useful of all red garden Roses.
General Jacqueminot—dazzling red. This is to red Roses what such fine varieties as Baronne Prévost are to rose-coloured or pink Roses. First-rate in every way and for all purposes.
Gloire de Ducher—crimson; rich and showy.
Glory of Cheshunt — rich crimson.
Glory of Waltham — brilliant crimson.
Jean Cherpin—rich velvety-red.
John Bright—brilliant scarlet.
John Hopper.—one of the richest and finest flowering of soft rosy-crimson colour; still frequently shown, but one of the most valuable of garden Roses.
Jules Margottin—rich rosy-red; one of the finest of all autumnal-blooming Roses.
La Brillante—light carmine; one of the most showy old Roses.
La France—as valuable for the garden as for exhibition; bright soft pink, with silvery touches on the outside of the petals; exquisitely sweet.
La Reine—hardly yet superseded among soft, bright rose-coloured flowers.
Lion des Combats — well worthy of its proud name as a garden Rose.
Lord Macaulay—deep crimson.

Louise Odier — bright rose.
Louise Peyronny—delicate rose.
Mme. Boll—bright carmine-rose.
Mme. Charles Crapelet—bright rose.
Mme. Charles Wood—rich carmine.
Mme. Claire Mathieu—soft rosy pink.
Mme. Clémence Joigneaux—reddish-lilac.
Mme. Creyton—light carmine.
Mme. de Cambaceres—rosy-carmine; large and full.
Mme. George Schwartz—soft shaded pink.
Mme. Hector Jacquin—rosy-lilac; large.
Mme. Knorr—deep pink, with rosy centre.
Mme. Lacharme—pale blush; very chaste.
Mme. Laffay—one of the sweetest and best of the rich purples.
Mme. Marie Cirodde—bright rosy-pink.
Mme. Rivers—soft bright flesh.
Mme. Victor Verdier—bright red.
Mlle. Bonnaire—delicate rosy-pink.
Mlle. Eugénie Verdier—crimson.
Mlle. Thérèse Levet—bright rose.
Marchioness of Exeter—bright rose.
Marguerite Jamain—deep flesh-coloured.
Marquise de Castellane—bright rose.
Maurice Bernardin—rich vermilion.
Miss Hassard—soft pinky.
Mrs. Harry Turner—rich crimson-scarlet.
Paul Neron—rich deep rose. The largest Rose in cultivation, and a capital autumnal bloomer.
Peach Blossom—delicate pink.
Perfection des Blanches—pure white; thin.
Préfet Limbourge—crimson, shaded purple; fragrant.
Prince Arthur—rich deep crimson.
Prince Camille de Rohan—rich velvety-crimson; very sweet and good. One of the very finest for bed or border.
Princess Christian—chaste and soft rosy-peach.
Princess Mary of Cambridge—pale rose.
Queen Victoria—pale pink.
Red Dragon, Red Gauntlet, Red Rover—three comparatively new bright Roses, of robust habit and sterling merit for the garden.
Souvenir de John Veitch—rich crimson, shaded purple.
Souvenir de la Reine d'Angleterre—large; bright rose-colour
Souvenir de Victor Verdier—red, shaded violet.
Thyra Hammerich—rosy flesh-colour
Triomphe de France—bright carmine; very fragrant.
Triomphe des Beaux Arts—fiery-crimson.
Vivid—very bright red.
William Griffith—soft satiny rose.
William Paul—bright crimson.

To these garden Roses two welcome additions have recently been made, albeit they are single—Paul's Crimson and White Perpetual. These Roses, though so opposite in colour, are both alike furnished with yellow stamens that add very much to their distinctness and beauty. The whole of the White Hybrid Perpetual Roses should also be reckoned among the very best for the garden; and, indeed, few or none are sufficiently full to be included among show Roses.

This batch of white will complete our list of garden Roses:—

Louise Darzens.—Full; white-cupped, tinted with pale flesh.

Elise Boelle.—White, tinted with pale flesh.

Madame François Pittet.—White; good grower.

Coquette des Blanches.—Pure white; large and free.

Boule de Neige.—Pure white; small, but perfect in form and full of fragrance.

Mabel Morrison, White Baroness, and Merveille de Lyon, are all sports from Baroness Rothschild, and are among the largest and most striking of all pure white Roses for the garden.

ORCHIDS.

By William Hugh Gower.

Huntleya.—This genus was named, upwards of forty years ago, in honour of the Rev. Thomas Huntley, who was a most enthusiastic lover of plants. The genus, however, is still very little understood, for this, together with *Bollea*, *Pescatoria*, *Warscewiczella*, *Warrea*, *Zygopetalum*, and *Batemania*, are very much jumbled together, and it is very difficult to strictly define their distinctions.

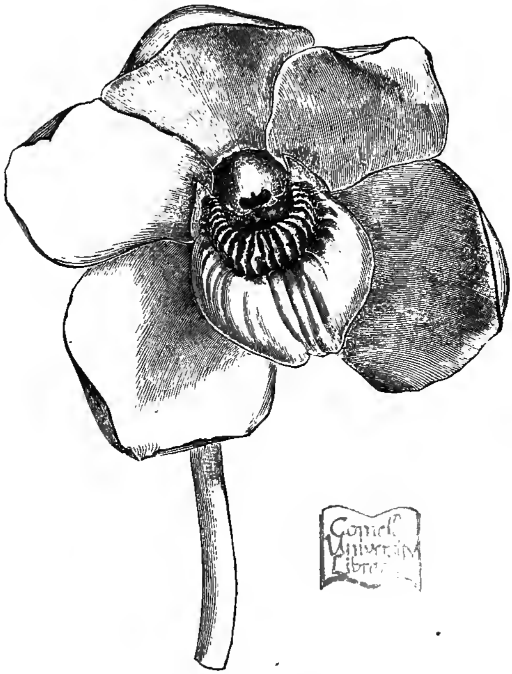
Huntleyas and their relatives have been somewhat uncertain plants, and have rather puzzled the cultivator to keep them alive for many years. Even where they grow and flower profusely, they have a bad habit of casting their leaves from the previous years' growths, so that it is not often that one sees very large specimens. These plants must never be allowed to suffer from drought, for although during our dull winter days less moisture is necessary, it must never be entirely withheld. In potting, rough fibrous peat should be used without sphagnum, and this only as a thin covering to the roots, the pot being filled with drainage. They are found growing at some 6,000 to 8,000 feet elevation, oftentimes in the company of *Trichopilias*, *Pilumnas*, and similar plants, and should be kept at the cool end of the Brazilian House.

H. albido-fulva.—This plant has always been scarce. It produces broad ligulate leaves, which are dark green above, paler below, and arranged in a distichous manner. Peduncles erect, one-flowered; sepals and petals oblong-acuminate, sub-equal, the basal half white, the tips tawny-yellow. Lip white tipped with rosy-red, crested at the base. Summer months. Brazil.

H. cerina.—The name of Waxy Huntleya is most applicable for this species. It was originally discovered by that veteran amongst plant collectors, Warscewicz, in 1851, growing in abundance on the volcanic mountain of Chiriqui, in the company of a host of *Trichopilias*, at nearly 8,000 feet elevation. The leaves are arranged in a two-ranked manner, they are oblong-acuminate, narrow, 9 to 12 inches long, and deep green; peduncle erect, shorter than the leaves, one-flowered. Flowers large, thick and waxy, upwards of three inches in diameter. Sepals and petals nearly equal, thick and fleshy, and of a uniform very pale straw-colour. Lip ovate, rich yellow, ornamented near the base with a lunate fringe, composed of numerous raised plates. It flowers during spring and early summer, lasting long in full beauty. Central America.

Ionopsis.—A small genus of very beautiful epiphytes, very nearly allied to *Burlingtonia*. The name comes from *ion*, "a Violet," and *opsis*, "like," from the flowers resembling a Violet in shape. They are quite destitute of stems, and have very small pseudo bulbs, consequently they require to be kept fairly moist all the year round. *Ionopsis* should be fastened to good-sized blocks of wood, with a little sphagnum moss round them, but as the roots are thin and very wiry, they do not like to be confined. The cool end of the Brazilian House.

I. paniculata.—This is one of the largest of the genus, and a profuse bloomer; indeed the whole family are so prolific, and continue in full beauty such a long time, that they often entirely exhaust themselves. Pseudo-bulbs very small, indeed scarcely perceptible, bearing erect, linear-lanceolate, coriaceous leaves, some four inches long, of a rich bronzy hue, changing with age to dark green. Scape much branched, upwards of a foot long, producing 60 to 100 of its beautiful flowers. Sepals and petals small, white; lip large and broad, deeply bi-lobed in front, pure white, with a beautiful purple blotch at the base. In some forms the flowers are stained with yellow, and rose, but the sepals and petals are usually white. Autumn and winter months, and frequently again in spring. St. Paul's, Brazil, and Para.



HUNTLEYA CERINA.

I. tenera, a small but elegant plant, with rigid, sharp-pointed leaves, which are carinate and deep green. Scape branched, many-flowered. Sepals and petals equal, pure white. Lip large, bi-lobed in front, downy-white, with a delicate blotch of pink at the base. Summer mouths. Cuba, at considerable elevations.

I. tenera, var. *violacea.*—This plant differs only in producing very dense panicles of flowers, which are of a rich deep purplish-violet. Summer months. Cuba.

I. tenera, var. *zonalis.*—In this variety the panicle is more lax than the preceding, and the flowers are light pink, with a lunate band of rosy-purple at the base. Spring and early summer. Brazil.

I. utricularioides.—The leaves of this species are oblong-acute, with a sharp keel at the back, and dark green. Scape short, sparingly branched, bearing numerous, somewhat small flowers. Sepals and petals nearly equal, the former acute, and the latter obtuse, all white, streaked with pale red. Lip cuneate, bi-lobed in front, slightly downy at the base, white, suffused with reddish-purple. Autumn months. Trinidad.

Ipsea. — A small genus of terrestrial Orchids, with the same habit as *Bletia*, and requiring the same treatment. East Indian House.

I. speciosa. — This elegant plant has corm-like fleshy rhizomes, which bear a pair of narrow lanceolate leaves; these are about 9 inches long, about half an inch wide, and bright green. Scape erect, longer than the leaves, usually two-flowered, each flower about 2½ inches diameter. Sepals and petals somewhat spathulate, the latter slightly the smaller, all of a uniform rich golden-yellow. Lip deeply three-lobed, golden-yellow, with a few faint red lines on the disc. Winter and spring months. Ceylon.

Lælia.—A genus of showy plants, resembling *Cattleya* in habit of growth and manner of flowering. Indeed, there is little or nothing to distinguish them, saving the fact of *Lælia* having eight pollen-masses, and *Cattleya* four. They require the same treatment as *Cattleya*, which see. Brazilian House, except where otherwise mentioned.

L. acuminata.—In its native country this obtains the name of "Flor de Jesus," on account of its extreme delicacy and beauty. It is a dwarf plant, with small clustering, wrinkled, ovate pseudo-bulbs, bearing a solitary coriaceous leaf. Scape terminal, erect, bearing about four to five fragrant flowers; sepals and petals spreading, the latter being broader, pure white; lip three-lobed, the side lobes covering the column; front lobes white, with a faint tinge of lemon-colour on the disc, and a blotch of deep purple at the base. Mexican division. Winter months. Guatemala.

L. albida.—This species requires to be grown in the Mexican division. The pseudo-bulbs are small and clustered, bearing a pair of coriaceous leaves. Scape terminal, three to six-flowered; sepals oblong-acute; petals much broader, somewhat ovate-acute, white; lip white, streaked with pale yellow lines. Very variable in colour. Winter months. Mountains of Oalaca, Mexico.

L. anceps.—Like the two preceding species, this plant succeeds best on a block, and should be kept in the Mexican division. Pseudo-bulbs ovate and ribbed; leaves, one to two, thick and coriaceous; scape one to two feet high, bearing on the summit three to six flowers; sepals and petals rose, or purplish-rose; lip deep purplish-rose, streaked with yellow on the disc. There are numerous varieties. The flowers open during the winter months, and last long in perfection. Guatemala and Mexico.

Ionopsis tenera.

L. anceps, var. *Dawsonii.*—This is a beautiful and distinct form of the species. Sepals and petals pure waxy-white, side lobes of lip white, front lobe purple, with numerous lines of deeper purple, and streaked with yellow on the disc. There is also a pure white variety (*L. anceps alba*). Winter months. Juquila, Mexico.

L. autumnalis is another of the Mexican species. The pseudo-bulbs, which are clustered, ovate, and much wrinkled, bear two narrow coriaceous leaves; scape terminal, erect, bearing three to six flowers, some four inches across; sepals and petals rosy-purple; lip white, with a broad border of deep rose, and yellow at the base. There is much variation in the depth of colour in different plants. The winter months. Mexico.

L. cinnabarina.—Pseudo-bulbs swollen at the base, tapering upwards, becoming somewhat flask-shaped, four to six inches high, bearing a single erect, rugose, dark green leaf; scape terminal, erect, many-flowered; sepals and petals narrow, about equal, and are together with the lip a bright cinnabar-red. Spring and early summer. Brazil.

L. crispilabia.—Pseudo-bulbs swollen at the base, tapering upwards, bearing an erect lanceolate-acute leaf, which, like the growth, is deep green. Scape nine to twelve inches long, five to six-flowered; sepals and petals equal, soft purple; lip three-lobed, the side lobes rolled over the column, rosy-purple, front lobe same colour, white at the base. Spring and early summer. Brazil.

L. elegans.—This species and its varieties so much resemble a *Cattleya* when out of flower, that they are scarcely distinguishable. Pseudo-bulbs somewhat fusiform in shape, about two feet high; leaves one to two, borne upon the summit. The scape is erect, arising from between a large spathe, three to six-flowered, each flower measuring four or five inches across. Sepals and petals very variable in colour; in some forms they are pure white, in others rose or carmine; lip brilliant purple. The variety *L. gigantea* has very large flowers, with delicate rose sepals and petals, beautifully spotted with rosy-purple; and *L. Warnerii* has light rose sepals and petals, and a deep crimson lip. Summer months. Brazil.

L. elegans, var. *Turnerii.*—Though similar in habit to *L. elegans*, this grand plant is almost distinct enough to entitle it to specific rank. Pseudo-bulbs slender at the base, thickening upwards, and bearing on the apex a pair of large broad-oblong leaves, nearly a foot long, carinate and dark green; scape erect, longer than the leaves, three to five-flowered, each flower nearly six inches across; sepals and petals spreading, the latter much broader, of a uniform deep purple; lip three-lobed, the side lobes rolled over the column, rosy-pink, middle lobe flat, spathulate, intense deep purplish-violet. Late summer and autumn months. Brazil.

L. flava, a dwarf-growing plant, with something of the habit of *crispilabia*, and requiring the same treatment. The sepals and petals are narrow, about equal in size, and, together with the lip, a beautiful clear deep yellow, a rare colour in this genus. Spring and early summer. Brazil.

L. flammea.—Of garden origin, obtained from seed in the establishment of Messrs. Veitch. It is the result of a cross between *Lælia cinnabarina* and *L. Pilcherii*, the latter being a hybrid, and it is described by Prof. Reichenbach in the following manner:—"Imagine a flower of *Lælia cinnabarina* increased three times. With its brightest vermilion, give it a splendid yellow lip, with an amethyst-purplish wavy anterior lacinia, and a small white column, washed under the stigma with purple; thus you have this first-rank beauty." It is also known by the name of *Lælia Chelsonii*. Spring months. Garden hybrid.

L. harpophylla. —A very slender-growing but elegant plant. Pseudo-bulbs small and stem-like, bearing a single linear-acute pale green leaf; scape pendent, bearing several of its brilliant orange-red flowers; sepals and petals about equal, long and narrow; side lobes of the lip rolled over the column, the middle lobe flat and creamy-white. Spring months. Brazil.

L. Jonghiana.—A dwarf species. The pseudo-bulbs seldom exceed three inches in height, and bear a single, very thick and leathery, dark green leaf, about five inches long; scape short, one to two-flowered, flowers spreading, three to four inches across; petals much broader than the sepals, all rich amethyst in colour; side lobes of the lip convolute, front lobe spreading and beautifully frilled, white, with golden-yellow crests on the disc. Spring months. Brazil.

L. lobata.—This is a bold-growing plant, with much the habit and appearance of *Cattleya labiata*, and the flowers are about the same size; petals frilled on the edges, very much broader than the sepals, and of a uniform rich rosy-purple; lip frilled on the margin, deep rosy-purple tinged with violet, and veined with crimson. May and June. Brazil.

L. majalis.—This is the "Flor de Mayo" of the Mexicans, and a truly grand flower it is. It is rather difficult to cultivate, and a somewhat shy bloomer. The pseudo-bulbs are small and ovate, bearing usually a single leaf, but sometimes two; flowers solitary, rarely in pairs, some four inches across, coming up with the young growth; sepals and petals spreading, sepals lanceolate, petals much broader, oblong-lanceolate, delicate soft rosy-lilac; lip three-lobed, the side lobes small, covering the column, front lobe large and flat, broadly margined with dark rosy-lilac, white in the centre, streaked and dotted with lilac and brown. We are told the Mexican name for this beautiful flower is *Chichilitic Jepetlavhxochitl.* May and June. Province of Mechoacan, Mexico.

L. Perrinii is a very *Cattleya*-looking species, with stout erect pseudo-bulbs, bearing a single leaf; scape erect, three to six-flowered; sepals and petals light rosy-purple, tipped with magenta; lip three-lobed, deep crimson. October and November. Organ Mountains, Brazil.

L. præstans.—This is a dwarf plant, thriving best on a block of wood; pseudo-bulbs and leaves rarely exceeding some six inches in height. Scape one-flowered; sepals and petals broad and spreading, rich dark rose in colour; lip intense deep purple. It frequently flowers in spring or early summer, and again in the autumn. Brazil.

L. pumila.—Similar in habit to the preceding, and requiring the same treatment. It has received many names since its introduction, arising from the variations of its colour. Originally named *Cattleya pumila*, it is also known as *C. marginata*, which name was evidently derived from the distinct white border to the lip. *C. Pinelii* and *Bletia pumila* are other names under which it is to be found, and at last it becomes a *Lælia*, on account of its eight pollen-masses. The pseudo-bulbs slender and somewhat oblong, scarcely six inches high, bearing a single oblong-acute, coriaceous, light green leaf; scape one-flowered, flowers large and spreading; sepals and petals purplish-lilac, in some varieties deep rose, shading to crimson, the petals twice as broad as the sepals; lip obovate, side lobes rolled over the column, white tinged with rose, middle lobe purplish-lilac, in some varieties deep purplish-crimson, and in all forms ornamented with a distinct white border. It blooms in autumn, just as its growth is complete. Brazil.

L. purpurata.—This is undoubtedly one of the very grandest Orchids in cultivation. Its broad rich green leaves and immense flowers render it a very striking object. This species, like most other Orchids, is subject to considerable variation in colour, and also in the size of the labellum; but all are beautiful. Pseudo-bulbs oblong, slightly compressed, thickening upwards, dark green, bearing a single broad-oblong erect leaf, which is coriaceous and rich deep green, the whole growth attaining to a height of from two to three feet. From the apex of the pseudo-bulbs and the base of the leaf, a large green spathe arises on the flowering growths, and from between this the peduncle springs, bearing three to five large flowers, which measure upwards of six inches in diameter; sepals linear-lanceolate; petals much broader, oblong-ovate, and undulate on the margins, all of the purest white; lip upwards of three inches long, side lobes rolled over the column, front lobe large and spreading, rich deep violet, suffused with crimson, becoming slightly paler towards the margin; basal part of the lip golden-yellow, ornamented with crimson lines. In the variety *Brysiana* the sepals and petals are beautiful soft rose, with the same intensely dark lip. The flowers last long in perfection if kept dry. Early summer months. St. Catherine's, Brazil.

L. superbens.—A grand species, forming pseudo-bulbs twelve to eighteen inches long. These are somewhat oblong in shape, slightly tapering at each end, and bearing upon their summit a pair of broadly-oblong, coriaceous, deep green leaves; spike terminal, often reaching five feet in length, upon the top of which the raceme is formed, ten to twenty-flowered, each flower measuring some four inches in diameter; sepals and petals nearly equal, lanceolate-acute, of a uniform rich rose-colour; lip three-lobed, side lobes erect, scarcely covering the column, deep crimson, middle lobe large oblong and spreading, waved at the edges, rich crimson, the crests on the disc being orange-yellow. November and December. Guatemala.

Læliopsis.—This is a small genus, which has really little to distinguish it from *Cattleya;* the chief points are its bearded labellum, and the general membranous texture of its flowers.

They should be grown upon a block of wood, and suspended from the roof, during the growing season. They enjoy an abundant supply of water; less must be given during the period of rest, but they require careful handling at this particular season. Brazilian House.

L. domingensis.—A curious dwarf-growing plant, with clustered oblong-obtuse pseudo-bulbs, some three inches high, bearing a pair of short, oblong, coriaceous, deep green leaves. Scape terminal, erect, about a foot long, six to eight-flowered. Sepals and petals about equal, soft lilac; lip cucullate, spreading in front, bright rose, white towards the base, and streaked with yellow, the central veins bearded. Early summer months. St. Domingo.

Leptotes.—The name comes from *leptos*, "slender," and refers to the slender leaves. It is a small genus of small plants, which are thus defined: "Sepals and petals linear, spreading, and nearly equal; the lip three-lobed, parallel with the short thick column, around which the lateral lobes are convolute, the six pollen-masses incumbent, the two upper ones pear-shaped, the four lower ones unequal and thinner." These little plants are very pretty when grown into large masses; they succeed best upon blocks of wood or in hanging-baskets, with peat and sphagnum. Water liberally when growing, and never entirely withhold it. Brazilian House.

L. bicolor.—A small-growing plant, very seldom exceeding six inches in height. The leaves are terete, thick, and dark green; flowers slender and pure white, saving the base of the lip, which is stained with purple. The seed-pods of this plant are used for flavouring iced-cream; they have the odour of the Tonquin Bean. Winter months. Organ Mountains, Brazil.

L. serrulata.—There is really very little to distinguish this species from *L. bicolor*, saving size, and this plant is a much stronger grower, and produces flowers nearly double the size of the previously described species, but the colours are the same. Winter months. Organ Mountains, Brazil.

Limatodes. — A small genus established by Blume, who does not explain the meaning of the word. They resemble, and are very nearly allied to, one section of *Calanthe*, indeed *L. rosa* is one of the parents of the beautiful hybrid, *Calanthe Veitchii.* The present genus owes its separation from the *Calanthes* to having the labellum free, instead of being joined to the column. Culture the same as for *Calanthe vestita*, which see. East Indian House.

L. rosea.—A terrestrial species, with somewhat fusiform pseudo-bulbs, which are curiously contracted into a narrow neck near the middle, and which bear on the summit a pair of smooth, plaited, oblong-lanceolate, light green leaves, which are deciduous, usually dying off before the flowers expand. Scape much longer than the leaves and many-flowered; flowers of a uniform bright rose; the lip is flat and oblong, the side lobes curved round the short column, deep rose with a small patch of white at the base, spur straight and blunt. Winter months. Moulmein.

L. rosea, var. *vestalis.*—The species is very variable in its colour, some being dark and others pale rose; the present variety, however, is thoroughly distinct, and most desirable; the shape of flowers and habit of growth are the same, but the blooms are of a uniform pure white. Winter months. Moulmein.

Lissochilus. — A genus of terrestrial plants, mostly natives of Africa. They are bold-growing plants, with much the habit of *Phajus*, to which, however, they are not related; their nearest ally is, perhaps, *Eulophia*, but whilst in that genus the sepals and petals are equal, or nearly so, in *Lissochilus* the petals are invariably very much the larger. These plants should not be potted above the rim of the pot, but be treated as ordinary stove-plants. The soil they thrive best in is equal parts of peat, loam, leaf-mould, and sand. Drainage must be perfect. They do not require severe drying off, but enjoy an abundant supply of water when growing. East Indian House.

L. Horsfallii. — The species belonging to this family are not numerous, and several of them are not showy; in this instance, however, the plant is both stately and bold in growth, and possesses great beauty when in bloom. In general appearance it resembles *Phajus Wallichii*, with large, plaited, dark green leaves; the scape is erect, and the many-flowered raceme of showy flowers stands well above the foliage. Sepals small, spreading, purplish-brown, petals very much larger and broader, also spreading, white, tinged with delicate rose; lip large three-lobed, the basal lobes erect, green streaked with reddish-purple, the middle one ovate, reddish-purple, ornamented with three raised white lines on the disc. October and November. Old Calabar, West Africa.

L. Krebsii.—This species, coming from quite an opposite part of Africa, requires somewhat less heat. The pseudo-bulbs are small, oblong, and deep green; leaves about a foot high, plaited, and deep green; scape erect, twice as long as the leaves, flowers rather laxly set, raceme bearing upwards of twenty blooms; sepals undulate at the margins, green blotched and banded with dull purple, petals very much larger, and deep golden-yellow; lip three-lobed, side lobes short, erect, dull brown, middle lobe ovate, pale yellow. Summer months. Natal.

Lüddemannia.—This genus has been separated from *Cycnoches*, and very justly so, we think, as its affinity always seemed to us to be with *Lacæna*. It is, however, distinct from both genera. In habit of growth, general appearance of the plant, and with its pendulous racemes of bloom, it resembles *Lacæna*, but it is distinguished by "its sessile depressed spherical pollen-masses and minute caudicle;" the same differences arise in the genus *Cycnoches*, and the peculiar quadrate lip is also another distinction.

The species described here should be grown in a hanging-basket, on account of the long pendulous racemes, and the soil best suited to it is about equal parts of peat and sphagnum, with some nodules of charcoal to keep it open. Supply liberally with water during the growing season, and do not allow the pseudo-bulbs to shrivel during the resting season. Brazilian House.

L. Pescatorei.—Pseudo-bulbs robust, oblong, and dark green, bearing a pair of stout, broadly lanceolate, plicate leaves, like those of an *Acineta* or *Lacæna*. The long spikes are pendulous, and bear twenty to thirty flowers somewhat laxly set. Sepals tawny-yellow outside, light brown within, streaked with crimson; petals smaller, bright yellow; lip quadrate, toothed in front, bright yellow. Spring and early summer. Venezuela.

Lycaste.—The plants belonging to this genus were originally included with *Maxillaria*, but have been separated from that family by the transverse fleshy ridge which ornaments the lip, and the pollen-masses being furnished with little foot-stalks. The name commemorates a beautiful woman of the mythological era.

Lycastes are peculiarly amateurs' Orchids, inasmuch as they thrive with very little artificial heat, and will continue in bloom unharmed for a long time in an ordinary room.

Pot in rough peat and sphagnum. During the growing season they enjoy a copious supply of water, and during the resting-season they should never be allowed to dry, although much less will be requisite. Peruvian House.

L. Barringtoniæ, var. *grandiflora.*—A beautiful form of a very old species. It has stout oblong pseudo-bulbs, and large, broadly-oblong, plaited, dark green leaves. The scapes arise from the base of the pseudo-bulbs, and are about six inches long, erect, bearing a single large flower, which is thick and fleshy in texture, some five or six inches across; white, slightly tinged with green. Spring months. South America.

L. Deppei.—In this plant the pseudo-bulbs are not so robust as those of the last-named species, and the broad plicate leaves are paler green. Sepals and petals brown, streaked and spotted with white and orange; lip small, deep orange. Winter and spring months. Mexico.

L. gigantea.—This is a strong bold-growing plant. Pseudo-bulbs upwards of six inches high, bearing several large and broad plicate leaves, two feet or more long. The flowers arise from the base of the pseudo-bulbs (like all the Lycastes), about the same

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time as the young growths. Scape erect, longer than the pseudo-bulbs, one-flowered. The flowers are very large; sepals and petals greenish-brown, tinged with yellow; lip three-lobed; the front lobe deep velvety crimson-maroon, bordered with orange-yellow, and very prettily fringed with dark hairs. Spring and early summer. Central America, at considerable elevations.

L. Harrisoniæ.—A somewhat neglected but fine species. Pseudo-bulbs pale green, with a narrow band of black at the apex, bearing a single, very deep green, leathery, plaited leaf. Scape one to two-flowered, each flower measuring some three inches across; sepals and petals large, thick, and waxy, pure white; lip rich purplish-lilac. In the variety *citrina* the sepals and petals are pale yellow, and the lip lilac and white. Spring and summer, lasting many weeks. Brazil.

L. Skinnerii.—This is by far the grandest member of the family. In general habit it resembles the other species, but the flowers are more gorgeous; but the varieties are so numerous that it is somewhat difficult to describe the colours. The flowers are usually some six inches across, broad, thick, and waxy. The sepals are large and spreading, pure waxy-white, sometimes more or less tinged with flesh or rose-colour. The petals are smaller, standing forward, and form a large hood over the column. These are sometimes pale rose, or deep rose, or crimson. Lip deep rose, or crimson. Winter and spring. Guatemala.

L. Skinnerii, var. *alba*, sometimes called *Lycaste virginalis.*—This is a rare and beautiful form of the species. The sepals and petals are of the purest waxy-white. Lip also white, with a faint stain of pale yellow at the base. Winter and spring months. Guatemala.

Masdevallia.—A genus of dwarf epiphytes, which, in the early days of Orchid-culture, were somewhat despised, and were said to be remarkable for the singularity of their flowers more than for their beauty. Since then, however, the mountain regions of New Grenada and Peru have been more thoroughly explored, and the numerous species sent home prove that this idea was erroneous, and that many species, in addition to their wonderfully grotesque forms, produce flowers with brilliant colours. This, added to the fact of their requiring the very coolest treatment, and their blooms remaining a very long time in perfection, has led to their becoming general favourites with cultivators.

For a long time after the discovery of these brilliant species, heavy expenses were incurred in the attempts to introduce them to cultivation, and great disappointment and regret were felt in the horticultural world at the want of success attending the expenditure of, in some instances, both life and money upon the collecting of them. Masdevallias have no thickened pseudo-bulbs to assist in supporting vitality in the dormant stage, and as the transit occupied a considerable time, they usually arrived in this country in a dead or dying state; and even when a few did arrive alive, they were treated in such an uncongenial manner that they literally melted away. Happily we now live in better times, transit is rapid, and the fact of their being mountain plants fully recognised, so that we have succeeded in establishing most of the kinds sent home.

As a genus, *Masdevallia* is characterised by its sepals, which are joined at the base, and thus forming a tube, while the apices are often drawn out into long tail-like points; the petals are concealed in the tube, and (unlike the majority of Orchids) these are very small; lip small, and jointed with the column, which is round above, and semi-circular on the under side.

Masdevallias, as before remarked, are mountain plants, being found at elevations of from 8,000 to 10,000 feet, and, therefore, they require cool treatment; indeed, they will not long survive if placed in a high temperature. To be successful in their cultivation, the greatest attention must be paid to drainage, for these plants enjoy a copious supply of water; but nothing stagnant must upon any account be allowed to touch their roots, and they must never be deprived of moisture, as they cannot suffer drying off. For compost, use rough peat and living sphagnum moss, in about equal parts, and a little sharp sand. These plants are always growing, and consequently flower several times in the year, and their brilliant colours form a splendid contrast to the pure white flowers of *Odontoglossum Alexandræ*. The most beautiful species of this genus are here described; but there are many others in cultivation, well deserving the attention of cool Orchid growers, of which the following are amongst the most curious and showy: *attenuata*, *Backhousiana*, *Denisoniana*, *ephippium*, *inflata*, *ionocharis*, *macrura*, *militaris*, *Peristeria*, *psittacina*, *Reichenbachiana*, *radiosa*, *rosea*, *triaristella*, *trochilus*, *vespertilio*, *Wagneriana*, and *xanthina*. Peruvian House.

M. amabilis.—A very free-growing plant. Leaves almost sessile, five to six inches high, oblong-ovate, deep green above, paler below. The radical stalks are twice as long as the leaves, erect; flowers solitary, rich orange-carmine in colour. Peru.

M. bella.—This is an extremely beautiful species; leaves erect, thick, and coriaceous, oblong-lanceolate, carinate, and deep green; peduncle one-flowered, pendulous; flowers large, measuring upwards of six inches from tip to tip of the sepals, which are drawn out into long tails; ground-colour creamy-white or yellow, profusely blotched and streaked with chocolate, and spotted with purplish-black; lip somewhat lunate, white, the sides rolled over, nearly meeting in front.

M. Chimera.—In this species we have a combination of the grotesque, the wonderful, and the beautiful; leaves almost sessile, oblong-lanceolate, acute, carinate, six to nine inches high, dark green on the upper surface, paler below; scape scarcely so long as the leaves, bent forward in the shape of a swan's neck, one-flowered; flowers upwards of eight inches across; sepals obovate, ground-colour creamy-yellow, profusely spotted with bright chestnut, and the surface covered with short black hairs, the point of each sepal lengthened out into a long red tail; lip small, somewhat calceolate, white. Winter months. Mountains of New Grenada.

M. Davisii.—A very distinct and beautiful species; leaves supported upon short stems, narrowly oblong-lanceolate, obtuse at the apex, keeled, and deep green; the scape longer than the leaves; flowers solitary, large, and rich bright yellow in colour. Summer and autumn months. Peru.

M. elephanticeps.—This is a robust-growing plant with somewhat spathulate leaves; scape erect, bearing a single large flower upwards of six inches long, the tail-like point of the dorsal sepal being bent over like an elephant's trunk, whilst the two lower ones represent the tusks; the upper sepal is golden-yellow, as also are the tails of the lower sepals, but the basal part of the latter are rich deep purplish-crimson. New Grenada.

M. Estradæ.—A small and compact species, and a profuse bloomer; leaves somewhat spathulate, with short stem about three inches high; scape much longer than the leaves, supporting a solitary flower some three inches across, white or pale yellow, with a rich blotch of purplish-mauve, or violet; the slender tails are pale yellow. Spring months. New Grenada.

M. Harryana.—This is an extremely handsome, and a very variable plant; leaves oblong-obtuse, six to eight inches high; scape longer than the leaves, solitary, about four inches in diameter, varying from reddish-purple to deep crimson, and mauve, and usually stained at the base with yellow. It is almost a perpetual bloomer. The named varieties of this species are numerous; amongst the best are *atropurpurea*, *atrosanguinea*, *brilliantissima*, *cœrulescens*, *elegans*, *insignis*, *purpurea*, *sanguinea*, and *violacea*. New Grenada.

M. ignea.—Resembling the preceding in habit, with bright red flowers, shaded with violet-rose; the dorsal sepal narrow and bent over the lower ones. There are several varieties. Autumn and winter months. New Grenada.

M. Lindenii.—This gorgeously beautiful plant belongs to the same section as the two preceding species, and resembles them in habit, but is more slender; it is a free-growing plant, and a profuse bloomer; leaves oblong-lanceolate, the flowers resembling those of *Harryana*, but smaller, and usually brillant violet-rose or magenta, white or pale yellow at the base. Summer months. New Grenada.

M. maculata.—Leaves borne on short foot-stalks, narrowly-lanceolate, deep green; flowers rich deep crimson-purple, spotted with rose; the point of the dorsal sepal is yellow, the lower ones green. There are several varieties of this plant; in some forms the ground-colour is dull yellow. Autumn and winter. Caraccas and Columbia.

M. melanopus.—A densely-tufted dwarf-growing species, with obovate-lanceolate leaves, borne upon short stems; scape longer than the leaves, erect, bearing several flowers, usually five to six; flowers white, beautifully dotted and freckled with purple; the tail-like points of the sepals are yellow. Spring months. Andes of Peru.

M. polysticta.—Similar to the preceding, yet very distinct; leaves somewhat spathulate, upon short stems, pale green; scape erect, and many-flowered: sepals pale mauve or lilac, freckled with purple; dorsal sepal hooded, lower ones becoming narrow, and ultimately tailed, these tail-like points being also freckled. Winter months. Peru.

M. Shuttleworthii.—A very dwarf plant, seldom exceeding three or four inches in height; leaves shortly-petiolate, somewhat oblong, but narrow at the base, light green; scape longer than the leaves, bearing a single flower, about six inches across from point to point of the tails; dorsal sepals hooded, lengthened out into a very long greenish tail, reddish at the tip; lateral sepals also tailed, ovate and spreading, rosy-red, all being freckled and dotted with deep red. Spring months. Columbia.

M. tovarense.—This beautiful species, sometimes called *M. candida*, is a compact and free-flowering plant; leaves somewhat oblong, inclining to spathulate, four to six inches long, coriaceous, pale green; scape erect, two to four-flowered, but two the most usual number, these being pure snow-white, slightly tailed; the old scape often produces a double crop of blooms. Winter months. Tovar in Columbia.

M. Veitchianum.—The colours of the flowers of this species are most difficult to describe. It is a bold and strong-growing plant, with leaves six or more inches high, narrowly-oblong, coriaceous, and deep green; scape one-flowered, measuring six inches in diameter; the sepals are slightly tailed, rich bright orange-scarlet, shaded with violet-purple and yellow. It blooms several times during the season. Mountains of Peru.

COMMON GARDEN FLOWERS.

Sea Lavender (*Statice*).—Lavender, or the Latin *Lavendula*, is from *lavare*, "wash," as being the plant used to scent newly-washed linen, whence the expression of "laid up in lavender," or, as Diez tells us, from being used at the baths in washing the body. The real Sea Lavender is *Statice Limonium*, or Wild Marsh Beet, and is frequent on the muddy shores of England; and its root has been known as an astringent from the time of Pliny. The name Statice is from *statizo*, "to stop," on account of its astringent property. The Statices are a curious family of plants, the majority of which are hardy perennials, growing vigorously in ordinary flower borders, where they throw up their widely-branching flower-stems with hundreds of small blooms covering them all over, and forming a complete feather or plume of diminutive blossoms variously coloured, but for the most part confined to white and blue. The dwarf kinds form charming subjects for the rock-work, while the stronger-growing kinds should be placed in borders. The flowers are very useful for cutting, retaining their colour for years after being cut. The flower-stems should be cut just as they are fully matured, tied together in bunches, and hung in a cool place heads downwards, where they can dry gradually; the stems will become rigid when their juices have dried up, they can then be used for the decoration of rooms in winter.

The best species and varieties for garden culture are *Dobartii*, bearing heads of lavender-blue, and growing to a height of eighteen inches; *angustifolia*, the Narrow-leaved Sea Lavender, considered a fine variety of the British Lavender, *S. Limonium; elata*, the Tall Sea Lavender, flowers bluish-lilac in long panicles, an introduction from Southern Russia; *Gmelini*, or Gmelin's Sea Lavender, from Siberia, an excellent Alpine border plant; *incana hybrida*, a fine form of the Hoary Sea Lavender, from Central Asia; flowers crimson, with a white calyx; *latifolia*, the Great Sea Lavender, which grows to the height of about two and a half feet, forming an immense branching panicle two feet across, covered with a myriad of lavender-lilac and white calyces and flowers (this is particularly ornamental in a dried state); *paniculata*, a very handsome border plant that can be highly recommended; and *tartarica*, a very handsome and dwarf kind from Tartary, bearing small and very numerous rose-coloured or reddish flowers late in summer. Most of those named can be propagated by careful division of the roots, and seeds.

There are several evergreen green-house species of value both as decorative and exhibition plants, which it is not necessary to refer to in this relation. There are also two annual species quite hardy and of a very interesting character: one is a dwarf-growing form named *spicata*, rising to a foot or more in height, and bearing pretty pink flowers, and it makes an excellent "everlasting" when dried; the other, *S. Suworowi*, said to be of Polish or Russian origin, and by far the finest of all the annual Statices. The small foliage lies flat upon the ground, and above it rise many-branched spiral flower-spikes to the height of twelve or eighteen inches. The plant continues in bloom for quite two months, and from sowings in February, March, and April, it is easy to secure a constant succession throughout the summer and autumn; the colour of the flowers is bright rose shading off to a paler tint. It is also well adapted for cultivating in pots for green-house decoration.

There are a great number of Statices, and they grow most abundantly on the sea-shores of the temperate regions of both hemispheres. Some of them possess peculiar properties. The root of *S. caroliniana*, called in the United States of America the Marsh Rosemary, is bitter, and extremely astringent, and may be used for all purposes for which Kino and Catechu are given, but it is most frequently used as a domestic remedy for aphthous and ulceratial affections of the mouth. The root of *S. Limonium* has been recommended for use as a gargle for ulcerated sore throat, in ulcers of the mouth, and dysentery. In the Caucasus, the root of *S. latifolia* is used for the purpose of tanning skins. Several of the species bear galls, like many other plants that contain tannin.

Trillium.—We have no common name for this genus, though the best-known species, *T. grandiflorum*, is known as the White Wood Lily. We get the generic name, *Trillium*, from *trilix*, "triple," the parts of the flowers being in threes. There are several species forming the genus, and they are natives of thickets in Europe, Asia, and North America. They require special treatment and careful attention, but they well deserve it, and when successfully grown they are most attractive. *T. grandiflorum* is acknowledged to be one of the most singular and beautiful of all hardy plants, belonging to a well-known American family. When well established and in good health, each stem bears a lovely white three-petalled flower, fairer than the White Lily, and almost as large when the plant is strong, but much depends upon the vigour of the specimens. It seems to thrive well under any kind of treatment, and blooms tolerably well even in small pits and frames. But to have "large and fleshy leaves, the plant assuming natural proportions, and so becoming a free-growing herb in the open air, certain requirements are necessary—a free soil full of vegetable matter, and a shady position either in the hardy fernery or some depressed nook, or, failing such, among the Rhododendrons in peat beds. If placed in a sunny or exposed position, the large soft green leaves are not sufficiently developed, and consequently the plant fails to become strong. In a position much exposed to sun and wind I have grown it to perfection by planting it in peat, and keeping it covered with a clouded hand-glass so long as the leaves were above ground. At Biddulph Grange, Congleton, I first saw it in its true glory, forming bushes of the healthiest green, more than

TRILLIUM GRANDIFLORUM.

two feet high, and spreading out as fully as any border plant. Every plant bore traces of flower, and it may easily be imagined what pictures of beauty these plants must have been in spring. They were planted in a moist spot, very much shaded by highly-raised root and rock work, and shrubs perfectly sheltered by the same. In like position it may be grown as well as in its native woods. Depressed shady nooks in the rock garden or hardy fernery will suit it admirably." (Robinson's *Alpine Flowers*.) It can be increased by division of well-established bulbs.

T. erectum, or *atropurpureum*, is in striking contrast to the foregoing, producing erect flowers of a deep rich purple, and should have similar treatment.

T. erythrocarpum, the Painted Wood-lily, bears lovely, pure white flowers, with three distinct bright rose or pale crimson spots at the base of the petals; it is one of the very handsomest of the group. The blossoms are scarcely so large as those of *T. grandiflorum.*

T. nivale has pure white flowers, and is of dwarfer growth than *T. grandiflorum*, and distinct from it.

T. ovatum is a rare Californian species, with dark green ovate leaves, and pure white flowers slightly recurved.

T. sessile is so named from the flowers having no foot-stalks, but fitting as it were immediately on the end of the main stalk; the leaves are marbled with white, and the flowers, which are pale purple in the original form, are found to vary in colour from pale yellow to deep purple; it is one of the earliest to flower, coming in with the Snowdrop.

T. recurvatum is of very dwarf growth, and quite distinct; the flowers purple and, as, its name implies, very much recurved.

We have seen in Lancashire fine plants of *T. grandiflorum* grown in pots in a cold house, flowering freely and abundantly in spring. They were growing in a compost made up of yellow loam, plenty of leaf-mould, and peat, the pots well drained. An excellent bed could be made up for Trilliums in a common dry ditch shaded with trees. It would be necessary to put a foot or so of coal-ashes and lime rubbish into it so as to form a dry walk in case of wet, and on the banks many choice subjects that love and thrive in shady, sheltered spots could be planted, and with due attention they could scarcely fail to succeed. Such a place would, we think, prove a perfect paradise for Trilliums and such other things as are found growing in dense woods.

The Flame Flower (*Tritoma*).—This genus is now often called *Kniphofia*, but in such a work as this it is probably best to retain the designation best known to our readers. *Tritoma* is derived from *treis*, "three," and *temno*, "to cut," in allusion to the three sharp edges of the ends of the leaves. There are two common names—the Flame Flower and Red-hot Poker Plant—both bestowed on account of the long flame-like spikes of yellow and scarlet flowers the plant produces. The former is certainly preferable to the latter, as being more euphonious and less harsh. Tritoma represents a genus of noble autumn-flowering Liliaceous plants, whose brilliant spikes of deepest orange shaded to yellow have now for years formed a conspicuous element in the autumn decoration of our borders. All the species are natives of the Cape of Good Hope. If any one is at a loss to form a notion of what a Tritoma is, let him imagine some very broad-leaved Sedge, forming a spreading tuft with its recurved foliage, from the centre of which arises upright a flower-stem, bearing at the top a multitude of pendent blossoms, tube-shaped, shining like sealing-wax, and when sufficiently exposed to air and light, of almost as intense a vermilion; these collected into a roundish or elongated head, and he will then have a tolerable picture of Tritomas in general.

The best-known is *T. uvaria*. This is the original species that was planted out at Kew in 1848, with a view to test its hardiness, and is, when obtained true, one of the showiest.

It succeeds well in borders, beds, or in groups of the finer autumn-flowering perennials, or as isolated tufts on the grass, in a deep, free, and rich loam. It is advised that the roots of this be protected a little in winter.

T. uvaria has a few varieties, such as *glaucescens*, which has leaves of a more glaucous character than the type. It is of dwarf habit, and produces large and magnificent spikes of scarlet and yellow flowers; and *grandiflora*, or *grandis*, which is taller and later than *T. uvaria*, and has greener leaves; a most desirable form indeed, and one of the grandest of late-blooming perennials, because so tall and perfectly hardy.

T. Burchelli is Burchell's Flame Flower, a noble and showy perennial, distinguished from *T. uvaria* by its flower-stems being marked with black spots, and also by the colour of its flowers, which have a scarlet base passing into carmine, and then into pale yellow, and green at the extremities. The hardiness of this is sometimes doubted, and it should have some protection during winter, and be planted in a well-drained sandy loam. It does not throw up suckers so freely as some others, but perfects its seeds, by which means it can also be increased.

T. Rooperi was introduced by Captain Rooper from Caffraria. It has much the aspect of *T. Burchelli*, but is larger, with the leaves much longer, less rigid in texture, and recurved towards the points, forming a graceful curve, and is further distinguished, botanically, by its flowers having their anthers included within the tube, or scarcely exserted beyond it, and by the bracts at the apices of the spike forming a kind of crown or tuft above the developed flowers. It blossoms in winter and spring.

T. Macowani is a dwarf and brilliant Flame Flower, in colour intense orange-scarlet, and of graceful habit. It is an excellent subject for the mixed border or for the margins of beds of dwarf shrubs, and for groups and mixed beds in the flower garden, and it does not suffer much from rain in impairing its beauty.

T. nobilis produces tall and showy spikes of rich scarlet flowers, is early and continuous in bloom, and a fine subject for growing in clumps.

T. pumila is a dwarf and very neat spring-flowering species, not unfrequently blossoming again in autumn, the flowers bright orange-scarlet. It does well in a rich loam.

We may state of the Tritomas generally that they are not safe in the open ground from the effects of frost in many parts of the kingdom, and even in the most favoured localities sometimes; therefore, as a matter of precaution, some covering should be placed over the roots in winter. And in regard to their propagation, they can be increased by division, taking off the rooted suckers thrown up from the roots. This should be done about once in three years, shifting the roots, dividing and replacing in well-manured soil. The best time to divide is in October and early in November. The divided pieces should be placed singly in small pots, and plunged in coal-ashes in a frame, where they can be so far protected as to keep the soil from being frozen. This latter precaution should always be taken, even in the case of plants that are quite hardy. When their roots are in a pot they suffer much more from frost than when in the open ground; this at first may appear inexplicable, but the way it occurs is thus explained: when the soil is confined within the restricted limits of a pot, it has not room to expand when frozen in the same way as when in an unconfined position, the result of which is that an inward compression takes place which crushes the roots within it. From this it will be seen that even the commonest plant should not be allowed to have the soil frozen about its roots when so placed.

It is not difficult to raise Tritomas from seeds, and when the seedlings are well looked after they can be got into flower in a comparatively short space of time. The seeds should be sown in early spring, in pans or pots of a good free soil, and placed in a cold frame as soon as large enough. The seedling plants should be pricked off into store-pots, then, when they have grown into the necessary size, be potted off singly into larger pots, wintered in them, and planted out in early summer to flower. We have known the plants to bloom the same season from seed, but especial care was taken of them, and they were encouraged to grow in every possible way.

GLASS STRUCTURES AND APPLIANCES.

MANAGEMENT AND ROUTINE.

NOTWITHSTANDING the full descriptive notes given of plants in our exhaustive descriptive lists, what has been advanced on plant structures, and the cultural guidance already offered, possibly something more is needful to link, as it were, the plants, the houses, and the cultivator together in the familiar matters of daily practice. Even well-read and deeply-learned men are not seldom at a loss to know how to proceed when confronted with well-built plant-houses crowded to the doors with healthy plants. Their knowledge is often too abstract and too far off to become available in time, and while they are hunting it up the plants suffer or starve. The excuse is too often made that practical gardening can neither be popularised nor taught on paper. This is but half a truth at the best; and having done our best to teach and to learn it thus, the little truth left may be wholly exorcised.

No doubt object-lessons in horticulture are better than illustration, and a garden forms the best school, provided always there are wise teachers and good examples in it; but, still, books may do far more towards teaching horticulture than is generally supposed. This much, at least, may be affirmed: it is of little use building fine or useful conservatories, plant, stove, or Orchid-houses, &c., and furnishing them with plants of much beauty and great value, unless the every-day management of both is such as commands success. Now success is the product, not of one great effort, but of many little ones, such as temperature, heating, damping down, watering, cultivation, shading, cleaning, training, shifting, or potting, or substitutes for the same.

Remarks on these heads will be alike applicable to all sorts of plant-houses, and to every sort of plant grown in them.

Some of these points may seem trifling in themselves, but they are really not so; and while each is important in itself, attention to the whole is needed to insure anything like success in the culture either of plants in pits, conservatories, or Orchid-houses.

Temperature.—This is not only one of the most potent factors in cultivation, but the key-note, as it were, of the whole. A certain amount of heat is essential to the life and growth of all plants, and no sooner is a house fit for use, and indeed long before it reaches that state, than the temperature to be maintained in it must be determined.

Purpose, or rather occupants, goes a long way in determining these points. Taking a minimum or night temperature—one of 40° will suffice for a cool green-house, and 45° to 50° for a warm conservatory, in each case a rise of five degrees by fire-heat being desirable by day.

Practical men always make a broad and liberal distinction between artificial and natural—that is, as they term it, fire and sun-heat. It is found, indeed, as the result of constant experience, that five degrees of fire-heat will weaken and draw plants more than fifteen degrees of solar heat. In fact, this is hardly a fair way of putting it, for while the lesser increase of fire-heat may injure the plants, the greater increase of solar warmth may benefit them.

As the season advances, both green-houses and conservatories rise in temperature with the growing power of the sun, till the green-house advances by day to 45—50°, and the conservatory to 50°—55°, and beyond these figures neither house should rise without a free circulation of air, which may, if skilfully managed, be so admitted and discharged without creating cutting draughts, as to reduce the temperature under that of the external atmosphere.

Temperature of Plant-stoves.—Where there are two or three of these, it is a common and useful practice to keep one house five or ten degrees warmer than the other. In such cases the one is called the hot or tropical stove, and the other the cool or intermediate house. Both houses may also vary very considerably, according to the season of the year, and the time of day. It is customary to keep all plant-stoves at their summer heat during winter, and to bring down the daily summer heat to an hour or so before and after sunrise. It does not, however, suit stove-plants to be subjected to too low a temperature, and the hot-stove should not sink to less than 65° either during winter or the early morning.

The cool or intermediate house may sink fully five degrees more. The daily temperature should not rise more than from five to ten degrees higher with fire-heat. From November to February the plant-stove should also range from five to ten degrees lower than from February to October. During the latter periods from 80° to 90° sun-heat, for a few hours in the evening, will not injure these houses. As the light gains in intensity, the temperature may be safely increased in proportion.

Temperature of Orchid-houses.—Where these are numerous, at least three ranges of temperature are maintained, the hottest ranging from 65° to 70° in winter to 75° to 90° in summer; the second from 60° to 65° in winter to 65° to 75° in summer; and the third, or cool Orchid-houses, from 45° to 50° in winter to 55° to 65° in summer.

Heating.—This will be treated separately, in so far as boilers, pipes, furnaces, the arrangement of heating materials, &c., is concerned. Only the practical use of heating machinery in the every-day business of keeping up the heat, as it is called, will be adverted to in this place. This of itself, however, is a large subject, and embraces the economical use of fuel, as well as its timely consumption to the best advantage; in a word, the whole art of stoking—an art less understood and more wastefully practised than any other within the entire range of horticulture. Two sources of waste and mischief will be noticed. The first is the piling up of fresh fuel under the base of the boiler, and the second the banking up of fires during the day. The first does its best to keep the boiler cool, and burn out the furnace-bars with the intensity of the heat wasted. This practice often originates from having the furnace too short and too deep. All furnaces should have a dead-plate, a foot or two feet in length, between the furnace doors and the bars. On this plate the greater part of the charge of fuel should be laid; there it would be partially charred, and the flame and gases from the coal pass along under the boiler, and between its crown and the glowing embers beneath, adding immensely to the heat.

The first act of good stoking consists in pushing all the half-consumed fuel under the boiler, to become glowing embers in turn, then place a fresh charge of cold, raw fuel, on the plate, to succeed in due course that removed. There used to be a boiler with a second sloping plate — Kewley's patent — that lengthened the space for fresh fuel—and proved to some extent self-acting, by sloping down the partially decomposed coal on to the furnace bars below. The saving of heat by such modes of stoking is most inadequately measured by the saving of coal. On the contrary, that is the smallest part of it. The greatest saving is effected by the fact that by this simple mode of stoking each pound of coal gets at its work in glowing condition, so that its whole force is expended on the warming surface.

Banking Up.—A certain amount of banking up at night is a necessity. Unless stokers are to sit up all night, it is needful to mix buffers to pure coal, or other fuel (in the form of ash, clay, or chalk), as these check the fierceness of combustion, and make a fire hold out till the morning. Much of this, however, involves a prodigal waste of heat. Combustion might be equally well checked by moderating the draught up the chimney through shutting out most of the air, while the furnace would be full of glowing fire, instead of cold, inert ashes. But the evils of night banking are small compared with the day damping of fires. These have a provoking tendency to break through the inert blocks just when the heat is least needed (that is, when the sun is at its hottest), the pipes will often be found to match, and the result of the meeting of the two heats, as practical men put it, is most disastrous. The only safe way, and it would save often half the coal consumed, is to insist on no day damping up of fires from April to October. During that period, when there is a prospect of a bright day, the fires should be raked out at 7 a.m. By keeping a stock of kindling lying at hand it is easy to relight them should a change of weather occur, and the labour and trouble are nothing to the coal saved, and the insect and other evils averted from the plants.

By careful attention to these two points daily, the most heat would be got out of the coal, a regular temperature maintained, and all possibility of a most injurious mixture of solar and fire-heat, and consequent excess, avoided.

Damping Down.—The use of artificial heat almost involves the necessity of this practice, which is one of the most important daily routines in plant-houses. It is a common saying that artificial heat dries the atmosphere. Some advocated flues on this account, and others condemned them for over-drying. One of the prejudices against hot-water pipes at first was, that they would make the air too moist. This was soon found to be a mistake. Excepting for the small modicum of heat absorbed by the bricks or tiles of flues, they dried the air no more than hot-water pipes, which are as impervious as they are non-absorbent. But all heat added to the air strengthens its capacity for moisture. Hence the more heat, the more moisture absorbed, and the larger the supplies needed to keep the air of plant-stoves and Orchid-houses sufficiently moist.

And thus it comes to pass that while these may need damping down full half a dozen times a day, cool green-houses and conservatories may need none, and in winter too much care can hardly be exercised to keep the paths and stages dry. In winter, too, even in tropical temperatures, little or no damping down may be needed, as there is no sun to dissipate the moisture, and the plant may need to be forced to rest or ripen in a dry atmosphere. But during the growing season persistent efforts to charge the atmosphere with aqueous vapour must be made. The phrase "damping down" is hardly descriptive of the practice, though its object is really to raise, not the dust, but aqueous vapour, which is pure water, free of dust and dirt of every sort, and hence one of the greatest merits of the practice. Sprinkle paths, shelves, stages, walls, once, twice, thrice, or oftener a day, and the air is charged with a sufficiency of pure vapour to supply the top wants of the plants. Other means are also used, such as overhead syringing at 7 a.m. and 5 p.m., sprinkling of roof, rafters, front and back walls, &c., in pursuit of the same object, thus charging the atmosphere with vapour. Another ingenious method is also employed; at times a small boiler, or covered pot, with jet or pipe with tap attached, is so placed that steam can be distributed into the atmosphere when wanted. This obviates the necessity of overhead syringing; and, if a small jet is used, the heat of the steam does no harm to Orchids in full growth. And yet another plan, of employing vital distributors of aqueous vapour, as beautiful as useful, is frequently employed. The front, back, or end walls are clothed with Ferns, Selaginellas, or other drooping or creeping plants, and these raise and distribute much aqueous vapour by simply growing, generating it with twofold power when their leaves and branches are moistened with water.

Watering.—This refers to the roots, and in answer to the question, How often should these be watered? the only answer is, When dry. No other is possible, unless it would lead to the ruin of the plants. Water only and always by condition, never by time. Look over the plants daily, or twice a day in the growing season; test the water-wants of the plants by the eye, if thoroughly experienced, and by the following tests if not yet perfect in water knowledge of plants—weight, colour of surface, ring of pot, state of the leaves. Those accustomed to handle pots of given sizes can tell in a moment by their weight if the soil is dry. A light-coloured surface mostly indicates a need of water. A wet pot has no ring in it—it sounds as dead as a log of wood; a dry one sounds as clear almost as a bell when a willing knuckle is used vigorously on its sides. The flagging of the leaves is also a test of dryness, though less certain than either of the others, for this may arise from bright sunshine succeeding shade, and also from a saturated condition of tissue, resulting from an excess of water at the roots.

How Much Water to Give.—This must vary with the size and the character of the plant, and the relative size of the pot to the same. Of course the larger the plant the more water in proportion, though the larger the pot in contrast with the plant, the less. Plants with large and porous leaves will also need larger supplies than those with smaller and harder foliage. Sufficient should in all cases be given to reach every rootlet and grain of earth. For such waterings are thorough, and therefore safe, and not another drop should be given again until the roots manifest some or all of the symptoms of dryness.

These are what are termed routine, that is, regular waterings, and they apply to all plants in pots, whether in-doors or out, in a tropical or temperate temperature.

Exceptional Waterings.—These apply especially to Orchids, and it must not be forgotten that the withholding of water is the chief means of maturing their growth, compelling them to rest, and thus insuring their health, and augmenting their floriferousness. These forced rests through drought for special purposes are, however, quite outside normal waterings, though similar considerations limit the supplies to most stove plants in the late autumn and throughout the winter. The rate of growth determines, to a great extent, the amount of water utilised; and, hence, a state of maturity or semi-rest must needs prove a season when less water is needed.

The Giving of Air.—One of the things that surprise the amateur is the care and skill bestowed on the many contrivances invented for the prompt and almost immediate giving and withdrawal of air from plant-houses. Their first and chief idea of a plant-house is that of a closed structure, and they cannot understand why all this labour and expense in making them open and close. But a winter's experience in the management of an old-fashioned plant-house, and a record of the time taken up in opening and shutting ventilators daily, would alter the amateur's opinion. All this, however, will be found described and illustrated in a separate chapter. Here it is only needful to refer to the time to give air, and the amount of air to give. As to the time, by opening the ventilators so soon as the sun has raised the temperature five degrees or so, we give air, as it were, twice, nay, many times, and far less will be needed than if it has been longer delayed. Not only this, but by delaying the giving of air, the atmosphere is heated more rapidly than the leaves, the latter and the fruit being dewed over in consequence. Young cultivators look on this condensed aqueous vapour with favour. It seems so soft, so fine, so genial, and even enriching. No sooner, however, is air admitted than away goes the aqueous vapour on the wings of the dry air, and the leaves and fruit get a severe check in consequence.

The early giving of air so keeps down the temperature that very little is needed; and it may be remarked, that almost the less the better to tropical plants in tropical houses, while there is considerable disparity between the external air and the artificial atmosphere in the houses.

As the counterpart to the early opening of ventilators, early closing should also be practised. By removing all air, at, say, 4 p.m. or earlier or later, according to the aspect of the house, an immense amount of solar heat may be husbanded, almost sufficient, often, to keep up the temperature throughout the night, not only without injury, but with positive benefit to the plants. By damping down immediately, the hot air is filled with vapour, and plants grow like willows throughout the night. It may be remarked, in passing, that night is the season of growth, and that if plants rest at all, which they do not, it is in the day; the fact, however, being that they consolidate the growths made in the night the next day, and elaborate and transform the juices collected in the night into produce by the help of the sun. But to return to our subject, The chief merit of most ventilation is motion, and it is astonishing how an interchange between the external air and the internal atmospheres of hothouses insures perpetual motion. Ventilation is also a useful means of controlling temperature; but if the heating apparatus is kept cool in the early morning of bright days, it is astonishing how slowly mere sun-heat raises the temperature to injurious proportions, especially in larger houses; and, besides, ten, fifteen, or even twenty degrees of sun-heat do far less injury than ventilators thrown widely open to keep it down. A very little air given, as the thermometers begin to rise, will suffice as a sure and safe regulator of temperature, and when air is not needed for this purpose, none need be given, the hot air within, and the cold air without, being sufficiently intermixed without our aid, to maintain the purity and freshness of our artificial tropics.

Shading.—This is another means of husbanding the resources of heat and moisture instead of recklessly squandering them through open ventilators. Instead of setting these open and admitting a rush of cold air to plant-stoves and Orchid-houses, let down the blinds for an hour or two, and the proper temperature is preserved. If air must be admitted in tropical houses, let it in at the lowest point, and make it pass over the hot-water pipes, and a part at least of the open tanks, before its final dispersion over and through the house. Treated thus, and warmed and watered before distribution, it will do good and not harm.

Cleaning.—This is one of the most vital among every-day operations in tropical and temperate houses. Cleanliness is the parent of health among plants even more emphatically inside than out, and for this reason, that the cleansing, natural forces of wind, rain, and storm, are necessarily shut out from plants under glass; dust, soot, minerals in solution in water, insect pests, the necessary operations of path and stage cleaning, and labour—all tend to soil the purity of plants. Hence, jets and showers of water, the sponge, soft brush, &c., are, if not the breath of life to them, at least means of enabling them to breathe, absorb, and assimilate their food.

This cleanliness is especially important among Orchids, which, from their peculiar structure, afford an infinitude of safe hiding-places for insects, and for the storage of pollutions of all kinds.

Training Tropical Plants and Orchids.—Fortunately, the latter need little training, only a few need much or any supports to the flowers, and the long slender racemes of others look best simply tacked up to prevent their getting bruised or broken. Still, training and grouping are carried to a great extent in the making up of Orchid plants, that is, the forming of one or more specimens out of a score or more plants, and so long as the pilers up of beauty in units into masses are satisfied, no harm need be done.

But other stove-plants as well as conservatory ones need much training and careful staking and bringing into shape. It is better at all times if they can be grown into form, and kept in shape afterwards, without too much training; but the limits to area, and conveniences of easy portability, necessitate a good deal of concentration and moulding of pot-plants into handy forms by tying.

The pruning and cutting back of plants when in a semi-dormant state, and the stopping and pinching of their shoots during the growing season, all come under the heads of training.

Potting or Shifting.—This constitutes the larger and more important portion of the routine management of glass-houses, and has already been more or less referred to under the various heads. Only a point or two can be noticed here. Pots, baskets, crocks, soils, and the place of potting should all partake of the temperature of the house; neither should tropical plants nor Orchids have to go through the open air on their way to or from the potting-shed; nor should the process be hurried. The writer was astonished once to see an expert in Orchids take nearly an hour to shift a huge *Cattleya Mossiæ* into a larger pot; but neither Orchids nor other plants can be unduly hurried with impunity.

A good deal of time is needed to consolidate new soil around the roots and old ball, and much compressing with bare fingers and potting-sticks is required to give homogeneity of hardness to the new with the old soil.

After Potting.—An abnormally moist atmosphere and a higher temperature are useful for a few weeks after potting, the object being to stimulate the roots into taking full possession of the fresh earth. This is hastened, according to some, by prompt waterings so soon as potted. Others contend that by using soil and pots all of the same temperature as the house the plants were grown in, and tolerably moist, the roots will strike all the sooner into it if unwatered; either way a moist atmosphere and a rise of five or more degrees in temperature will for a fortnight after potting prove useful.

Difference between Potting Orchids and other Plants.—The hints here given relating to the daily routine management of conservatories and plant-stoves, and the fuller article on plant-potting (Vol. I., p. 112), will give a tolerably clear notion of this important practice. The cultural notes on Orchids will also prove a guide to the shifting and basketing of these magnificent plants. Still, to prevent the amateur treating both sets of plants alike, it may be well to remind him of the broad distinction between them. Orchids are potted on, rather than in, the soil, in a compost often consisting of half drainage, and more living sphagnum than dead peat or other matter. The drainage also very often nearly fills the pot, the roots and compost being heaped up above its surface. The roots themselves are seldom buried in any large proportion, but rather scamper wildly over the surface of the compost, and droop freely down into the air. (See cultural notes on stove-plants and Orchids.) It is to be hoped that these general hints will prove useful reminders of, and safe guides to, the routine work that must be done in plant-stoves and Orchid-houses, day by day, throughout the year, if success is to be reached, and a full harvest of beauty and pleasure is to be reaped and thoroughly enjoyed.

HOUSE, AREA, AND WINDOW GARDENING.

By William Thomson.

PROPAGATION.

THERE are many ways in which plants may be increased; of some of them, such as twisting, tonguing, ringing, budding, grafting, it is scarcely necessary to say much, since they are not likely to be put into practice by the in-door gardener.

Twisting, tonguing, and ringing are three different ways of checking the flow of sap, and inducing the branch thus treated to throw out roots at the part injured. When the branch is bent down and pegged under the ground, it is called layering. If the branch is too far from the ground to be bent down, a flower-pot may be cut in halves, tied round the branch, and then filled with soil—this plan has been called "circumposition." In all these cases, when a sufficient number of roots have been formed, the branch is cut away from the parent plant below where the roots have come out.

Budding consists in inserting into a slit in the bark of some common plant a bud from the shoot of a scarce variety of the same kind of plant. There are many ways in which this operation is performed. Roses are principally propagated by budding.

Grafting is used mainly for fruit-trees, and consists in making a shoot from one tree grow upon another tree by fitting the parts neatly together, and surrounding them with clay or grafting-wax until the surfaces have united. (See articles on Propagation in general, and the propagation of such genera as the Rose.)

The methods of propagation which most concern the house gardener are sowing seeds, dividing roots, and striking cuttings.

Sowing Seeds.—However much we may admire and care for a plant which has been given to us, we naturally think more of those which we have ourselves raised, whether it be from seed or from a cutting.

In sowing seeds, the most usual mistake is in putting them too deep in the earth. Seeds only require to be deep enough to secure an even quantity of moisture during their germination; this can be secured in a pot, not quite full of earth, by laying a sheet of glass across the top of it, under which conditions most small seeds will sprout as well on the surface of the earth as under it. The earth should be neither wet nor dry, but damp; if it be necessary to give any water to the earth, it is better to do it before than after sowing; the moistened soil should then be well turned over and worked together so as to make it all uniformly damp throughout, after which the seeds may be sown, and lightly covered with a sprinkling of the same damp earth. It is important that the earth should be of a light character, leaf-mould and sand preponderating; if the soil be too heavy, it surrounds the seed too closely, and prevents access of air, which is necessary for germination.

In all this we are merely imitating nature. After the seeds have been shed, whether from a tree or from the smallest plant, the leaves then die and fall, they decay, ferment, and give out warmth, they rot and pulverise, and lightly cover the seed, protecting it through the winter, and furnishing it with suitable soil to germinate and grow in when spring comes round.

The natural time for sowing seed is when it is ripe, for then it would, if left alone, fall and sow itself. But it is not always convenient to allow seed to grow just at that time. It is often desirable to keep seed through the winter, and sow it in the spring. In order to keep the seed in the best condition all extremes must be avoided; it must be kept in paper bags in a room where the atmosphere is neither hot nor cold, neither damp nor dry.

Warmth hastens the germination of most kinds of seeds, and some seeds that come from warmer climates than ours will not grow unless assisted by heat. It matters not how the heat is obtained, but it must be uniform, or as nearly so as possible. A shelf in a warm corner of the kitchen will be found to be the best place at the command of the in-door gardener. An enthusiastic old lady of our acquaintance used to raise seeds in the pocket of her dress; in a glass bottle half full of damp earth she grew at various times Oranges, Lemons, Tamarinds, *Acacia lophantha*, and several other plants, many of which were to be seen afterwards in the form of sturdy little specimens decorating the window of her room.

Division of Roots.—The propagation of plants can often be effected from buds as easily as from seeds. While almost all plants have buds upon those portions of their stems which are above the ground, there are many plants which form buds on the underground parts of their stems; and as these grow into shoots, roots are sent out from the lower portion of them. Primroses are a familiar instance of this method of propagation. If one of these plants be dug up in the autumn and the earth be washed away from the roots, it will be seen that it can be cut up into several little plants, each of them being well furnished with roots. If these are potted separately and kept in a shady place for a week, they will be found to have suffered nothing from their removal from the parent plant, but will grow on as independently as seedlings.

There is one very important advantage in increasing plants in this way. Where plants are raised from seed there is frequently much variety in the size and form of the seedlings, and in the colour of the flowers. On the other hand, by dividing the roots you insure having an increased number of plants of exactly the same variety.

Striking Cuttings.—What a gardener understands by a "cutting" is any portion of a plant which can be induced to throw out roots, and thus form a separate plant. Small shoots from the sides are usually taken for this purpose. Nevertheless a long shoot may be cut up into short pieces, and, providing that each piece contains two or three buds on it, there need be no difficulty in making a plant out of every piece.

It will materially assist the intelligent cultivator to understand the principle of growing plants from cuttings, if he will keep before his mind the following scrap of botanical knowledge. A complete plant consists of three parts, a root, a stem, and a leaf. At the place where the leaf joins the stem a bud is formed, which grows into a shoot, having buds upon its sides. At the base of these buds, roots are more readily emitted than at any other part of the plant. If a piece of watercress be kept for a few days in a phial of water, the glass of which is thin and clear, rootlets will be seen growing out at the parts indicated; and if the piece of cress be suspended by a thread, so that the base of only one leaf be immersed in the water, the rootlets will be found only coming out at that part. This part is botanically called a node, meaning a knot or swelling in the stem, and in striking cuttings only one of these nodes need be underground.

Until cuttings are fairly rooted they should be carefully protected from the light of the sun, while, at the same time, they are allowed the full benefit of all its warmth. Sheets of newspaper will be found to be efficient screens for this purpose.

WATERING.

If there be one portion of horticulture which requires more care than another it is watering. Protection against improper watering is an all-important matter to plants in pots.

It takes some time to learn when a plant really wants water, and how much should be given. and nothing short of a thoughtful consideration of all the circumstances of each case can enable any one to answer these questions correctly. A beginner may have been told over and over again, but he is very likely to forget, unless he understands clearly the reason why a plant should want any water at all.

It must be remembered that plants have the power of giving off moisture from their leaves. If this be doubted, take a glass shade, large enough to cover any small plant, hold the shade in front of a good fire for a short time, so as to thoroughly dry the air inside it; now put the shade over the plant, and you will soon lose sight of the plant altogether; the inside of the shade has become covered with moisture, which has evaporated from the leaves of the plant. Now this evaporation is always going on in all plants, and water must consequently be supplied to the roots in sufficient quantity to meet this drain upon the leaves of the plant. If evaporation were always going on at the same rate, it would be a very easy matter to regulate to a nicety the quantity of water which a plant should have given to it; but this is not the case. Plants grown in a Wardian case or under a glass shade will not require any watering for weeks or months, because the atmosphere in which they grow is a very damp one, and under these circumstances there is but little evaporation from the leaves. On the other hand, plants grown in a room are in a dry atmosphere, which causes the plants to part with a great deal of the moisture from their tissues, and if this loss be not made good, the plant will shew it by its leaves hanging down in a flabby condition. Hence the object of watering is to supply a deficiency of fluids in the plant, and the quantity of water to be given must be regulated by the losses which the plant has sustained from evaporation.

But the quality of the water must not be overlooked, or thought of no consequence. Of surface waters, that which comes from chalk hills is the worst kind, because lime is injurious to many plants. Rain-water is unquestionably the best, and if that cannot be procured, then use pond-water, provided that the pond is not supplied by a spring in it.

The temperature of the water is also of importance, inasmuch as it should not be hotter or colder than the air in which the plant is growing. Water too hot stimulates the plant unnaturally, and water too cold checks its growth, in fact, gives it a chill. Therefore care should be taken in watering that the water is of a suitable temperature. Especially avoid using spring-water, and water from a well, both of which are too cold even for plants out of doors.

The time of the day at which watering should be done is also to be thought of. During the colder half of the year it is best to water in the morning, and during the warmer half in the evening; in hot weather, however, plants may need watering in the morning also. This applies to the roots. Syringing over the leaves is another matter, and requires to be done with discretion. If it should be necessary to do it at all in winter, it should be done in the middle of the day; in the summer it should not be done before the evening, as the sun is so hot that it might burn the leaves if they were syringed earlier in the day. In spring and autumn the morning is the best time, but it must not be done too early.

PROTECTION OF PLANTS.

Whether plants are grown inside or outside the window-pane, the secret of their successful cultivation may be summed up in one word—protection.

It is too often forgotten that what we see of a plant is not the whole plant, and that the invisible part of it requires at least as much care and attention as the visible part. Most of us are aware that the part of the plant which is above the ground requires protection at some time of its growth, protection from sun, from wind, from hail, snow, or rain. But the roots, which are below the ground, must also be protected. They require protection from heat and from cold, from drowning and from drought, from improper soil, and from unsuitable manures. A plant requires protection in the broadest sense of the word, as much as a child, and the best cultivators will always be those who have devoted the greatest attention to these points.

Protection from Sun.—It may seem strange to hear that there can be too much sunlight, but this is so. Some plants require to be always shaded more or less, while others merely want screening from the effects of the sun during the hottest days in summer. Plants in pots require shading from bright sunlight much more than plants in the ground, because their roots, from being confined within a small space, are more liable to get dry than those of plants growing naturally, and when the roots are dry, the plant is less able to bear heat or sunlight, and is more quickly affected prejudicially, than if the roots were in a condition to replace the moisture which has been evaporated from the leaves. One cannot be always watering the roots of a pot-plant, even if it were desirable, but one may prevent the plant from being exhausted (from flagging, as gardeners call it) by shading it.

These remarks have been made with reference to plants in health and active growth. With much greater force do they apply to plants in ill-health, and to plants in which the vital actions have been disturbed and checked, as, for instance, in re-potting and in striking cuttings. In all such cases the effects of strong sunlight are very damaging, and plants thus out of health must for a time at least be kept entirely in the shade.

When it becomes necessary to place plants in the shade, and there is no shady place to which they can be moved (which is by no means an uncommon experience with window gardeners of limited means), it follows that the shading must be brought to the plants, and so fixed over them as to answer the required purpose. There are many ways in which this can be done. Perhaps the cheapest form for a window, where the plants are outside on the window-sill, is a wire frame to hook into staples driven into the wall upon either side of the window, the frame to be covered with the material which is to give the required shade.

In choosing a suitable material for temporary shading, it would be a mistake to take any thick closely-woven substance. It is not desirable to obscure the light, the object should be to modify and subdue the brilliancy of the sun's rays, and this will be best effected by using some light thin fabric with an open texture, such as cheese-cloth, tiffany, frigi domo, or some other similarly-made kind of flimsy canvas. These materials are to be had in lengths of twenty and thirty yards, and of widths varying from thirty-six to ninety inches, most of them being one or two yards wide. The prices range from 2½d. to 8d. per square yard, according to substance and quality. Woollen matting is very efficacious, but more costly.

Apart from the need for shading in cases of liability to injuring plants from exposure to a burning sun, there is a use in shading plants in flower which must not be forgotten. It has the effect of keeping plants in bloom for a much longer time than they would last otherwise, and this is often a point of much importance.

But shading, like every other blessing, may be abused. It is only required when the sun is shining very brightly. Keeping it on at other times would do harm to plants, and therefore there is discretion to be exercised in the use of it. Plants always under shade, even in summer time, would be in a most unnatural position, and would be very liable to fall into an unhealthy condition.

Protection from Drought.—A plant in a pot is more liable to be injured by allowing its roots to get dry than by any other neglect. The soil in which a plant is grown in a garden only parts with its moisture on the surface; but the soil in a porous pot is parting with its moisture from and through the sides of the pot as well as on its surface. Hence any plan which will diminish or prevent evaporation from the sides of a porous pot must be better for the health of the plant than the most regular and judicious watering that could be given.

The use of flower-pots which have been glazed outside is one way of obviating this difficulty, and they should be used when they can be obtained.

But inasmuch as glazed pots are not everywhere obtainable, and even when they are it is not always expedient to shift a plant into one, the simplest plan is to place the pot in which the plant is growing into a pot two or three sizes larger, and to fill up the space between them with moss. Although the outer pot will now be just as much subjected to drying influences as the inner pot was before it was thus surrounded, yet the intervening moss, when well wetted, gives up its moisture much more slowly than earth does, and consequently the wetted moss keeps the soil in the inner pot moist for a long time, and prevents the roots from being exposed to such frequent alternations of wetness and dryness. Though natural to plants under certain atmospheric conditions to be sometimes wet and sometimes dry at the root, yet it is not natural that these changes should take place very frequently. And it is still more unnatural that their roots should be dry when it has been pouring with rain for some time, or that their roots should be soaked with water in hot, dry weather. While there is no denying the fact that a plant in a pot is in an unnatural condition for growth and flowering, at the same time it is not good gardening to allow the roots to remain dry when the atmosphere is loaded with moisture from rain, or to deluge the earth with water when the air is hot and dry. The unnatural conditions in which a potted plant exists, doubtless justify and demand the giving and withholding of water at times and seasons which do not correspond with the state of the atmosphere; but then these necessary deviations from natural atmospheric conditions must be carried out with moderation and discretion.

Protection from Wind.—Wind affects plants in more than one way. The force of the wind, when it blows hard, injures them by dashing the leaves and flowers against the branches, and the branches against each other, thus bruising the softer parts, and often seriously damaging the whole plant. The quantity of moisture in the wind depends mainly on the direction whence it blows, and this has an important influence over the growth and health of plants. Winds that blow over England from the north-east, east, and south-east, have, before reaching our island, passed over large tracts of land, and in so doing have yielded up much of their moisture, and arrive here in a dry condition; hence they are prejudicial to vegetation of all kinds, and particularly so to plants placed in unprotected situations such as windows. On the other hand, winds that blow from the north-west, west, and south-west, come fresh from the Atlantic Ocean, and are laden with moisture, which is favourable for cultivation and development in all sorts of vegetable growths. There is, therefore, good reason for protecting window-plants from the drying and withering effects of all winds coming from the eastward, and this may be done either by a screen of hardy evergreens in pots, or by a blind of some closely-woven substance, or by a wooden screen. When, on the other hand, the wind comes from the westward, it is best to leave window-plants to the full benefit of its moisture-bearing influences. It is fortunate for us and for our plants that we have much less easterly than westerly winds. On the average we have westerly winds for 223 days out of every 365, and only 108 days of easterly wind, the remaining few days having wind from either north or south; so that, roughly speaking, we have two days of moist wind for every day of dry wind. To this fact we may, in a great measure, attribute the beauty and luxuriance of British gardens compared with those on the Continent.

There is yet another condition of the wind which demands our consideration and attention, and that is its temperature. This, of course, is dependent to a large extent upon the season of the year, all winds in winter being naturally colder than the same winds in summer. But there are sometimes temporary and local influences which affect the temperature of the wind. Thus, when icebergs come further south than usual in the Atlantic Ocean, and the wind blows over them before reaching our shores, the wind which we are accustomed to regard as a warm wind will then prove to be a very cold one, and plants in exposed situations must then be protected, if they are at all tender.

The foregoing remarks refer to natural winds, and concern plants out of doors. Cultivators of in-door plants are not entirely unconcerned about these matters, but they are very much interested in those artificial winds which we know as draughts. Open the window of a warm room on a chilly day, and you at once have a current of wind which is extremely prejudicial to plant-life, more perhaps from the sudden change of temperature than from any other cause. The air which is rushing in may not be drier than that of the room; if it be, it will do all the more mischief, because it will rob the plants of some of their moisture as well as chill them.

Protection from Rain, Hail, and Snow.—Rain, if it be moderate, is beneficial to pot-plants provided that they have not been just watered. Heavy rain bruises the leaves and spoils their beauty quite as much as a high wind does. Hail cuts holes through the leaves of many plants, and snow, by its weight, breaks off branches.

Partial protection is obtained in covered verandahs and balconies; and where the eaves of the roof project far beyond the walls, a great deal of protection is thus afforded to plants on window-sills, especially to those of the upper windows.

For plants in balconies and on window-sills, there is no better protection than a stout roller-blind fixed to the wall of the house. It can be used not only as a protection against hail, snow, or heavy rain, but also against sun when it is very scorching. The blind will protect the roots almost as much as it does the branches, leaves, and flowers.

Protection from Heat and Cold. — The stout roller-blind, recommended as a screen from snow, hail, and heavy rain, will also be found of great use as a protection for flowers and leaves against extremes of heat and cold. The roots of pot-plants can be protected against both by the use of double pots, with a layer of dry moss or cocoa-nut fibre between the two, or by keeping the pots in boxes of either material. Something of this kind should be provided for all plants in pots in very exposed situations.

If a plant should unfortunately get injured by frost, it should upon no account be moved into a warm place, as the sudden thawing of its frozen juices would in all probability burst its tissues, and either kill or seriously injure it. It should be put in the coldest room in the house, or in any place where the temperature is only a few degrees above freezing; there it will thaw gradually, and may the next day be removed into its usual temperature, when it will very probably be found to be none the worse for its freezing.

Protection from Dust.—This is not an easy matter to accomplish by means of any temporary arrangement, since dust finds its way through most kinds of canvas. Prevention is here better than cure; by prevention is meant removal from the dusty atmosphere. Window-sills of houses near a road, over which there is much traffic, are especially liable to dust, but there is not much harm in this dust, as it is easily washed off by using a water-pot with a fine rose. If the watering required to remove the dust is likely to make the roots too wet, this difficulty can be got over by laying the plant on its side before watering it, or by slipping over the stem of the plant a round piece of stout cardboard with a slit in it (Fig. 14). It should be rather larger than the rim of the pot, and will, if painted with oil-paint, last a long time.

Another way is to have two semi-circles of cardboard, with a notch in each for the stem (Fig. 15). Either of these plans will prevent too much water going into the roots, which is particularly to be avoided in the dry weather which prevails when dust is plentiful. These cards are also useful when you have to turn a plant upside down to dip it in a pail of insecticide, or to examine its roots by removing the pot.

The dust to which plants in rooms are exposed from sweeping, or from a dance, is more hurtful than external dust. The latter is all mineral dust, and if not removed by rain or the watering-pot, will probably be shaken off by the first breeze. But indoor dust is either animal (woollen or silk), or vegetable (linen or cotton) dust, and does not come off so readily. Hence, it is better to remove plants from a room where they are liable to these influences. Servants should be instructed, as an invariable rule, to remove plants from a room that they are going to

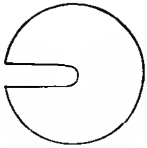


Fig. 14.

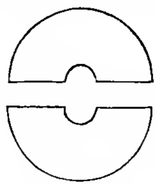


Fig. 15.

sweep, into the hall or landing, and not to replace them until the dust has settled. In some cases it may be practicable to throw a dust-proof covering over the plants in their places before sweeping begins; but as this is liable to be forgotten, it is better to insist on the removal of the plants from the room.

Aspect.—Windows which face south and west have an advantage over those which face north and east. The great drawback to which plants placed in windows facing east are exposed, is the comparatively sudden change of temperature. It is well known that the coldest hour of the night is the hour before sunrise. Plants, therefore, in an eastern aspect are exposed to the warm rays of the morning sun sooner than in any other position, and consequently pass from a cold temperature to a warm one in a shorter space of time than they would anywhere else. Although this may not be sufficiently detrimental to some plants to prevent their blooming, yet it will be found that most half-hardy plants flower better, and look more healthy, in a south or west window.

The drawback to a north aspect is the absence of direct sunlight. This suits Ferns admirably; but it does not suit flowering plants, which have, in this aspect, a tendency to run to leaf instead of flower. This is especially the case with Geraniums and Petunias, which will not bloom without plenty of sunlight. Calceolarias and Fuchsias do better, and flower fairly well; if brought into bloom in a sunny place, and then moved into a north window, they will keep in bloom for a very long time. A north aspect is, however, on the whole, more suitable for plants grown for their foliage than for their flowers; nevertheless, it is too cold and sunless for Begonias, while Moneywort, Ivy, and Virginian Creeper seem quite happy when facing the north.

Plants which are most susceptible to change of temperature should be grown in a westerly aspect· because the change there is more gradual, and therefore less felt.

Many plants which are supposed to have been killed by frost, have really been killed by aspect. Their tissues have been burst by too sudden thawing under the influence of a hot morning sun. The same plants under a west wall would have been none the worse for the frost, because the thawing process would there have been slow and gradual.

Under the heading of aspect we have something to say about position.

You may have been in a nursery garden when some gentleman's gardener has been making a large purchase of shrubs, and you will have noticed that he is picking out those best suited to his purpose, and tying on a label to each. You may fancy that this is only to let the nurseryman see which specimens he has selected, but there is another object in his proceedings. Watch him closely, and you will observe that there is a coincidence between the position of his label on the plants and the points of the compass. If he is choosing shrubs that are to go upon the north side of a pathway, it will be the south side of the plants which will be most seen, and consequently he is selecting in the nursery those which seem to be best developed on that side, and marking them *on that side*, so that when they are re-planted they may find themselves in the same position as that in which they had been growing. If he is buying for more than one position, a single letter (N, S, W, or E) on the label will enable him to assort his shrubs on their arrival, and put each into its proper position.

The reason for all this care is that, however carefully a plant may have been moved as regards injury to or exposure of its roots, it is liable to have its growth much checked by being turned round, or planted in a different position to that in which it has been growing.

All plants, whether in or out of pots, naturally grow most and flower best on their south side, because from that quarter they get most light and most heat. If, therefore, you wish a plant to bloom equally well on all sides, it follows that you must turn it every day or two, so that each part of it in turn may have its share of southern light and heat. Knowing, however, that this change of position is more or less of a check to the development of the plant, we should avoid doing it with a new plant, or with one that has the reputation of being a shy bloomer, until we have the pleasure of seeing it flower for the first time; after that we can afford to experiment with it, even if we have not been able to get any cuttings from it.

Period of Rest.—Plants require rest quite as much as animals. Plants get their annual rest during winter. Our winter months are December, January, and February; but June, July, and August are the winter months of plants which come from the other side of the equator, from South Africa, Australia, and the southern parts of South America. These plants should, therefore, be rested during our summer, and stimulated into growth in our autumn, which is their natural springtide.

From this it is evident that a good horticulturist must of necessity have a general knowledge of geography; and further, that those cultivators who have taken the pains to make themselves acquainted with the physical geography of the parts of the world from which their plants come, must have an immense advantage over those who have not studied the range of temperature, the rainfall, the seasons of drought, the surface-soils, and other kindred matters which affect the growth and well-being of plants.

The way to give a plant rest is to withhold it from those influences which ordinarily excite growth, such as light, heat, and moisture. It must not, however, be inferred from this statement that all plants must be put into very dark, very cold, and very dry places during their natural time of resting. Some require only to be kept dry. The amount of light, heat, and moisture under which plants rest best must be learnt from books or from experts.

Troublesome Animals.—We prefer this title to that of "noxious insects," because there are many creatures that give trouble to gardeners, which have no more right to be called insects than they have to be called birds. If anything that can fly is to be called a fly, then a bird must be a fly! A fly is an insect with two wings; therefore an aphis, which has four wings, is not rightly called a fly any more than a butterfly or a ladybird. So also spiders, which have eight legs, are often wrongly spoken of as insects, seeing that true insects cannot possess more than six legs. No doubt the caterpillars of butterflies, and of some other insects, are furnished with several pairs of false legs, which are usually soft and fleshy, and are found near the tail, whereas the six true legs are always observable just behind the head.

The animals which mostly injure the roots of plants are worms and caterpillars of beetles and moths. Worms in a pot do harm to the roots principally by their burrows, which admit more air under the soil than is good for the roots, and which allow the water when given to run off too quickly. The plant must be inverted, and the pot tapped upwards and removed, when the worms will usually be found lying on the part of the earth that has been next to the pot, and can be picked off. If they at once disappear into the earth, the pot must be replaced and the soil well watered with lime-water, or (which is better) the plant stood in a jar of lime-water up to its brim. As the lime-water finds it way up the ball of earth, the worms will retire before it, and will all be found on the top, when they should be at once removed. Lime-water is made by throwing two or three lumps of freshly-burnt lime into a pail of water; after it has become quite clear it is fit for use. Caterpillars are usually found not far from the surface of the earth; if this part of the soil is loosened and shaken off, and replaced with good leaf-mould, it will often be the means of ridding the plant of caterpillars as well as of manuring it.

Slugs generally keep underground during the day and commit their ravages at night. They should therefore be searched for with a bull's-eye lamp about 11 o'clock at night—23 o'clock new style.

The animals which injure the stems, leaves, and flowers of plants are aphis (or green fly), soft coccus (or mealy bug), hard coccus (or scale), and thrips, all of which are insects. Besides these there is the so-called red spider, which is an acarus or mite.

Washing with an insecticide, and subsequently with clean water with the chill off, is the best means to be adopted for removing these pests. There are many kinds of insecticides advertised, all of them more or less useful, all of them more or less expensive, considering that you can make an equally effective fluid for much smaller cost.

Boil an ounce of quassia chips in three pints of rain-water, and use it after it has been strained and is cool. Plants dipped in this, sponged with it, or syringed with it, will be speedily cleared of all insects. If it is not easy to get quassia, an ounce of tobacco may be substituted for it, and will be found to be nearly as good.

A weak solution of paraffin in water is highly effectual; but we cannot recommend its use for house gardening.

The fumes of burning sulphur are also an efficacious but dangerous method of killing insects, and quite unsuitable for our present purpose.

Red spider is often a trouble to cultivators, especially to growers of Cacti; the best thing to do to get rid of them in such a case is to sprinkle a little dry sulphur over the plant, which will drive them away. This must be repeated whenever they are observed.

Scale are likely to want a stiff brush to be used to get them off; if not moved in some way, the insecticide does not reach them.

Insects are more likely to be a source of trouble to those growing plants in-doors than to persons whose plants are exposed to wind and rain. Most of the insects which are injurious to in-door plants are readily removable by syringing with rain-water, but this is a remedy which an invalid cannot apply usually. So also fumigation with smoke of tobacco is not an amusement which will commend itself to any lady confined to her room; neither would she care to dust her plants over with tobacco-powder, which is another means of destroying insects. But there are other methods which may be adopted. One is to immerse the plant in water, or in some fluid destructive to insect-life, which will not injure the plant. This, however, is not always easily done in a room without the risk of making a mess. The easiest and least troublesome plan is to use a soft brush with some destructive wash, strong enough to kill the insects, but not strong enough to hurt the plant. Soap-suds, made by dissolving an ounce of soft soap in a quart of hot water, and applied, when you can only just bear your finger in it, with a camel's-hair brush, will be found very killing.

Where it is practicable to immerse the plant, no doubt the insects are removed or destroyed much more expeditiously. It will be well therefore to explain how this should be done. First lay down on the carpet several sheets of newspaper put out to their full size, or, better still, a large square of oil-cloth or American leather. Upon this place a foot-pan or bread-crock, over which you must hold the plant horizontally, with the palm and fingers of the left hand covering the soil to prevent its falling out. If the soil is much below the edge of the pot, this space must be filled up with moss or with crumpled pieces of paper, so that the soil may be kept firmly in its place. Having a large jug full of the fluid to be used, the right hand is free to pour this over the plant, thus washing off the insects into a pan or crock. This should be repeated several times, using the same fluid over and over again, until no more live insects can be seen on the plant. After this, the plant should be similarly washed two or three times with water slightly warmed, and thus the plant will derive no injury from the process.

Where it is not inconvenient to move the infected plants into another room in which they can be fumigated with tobacco-smoke, the following method, devised by Mr. I. C. Niven, curator of the Botanic Gardens at Hull, deserves to be recorded for its simplicity and effectiveness. Lay your plants carefully on their sides in the bottom of a washing-tub, over which stretch a towel that has previously been well wetted. Fill a long large clay pipe—a "churchwarden"—with tobacco, and then light it. When thoroughly alight, put the stem of the pipe under one edge of the towel, and push the mouthpiece down to the bottom of the tub, and as near the centre as you can. Fold two or three thicknesses of a cloth over the bowl of the pipe, and through these blow into the pipe. The inside of the tub will quickly be filled with smoke in which no aphis, thrips, or red spider can survive for more than a few minutes. The leaves of the plants must be quite dry before they are put in.

Fig. 16.

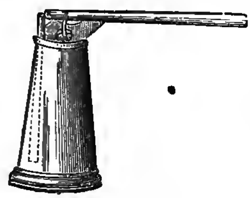


Fig. 17.

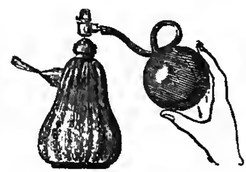


Fig. 18.

Fluid insecticides may be applied in a small way by means of a couple of glass tubes fastened at right angles to each other, as shown in Fig. 16. If the vertical tube be immersed in any fluid, and the horizontal one be blown through, it will cause the fluid to be distributed in the form of minute spray. By this means the branches affected with insects can have the spray directed upon them without its going all over the plant.

They are to be bought in the form indicated in Fig. 17, which is a convenient form of using them.

Fig. 18 shows another modification of this instrument, where the blowing is done by squeezing a hollow india-rubber ball. This may suit invalids; but most people will prefer to use the mouth.

Troublesome Plants.—Under this term we merely refer to parasitical plants, and of these fortunately there are very few. Mildew is a general term for these microscopic plants, which nearly all come under the genus *Erysiphe.*

Mildew is invariably caused by keeping plants in an atmosphere which is too damp, or the roots too dry, and in which there is little or no circulation of air. It is rarely found where there is any draught or current of air. Roses are particularly liable to it.

The best cure for it is to dust flowers of sulphur over the part affected, and this should be done as soon as possible; for these minute fungi grow and spread with wonderful rapidity, and the sooner they are killed the less will be the injury to the plant.

THE HARDY FRUIT GARDEN.

By D. T. Fish, assisted by William Carmichael.

THE GENERAL CULTIVATION OF THE APPLE.

HAVING planted the trees in proper soil, in the most skilful manner, pruned and trained them into form, and moulded them into fertility, there are yet several things to be attended to, that may be most properly designated general cultivation. Among these the more important are surface mulching, watering, protection of the blossom, thinning the fruit, perfect development of the fruit, tests of ripeness, gathering, storing, and packing.

Mulching.—On light soils and in dry localities, few practices are more useful in Apple culture than the application of a surface mulch. It may consist of almost anything, from moss or short grass to sheer manure. The first would be chiefly conservatative and passive; the second, active and manurial. It would be difficult to say which of those qualities in mulches are the more useful. The first conserves the strength and moisture of the soil, the latter adds to its strength, while *also* husbanding its moisture. Both classes of mulch also exert a third effect, perhaps of equal or greater cultural importance than either of the two named. They attract the roots near to the surface, and keep them there; for though it be true, as so clearly shown in our Life-History of Plants, that roots naturally, and in spite at times of many obstacles, dig their way downwards, it is equally true, though not to the same extent or degree, that they will come up into surface mulches, if of tempting quality and properly applied. And this apparently on the vulgar principle, by no means confined to the roots of plants, of finding their way to the best larder, and having found it, remaining in it. But unprofessional readers will naturally ask what is a mulch? It is, in brief, a layer of manure or other loose material, spread over the surface of the ground. In practice, mulches vary as much in thickness as in quality. They range in depth from an inch to six inches or more. Three inches is a good average depth. If too fleet, a week's drought shrivels them up into worthlessness or nothingness; if too deep, they lose somewhat of their efficiency. As a mulch to be effective must be composed of loose, and consequently slow-conducting materials, the soil under a deep mulch in summer would rise but little above its normal winter temperature. A deep mulch consequently means a cold root-run, which might suit Apples well in Devonshire, and chill them into canker and mildew in Cumberland or Scotland. In fact, in the North, say beyond York, the roots of Apple-trees need little or no mulches, and those applied should be finer—that is, less powerful—than those used in the Midland or Southern Counties.

Materials for Mulches. — Partially decomposed hot-bed and farm-yard manures, spent mushroom beds, and leaves of trees, rough cocoa-fibre refuse, wood and coal ashes, moss, short grass, long litter, turfy loam, or other loose soil, spent tan, rotten rags, or other refuse, are among the cheapest and most efficient materials for mulches. Where the soil is poor, and the trees are weakly, the stronger of the above, or even a thin surface covering of horse-droppings, sheep and cow manure, hen or pigeon's dung may be used. The two latter, however, should be mixed with four times their bulk of fresh loam, and allowed to decompose for six or twelve months before being applied to Apple or other trees; otherwise such powerful stimulants fail to attract the roots, and should they do so, would greatly injure them, being so powerful as to burn them, as gardeners call it. Of course, exposure on the surface quickly decomposes and sweetens the manures, but unless under exceptional circumstances the lighter mulches, such as spent mushroom-beds, cocoa-fibre refuse, and old hot-beds, are the more suitable for Apple and other fruit trees.

Watering.—During spells of drought, one or more good soakings of water are of the greatest use to Apple-trees. True, the surface mulching by checking evaporation renders less water necessary; it also renders artificial watering far more efficient by conserving the whole of it for the use of the roots. By checking evaporation, it also keeps the roots warm—a point of great moment—for one of the greatest drawbacks to copious waterings in the open air during bright, hot weather, is the chill thus given to the roots through the energy of evaporation from the moist surface.

Hence, roots under mulches enjoy comparative uniformity of temperature, and escape all those extremes so injurious to fruit and other trees and plants.

Sewage, house-slops, soap-suds, or manure-waters made of different droppings, soot, guano, and bone-dust, dissolved bones, &c., are better than clean water. As to the strength of these and other manures, weak and often is a good safe rule; especially must this be adopted with drainage from stables, piggeries, &c. From six to a dozen parts of clean, soft, rain or river water, to one of such manures, is sufficiently strong for Apple or other fruit trees; for guano-water, dissolved bones, &c., an ounce to a gallon is a safe measure. Two pecks of pigs', sheep's, cows', and one of fowls' or pigeons' droppings, to an eighteen-gallon cask of water, is sufficient.

Importance of Thorough Waterings.—Sufficient should be given to penetrate through the entire mass of roots; how much that may need will depend on circumstances; four gallons may be ample for a cordon, while a hundred may be needed for a full-sized Apple-tree in an orchard. Unless the watering is thorough, it had better be dispensed with. Driblets are worse than useless; they simply tempt and tantalise the roots to their destruction. One thorough watering may double the weight of the Apple crop; a dozen driblets may end in most of the crop dropping before ripe, and a weakly mildewed condition of tree.

Water, too, in dull, or even showery weather if possible. This may seem strange advice to give, but it is sound nevertheless. The water will do twice the amount of good while the tops are thus placed *en rapport* with the roots, luxuriating in a welcome flood of water. Flooding is in fact a better word than watering to designate the proper mode and extent of watering fruit-trees; and applied in this copious sense, it will seldom be needful to water Apple-trees more than twice, or at the most thrice during the driest season. In normal seasons one good watering in July will probably suffice.

Protection of the Blossom.—With dwarfing stocks and miniature trees, some slight protection to the blossoms against the destructive effect of late spring frosts becomes practicable and easy. Any sort of thin canvas or bunting, wool-work, or other netting, is suitable for this purpose. And in the case of an Apple orchard of dwarf bushes or cordons, the whole could be covered over easily, with a few posts and rails used for a framework; the canvas could then be made portable on rollers or otherwise. In the case of wall and espalier trees, or cordons, protection is still more simple and easy. A few newspapers have proved quite efficient against ten degrees of frost, and fortunately, when protection is most needed, that is on clear, frosty nights, neither wind nor rain is apt to displace or render the paper useless.

Better even than papers are a few boughs of Yew, Spruce, or other evergreen tree, Laurel, or other boughs. These may be laid on loosely, or stood up over cordon or other trees, with a minimum of labour and of trouble, and a maximum of success, in protecting the blossoms against any frost that is likely to occur.

All this may seem troublesome work to the uninitiated, but once done it is the more easily repeated; and such flimsy and universally available means of protection have proved themselves more efficient than the more ponderous and costly systems that have yet been devised. Some, indeed, reason and act as if no protection were needed, or as if no amount of it could save the crops. But seeing is believing in such matters, and the writer has again and again gathered good crops of Apples by means of those simple modes of protection, while unprotected trees all round have been fruitless.

Thinning of the Fruit.—This is a far more pleasant matter than that of protecting the blooms. But it is almost equally important, if fruit of full size and the highest quality is desired. And few sights are more painful to the skilful pomologist than that of trees broken down by crops of small-sized and consequently worthless fruit, when judicious timely thinning would have saved the trees from disfigurement, and furnished reasonably heavy crops of the highest quality.

Nor is it only the current year's crops that suffer deterioration; the trees themselves are often crippled, almost ruined, for a series of years, if not for life, by one or more enormous crops.

The modern methods of forcing and intensifying fertility have strengthened the necessity for the prompt and vigorous thinning of the fruit. The Apple flowers in bunches or trusses of flowers varying from three to a dozen, and it is only reasonable to suppose that if all remained on the spur, room could not be found for a fourth part of them. As modern culture aims at multiplying fruit-spurs until the tree is closely covered with them from base to summit, it follows that should the blossom set freely, occasionally the entire crop is dropped in this way. Too many mouths in the food-basket have exhausted the supplies, and the embryo fruits are starved off *en masse*.

Such *contretemps* may be avoided, or mitigated within the range of a useful crop, by timely thinning.

The Time to Thin Apples.—It is safer to complete the process at two or three times at an interval of two or three months. So soon as fairly set, say towards the end of May or early in June, carefully go over the trees, and gently shake them, or agitate with a light touch of hand or finger. Any that fall off are those that the tree would in any case have given notice to quit. Then observe any that show a tinge of yellow in the stems. These are also doomed to fail and should be removed. If still too many are left, reduce the numbers still further by the removal of all small, misshapen, or ill-placed fruit. So far the thinning has been confined to those already doomed by the tree itself to be either removed, or become comparatively worthless if left on the tree.

Artificial thinning may be said to begin at this point, to be afterwards carried far beyond it. With a pair of sharp-pointed scissors reduce the Apples to one, two, or three on a shoot, according to the strength of the tree and the distance apart of the fruit-spurs. About three of the largest, most perfectly formed, healthiest and best-placed Apples on a branch will prove a good average. The summer varieties will need no more thinning, but late Apples should be gone over again in July, and any malformed or very small fruit removed. If the crop then seems too heavy, or any of the fruit are so placed as to unduly crush each other, a few more may be taken off. This timely reduction of the weight of the crop, and its adaptation to the vital force of the tree, combined with timely watering of the trees should they be dry, will generally prevent premature dropping in the autumn, and finish the fruit perfect in form and filled with quality.

Perfect Development of the Fruit.—All the culture given will tend to this result. Mulching and watering will provide continuous and plentiful supplies of food, and the thinning will lessen the number of consumers, and adjust the resources of the trees to the demands made upon them. Still, something more may be done to foster the perfect development of the fruit. For example, the leaves may be kept clean, any that unduly shade the fruit may be removed, all small shoots should be taken off, and the stronger ones finally cut back, so as to allow the fullest possible access of light and air to the fruit. Fresh supplies of manure may also be applied to the roots.

The keeping of the leaves clean is of the utmost importance in or near towns, or close to public and consequently dusty roads. Again and again have we seen Apple or other trees refusing to thrive under such circumstances. They were simply half-choked with dirt, their leaves, branchlets, and fruits were white as if mildewed over with sheer dust. Contiguity to manufacturing centres varies the colour and aggravates the evil nature of the dust by adding soot and other abominations to it. Now, the best remedy for all this suffocating foulness is a hose from the water-main, or a garden engine of considerable size and force. A daily wash overhead at eventide, sending the water on with all the force at command, will keep the leaves and stems and fruit clean, and create and sustain a genial local atmosphere most favourable for the full development of the fruit.

The Removal of Fruit-shading Leaves.—Some look upon it as sacrilege to remove any leaves. They are the life, lungs, and heart of trees. Yes, all very true; still, there may be too many, and placed in inconvenient positions. Hence, when too thick, thin them, and when keeping off the light and heat of the sun, remove them, is advice as scientifically sound as it is practically useful. The leaves may also be bent under, or out of the way of the fruit, where it might not be wise to remove a fine leaf that is developing a fruit-bud for next year.

A great accession of light and air to the fruit may also be obtained by the entire removal of all small and hence useless shoots in its immediate neighbourhood. The stronger shoots may also be cut hard back to within three or four buds of their base in August or September, without much risk of forcing the remaining buds to break during the current season. But if through the character of the season, or other circumstances, there is any such risk, then these shoots can be broken almost through, and the top thrust out of the way of the fruit. The weakly life of the broken top will prevent the risk of forcing the buds to break at the base of the shoot. Besides, it will neither be needful nor desirable to cut or bend all the shoots back so far as those in the immediate neighbourhood of the swelling and finishing Apples. By such means every ray of light and heat may be brought to bear on the Apples, to the enlargement of their size and the improvement of their flavour.

Occasionally, with all due care and skill in the thinning of the fruit, it will be found that as they near the finishing stage the tree is overweighted. If there seems the slightest fear of this after the final thinning, the surface soil should be removed for a few inches, and a coating or mulching of good manure applied in its stead. If this is well watered home at once, much of the strength of the manure will at once be conveyed to the roots, to stimulate them in forwarding more and richer supplies of food to the fruit. Liquid manure is equally useful and still more immediate in its action, and the dose can be repeated as the state of the fruit and the trees seem to require. This special watering, or waterings, however, differs from those already referred to, in being for the benefit of the fruit rather than of the trees. Strong manure-water, however, should not be given within a month of the time of gathering.

Tests of Ripeness.—These are less easily applied than many practical men suppose. Some insist on full size and colour, but both may be attained long before the Apples are ripe enough to gather. Besides, the same Apples in the same garden are seldom exactly alike in size and colour two seasons running. Climate as well as site, soil, culture, result in wide diversities of size and great variations in colouring. So much are Apples modified by such changing conditions, that skilled pomologists have often considerable difficulty in identifying the same variety of Apples grown and shown over such wide areas as Exeter, London, Manchester, and Edinburgh. Fortunately, however, there are at least four tests of maturity that are as constant as they are trustworthy. These may be defined as the drop, touch, seed, and flavour tests.

The first is infallible, unless brought about by disease, treatment, or insects. Canker and mildew may both cause Apple-trees to drop their fruit prematurely. Over-cropping, or scarcity of food or water, may also cause the fruit to drop. Maggots, again, seem to bore their way through the connecting link or line between the tree and its fruit, and maggoty Apples fall in showers. In this case, however, the maggot hastens maturity, such as it is, and the fruit can hardly be said to fall before it has reached the stage of maggot-induced ripeness.

But apart from these extraneous causes of natural falling, the drop test is a sure and certain one, the tree's notice to quit being an absolute proof of the maturity of its produce.

Unfortunately, the drop test is of comparatively limited application. Only the summer or early autumn varieties can be subjected to it, and so soon as sufficient of these drop to demonstrate that the bulk of the crop is ripe, it should be carefully gathered and not allowed to fall.

The Touch Test.—This is of far wider application, and applies to the bulk of Apples and Pears. It requires, however, considerable skill in the using. The touch of pomologists differs as widely as hand-shaking in society, that is from a one-fingered tip to the veritable wring of a steel-like vice. Now our Apple maturity touch test can hardly be too gently applied. A simple lifting up or change of position of the fruit, and it falls in the hand. Try a few more; and if the result is similar, gather the crop with confidence that it is ripe enough for storing; but should the fruit cling to the branch, and refuse to come off without a portion of the spur with leaves adhering to it, leave the fruit on the tree, unless compelled by approaching frost to gather them.

The Seed Test.—Cut a few fruit into halves, and carefully examine and test the seeds; if they are plump, brown, and relatively hard to former seeds, the fruit may be gathered with perfect security if it is readily separated from the tree as well.

Unless the last test is present, examine the seeds afresh, and unless compelled by weather or lateness of the season, give the fruit the benefit of any doubt that arises, and leave the Apples on the trees as long as possible.

The Flavour Test. — Unfortunately, this is only available where it is least needed, that is, among the earlier Apples; the later ones have two chief stages of maturity—one that indicates the time to gather them, the other the time to eat them. Hence, many of our best Apples are gathered long before they are fit to eat.

The ripening process, being after a certain stage as much chemical as vital, goes on to completion after the fruits are removed from the trees.

This fact, however, by no means lessens the importance of gathering late Apples at the proper time; for if gathered too early, the conversion of acids into saccharine matter can never be perfected; the fruits also shrivel, and lose much of their weight as well as their beauty. The flavour test, however, determines with absolute certainty the exact time to gather summer Apples, as well as the season for eating all others. If more generally applied, early Apples would generally be gathered before they reach to the drop test; for it may be taken as absolutely proved that they either reach their most refreshing and aromatic state before they drop, or develop it after gathering, if gathered a week or ten days before the tree itself casts them off. For it should be borne in mind that the tree concerns itself only with maturing the seed, and has no care nor interest in the fleshy envelope (our edible Apple) in which the seed is embedded.

Gathering. — The careful cultivator and all amateur growers of Apples will, of course, carefully gather the fruit by hand. It should also be laid in flat baskets, lined with moss or cotton wool, as every bruise will hasten decomposition and lower quality. Orchardists, on a large scale, very often gather roughly, shaking down the fruit, and packing in sacks, or large baskets. If converted into cider, or sold and consumed at once, it matters less, though it seems a pity to injure good fruit for lack of a little more time and care in gathering. Many of the growers for market and the larger private growers, however, gather their fruit with care, and skilfully pack in bushel or other baskets and boxes at once, to avoid further risks of bruising and consequent injury. Gentle gathering and smooth carriage are very important to the good and sound keeping of the fruit. The former is also of great moment to the trees. By rough gathering, smashing the fruit down with sticks, &c., not only is the current crop ruined in the harvesting, but the succeeding year's crop greatly lessened by the wholesale destruction of fruit-buds. The amateur and true devotee to fruit-culture is not likely to hasten over the gathering of his fruit, which he will probably find his highest horticultural pleasure of the year.

The Packing of Apples.—Very much has been said on this vexed subject; fierce paper wars have been waged over boxes and baskets of different forms and sizes, and yet wider diversities of opinion have been manifested over the packing materials as buffers between the fruit to prevent them from being bruised in transit. Hay, straw, chaff, paper shavings, sawdust, cotton-wool, moss, malt combs, dry earth, cocoa-fibre refuse, &c., have all been recommended for this purpose. The Americans have well-nigh settled the matter in their own characteristic fashion, by ignoring all our old-world practices and experiences. They simply put their Apples into barrels, heaping them up until they form a flat cone in the centre, considerably above the level of the head; then by slow pressure the head is forced in or on, and the Apples despatched thus all over the world. And, strange to say, they arrive by hundreds or thousands in all our great markets, packed in this rough-and-ready fashion, without serious bruising or loss. In fact, the Newtown Pippins in Covent Garden are as fresh and free from bruises after crossing the Atlantic as are our Ribstons and Orange Pippins that have travelled but a few miles. The great evil of most buffers for Apples and other fruit arises, as it were, out of their merits, that is, their softness and elasticity. During the strain of a rough or long journey, they give way, the fruits thus have room to move, and hence the bruising.

Fortunately Apples, in sound condition, may be laid sufficiently close together to prevent their movement without injuriously bruising each other, especially if carefully placed in peck or bushel baskets, boxes, or, better than either, barrels.

Another great evil from the use of buffers for packing Apples or other fruit arises from the flavour they impart to the fruit, and which is seldom wholly got rid of if the Apples remain packed up for any length of time. Hence on the whole the success of packing Apples in small baskets, boxes, or barrels, and using nothing between them, if packed sufficiently firm to prevent the Apples moving during the journey. The open-topped low bushel baskets, so largely used in Covent Garden and other markets, are also admirably adapted for sending Apples long distances by road or rail.

The Storing of Apples.—For home use the packing stage is dispensed with, and the fruit is carried in open baskets to the place of storage. Any cool, moderately dry room, garret or cellar, where a regular temperature of 45° can be maintained in all weathers, is well adapted for the safe storage and long keeping of Apples. If the garret is used, special precautions must be taken against excessive dryness, and severe alternations of temperature: if the cellar, it may prove too damp. No place, however, proves a better Apple-store than a dry, frost-proof cellar; a spare bed-room or larder also proves almost equally suitable. In both, however, the strong odour of Apples may prove objectionable. In farm-houses, there are few more suitable places than a granary, fitted with close or latticed shelves along the side or end walls. In orchards or gardens where Apples are grown on a large scale, special places will be built or fitted up as fruit-rooms, wholly devoted to these fruits. Sometimes roots and seeds are stored with fruit, but this is objectionable, as fruits are specially sensitive to the giving and taking and long retention of odours.

Hence the importance of storing Apples in a place by themselves if possible, and especially away from strong-smelling matters, such as Carrots, Parsnips, Onions, or other roots. One of the worst modes of storing Apples is in a huge heap on the floor, lying on and covered over with straw. They can, however, be kept in many ways, as in drawers, boxes, jars, flower-pots, and other modes. One of the oldest-fashioned and still most successful methods of storing the very late varieties is to place them in jars, put a piece of slate over them, and bury them in the ground a foot or so under the surface, so as to be free from frost. Packing in dry sawdust, &c., is now generally abolished, as is the use of elastic beds of dry moss or other substances.

Deal shelves are also objectionable, as the odour of resin goes into the Apples by contact, and also through the odour exhaled. White wood, as it is called, such as Lime, Sycamore, and Poplar, forms the best shelves. And if deal or any other wood is used, it should be painted at least three times, and varnished over; this varnish prevents the taste or odour of paint passing into the Apples, and such shelves in lattice of three or four inch splints, with an inch or an inch and a half space between the splints, is the most cleanly and suitable. We have seen Apple-rooms fitted with ranges of shallow shelf-drawers, thus made with bottoms of open lattice or lath-work, so as to pull out singly at pleasure, and at such distances as to allow two or three inches between the tops of the Apples and the shelf next overhead. Where large crops are gathered, such an arrangement will store away an immense quantity of Apples in moderate space, all the fruit being perfectly accessible singly, and with plenty of air-space between.

The great points in Apple or other fruit stores are, uniformity of temperature and a moderately dry atmosphere.

All choice fruit should be laid in single file. Commoner and the earlier kitchen Apples, such as Lord Suffield, might be stored three deep. Were space sufficient, however, all would keep longer one deep. The old system of sweating Apples in large masses to hasten and heighten maturity is wholly abolished. It landed myriads of the finest fruit in sheer rottenness, and lowered the quality of any that escaped destruction. Not but that extra heat may be applied to small quantities of Apples to hasten maturity when wanted. A warm corner in a kitchen, or other hot place, such as a stable; the fruit being placed in jars, hermetically sealed, plunged in a hot-bed of 70° or 80°, or placed in a hot frame or house, may be thus ripened a week or a month before its natural season if wanted. But this should be exceptional, and each fruit, as a rule, should be coolly stored till its natural season arrives. Earth-storage, already referred to, retards the natural season of fruit almost as effectually as hot storage hastens it; and both, and even more extreme cold, may be employed to extend the season of Apples at both ends, and thus the more easily girdle the year round with this, the most popular and useful of all our fruits.

Lest any should be discouraged from growing Apples by the instructions in general culture here set forth, it may be added in conclusion that few fruit-trees are more able to take care of themselves than the Apple, if planted in good soil and a favourable site, and that the bulk of our orchard Apples really receive little or no attention in the way of cultivation, and yet go on growing and fruiting for a half, or even a whole century. Still, for garden culture, and especially in the neighbourhood of large towns, where it is most desirable to introduce some of the smaller forms of Apple into every villa garden, all the practical advice here given will be found useful in enabling the *petit* cultivator to grow and eat as good or better Apples than the grower of acres under more favoured conditions of soil, site, and climate.

HOT-HOUSE OR STOVE PLANTS.

By William Hugh Gower.

Bambusa.—A family of gigantic grasses, mostly natives of tropical countries, several species of which are simply invaluable to the inhabitants of the countries in which they grow; they are plants of very rapid growth, and extremely beautiful as decorative objects. *B. arundinacea* is the most common, and at the same time perhaps the most useful, as from it even houses and all domestic utensils are made, and the slender-stemmed species have lately become common in this country as bamboo canes, and are used as walking-canes, and for garden-sticks. *B. arundinacea* attains a height of upwards of a hundred feet, and grows at the rate of six or seven inches per day. Bamboos present a distinct and feathery appearance, and produce a beautiful contrast of foliage when grown with other plants; and although some species require to be grown in the hot-house during the whole year, others of dwarfer growth, and from more temperate regions than the species already mentioned, will not only thrive in a cool house, but form beautiful ornaments in the sub-tropical garden in the open air during the summer months. Bamboos have all more or less the same general aspect, but differ considerably in the size and colour of their stems. The most beautiful are—

B. arundinacea.	B. Japonica.
B. aurea.	B. nigra.
B. edulis.	B. Simonii.
B. Fortunei variegata.	B. viridi-glaucescens.
B. gigantea.	

Barringtonia. — This genus is named in honour of the celebrated antiquary, the Hon. Daines Barrington; they are usually placed in the order *Myrtaceæ*, but with a few other allied plants have been separated from these, and established as a distinct order under the name of *Barringtoniaceæ*.

Barringtonias are bold-growing, handsome plants, which attain the proportions of large forest trees, and when in flower are extremely handsome; it is, however, for their majestic appearance as young plants that we introduce them to the notice of our readers. These plants are distributed through various parts of India and the Indian islands; one or two species extend to Northern Australia; and one species has been found in Eastern Africa. They all enjoy strong moist heat, and should be potted in loam, peat, and sand.

B. speciosa.—This is perhaps the most beautiful species in the genus, although *B. racemosa* is a beautiful companion, with a similar habit of growth; it attains a height of from twenty to fifty feet, but as a young plant one or two feet high it has few rivals; leaves alternate, oblong - obtuse, one to two feet long, thick and fleshy, deep shining green on the upper side, paler below. Moluccas.

Beaucarnea.—A genus of large-growing plants belonging to the Liliaceous order; they are at once curious and handsome; the stems are erect, many feet high, and the base is much swollen into a woody bulbiform mass, the summit being crowned with a very large head of pendent ensiform leaves.

Beaucarneas are all natives of Mexico, and require an abundant supply of water during the summer season, but during the winter little or none is required. Pot in rich sandy loam, and drain the pots or tubs well in order to carry off the water rapidly. Temperature of the Intermediate House.

B. glauca.—This species is sometimes called *B. stricta;* the leaves are pendulous, narrow, about three feet long, and very glaucous; the variety *latifolia* has broader leaves, and a much stouter stem. Mexico.

B. gracilis.—An elegant, slender-growing plant, with straight narrow leaves, slightly channelled in front, and bright green. Mexico.

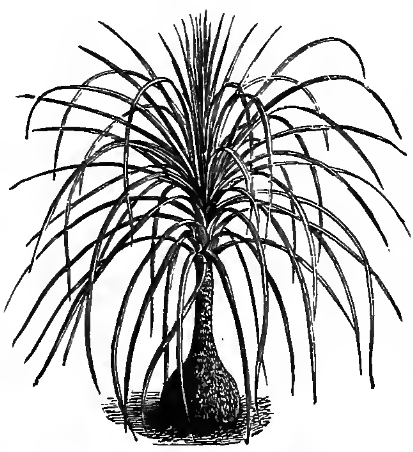
B. longifolium.—This is a magnificent and bold-growing plant, with broad recurved leaves some nine or ten feet in length, bright green in colour. Mexico.

B. recurvifolia, sometimes called *B. tuberculata.*—It bears a large head of long and tapering recurved leaves of a bright green hue. Mexico.

BAMBUSA VIRIDI-GLAUCESCENS.

Begonia.—A genus of plants giving its name to the order (*Begoniaceæ*), and it commemorates the labours of M. Begon, a Frenchman, who did very much towards the advancement of botanical science. One section of this genus (tuberous-rooted) has been treated as a "florist's flower" in the first volume of this work, and must necessarily be omitted here. Begonias are popularly known as "Elephants' Ears," which name has been given them from the shape of their leaves. It is a very large family, being widely distributed over the four quarters of the globe, although, until recently, Africa was supposed to possess none; now, however, both South Africa and the West Coast have contributed some handsome and remarkable kinds. There are several distinct groups of these plants: thus the tuberous-rooted — these are purely summer bloomers; then we have the ornamental-leaved group, of which *B. Rex* is the type, and from which such beautiful variations have been produced, and the flowers of which, although nearly always white, are very handsome; and, thirdly, there is the old-fashioned group of flowering kinds, which our grandfathers grew and greatly delighted in, and which, for the most part, display their beauties all through the dreary winter months. The ornamental-leaved group cannot well be overrated for the extreme beauty of its foliage; the parent of these, *B. Rex,* is beautifully portrayed in our coloured plate. These plants are splendid ornaments when grown large, either for the decoration of the stove or for exhibition purposes. They may be grown small and used as window plants, where they are really charming subjects. In ferneries they flourish vigorously, and produce a grand effect, their splendid banded leaves being beautifully relieved by the fern-fronds; whilst as Wardian-case plants they are unequalled if the atmosphere is not kept too heavily charged with moisture. From experience we know they thrive well in the open air during the summer months, the writer of these remarks having used them in this way on a sheltered piece of rockwork twenty-five years ago.

Begonias require to be grown freely and well, otherwise they, like many other of the soft-wooded class of stove-plants, present a very miserable and weedy appearance. The flowering group requires to be cut back directly the blooms are all past, the soil shaken from their roots, and re-potted in as small pots as it is possible to get them, and then from time to time, as they require it, shifted into larger sizes, until the plant has become a good specimen, when it will produce an abundance of flowers all through the winter months. The heat of the Intermediate House will suit these plants well, and the soil they flourish in should be light and open; peat, leaf-mould, loam, well-decomposed manure, and sand, in equal parts, with good drainage, suits them admirably. Water moderately at the roots, but very seldom with the syringe. This group of Begonias are mostly winter bloomers; to these we have principally confined ourselves, and none can be reckoned upon for public exhibition purposes, but for a beautiful display at home in the plant-stove they have few rivals. The ornamental-leaved group of Begonias are mostly of garden origin, the great ease with which hybridisation can be effected enabling every one, who cared, to raise fresh forms. The parent of this group is *B. Rex*, introduced from Assam, and when this plant was first publicly exhibited by the Messrs. Rollissons, of Tooting, it fairly took the breath away from the whole gardening fraternity. From this plant there soon sprang a large and variable progeny, until the unlimited forms seemed to pall upon the sight, and they became neglected. More recently, however, plant-growers seem to miss and want such Begonias, and they are now sought after again. These ornamental-leaved Begonias no doubt lost favour to a great extent from the fact that most amateurs and gardeners treated them as summer plants only, when really their great utility is conspicuously displayed when grown and shown in full beauty through the autumn and winter months. In the spring, they may be cut back and treated in the same manner as recommended for the flowering section.



BEAUCARNEA RECURVIFOLIA.

GROUP I.—FLOWERING KINDS.

B. albo-coccinea.—A dwarf plant, leaves thick and fleshy, peltate, deep green; flowers large, white, and reddish-scarlet. Winter and spring months. East Indies.

B. baccata.—An erect plant with large orbicular leaves, which are deep green above, slightly tomentose beneath; flowers in short cymes, upwards of two inches across, and pure white. Winter and spring months. West Tropical Africa.

B. crassicaulis.—A procumbent plant, with dark green palmate leaves; flowers white, suffused with a flesh-coloured hue. Winter months. Guatemala.

B. crinita.—This extremely pretty species grows about a foot high; leaves obliquely-ovate, coarsely toothed at the margin, deep green; flowers in erect branching cymes, soft rosy-red. Spring and early summer. Bolivia.

B. Digswelliana.—A dwarf free-flowering plant, with large pink flowers, the buds before opening deep red. English gardens.

B. falcifolia.—An erect plant; leaves falcate-lanceolate, deep green, with a few white spots on the upper side, reddish-purple beneath. Flowers in axillary cymes, deep rose-colour. Peru.

B. foliosa.—An elegant pendulous species, adapted for baskets; leaves oblong, obliquely-cordate at the base, dark green; flowers small, but numerous, white, slightly tinged with pink. New Grenada.

B. fuchsioides.—This is amongst the prettiest of them all; it is suitable for room decoration when small, and when trained upon a pillar or rafter it is very effective; leaves small, oblong-oblique, deep shining green; flowers in long pendent cymes, deep scarlet. Winter months. New Grenada.

B. geranioides.—A dwarf, small-growing, and elegant plant; leaves orbicular-reniform, petioles red blade bright green; flowers numerous, pure white, stamens golden-yellow. Spring months. Natal.

B. glandulifera.—This is a very beautiful dwarf species; leaves ovate-cordate, deep green upon the upper side, paler below; flowers numerous on erect branching panicles, pure white, stamens deep yellow. Winter months. Trinidad.

B. heracleifolia.—A stemless species, with large fleshy, palmate, deeply-lobed leaves, deep green above, tinged with purple on the inner side; petioles hairy, reddish-green; flowers numerous, on erect branching panicles, white and rosy-pink. Winter months. Mexico.

B. Ingramii.—In the form of *B. fuchsioides*, but larger in all its parts; very free-flowering. Winter and spring months. English garden variety.

B. Kunthiana. — A very elegant, erect-growing plant, with slender, dull purple stems; leaves somewhat falcate, coarsely toothed at the edges, deep glossy green above, bright crimson beneath; flowers large, pure white, stamens golden-yellow. Winter and spring months. Caraccas and Venezuela.

B. Lapeyrousii.—An erect grower, with large palmate leaves, and erect branching panicles of flesh-coloured flowers. Winter months.

B. longipila.—Stems erect, leaves palmate, deeply lobed, branching panicles dense; flowers pink. Winter months. Mexico.

B. microptera.—A slender erect plant; leaves unequally ovate-lanceolate, coarsely toothed, deep green above, with a bright red spot at the base of the midrib, pale green beneath; flowers numerous, in terminal corymbose panicles, white, tinged with pink. Winter months. Borneo.

B. natalensis.—Stem erect, much swollen at the base; leaves unequally cordate, deeply lobed, and deep green, spotted with white above, paler below; flowers numerous, white, tinged with rose. Winter months. Natal.

B. odorata.—Leaves deep shining green; flowers white, very fragrant. Winter months.

B. Prestoniensis.—Stem erect, red; leaves ovate, with a sharp point, serrate at the edges, deep green; flowers in pendulous cymes, orange-scarlet, and very fragrant. Autumn and winter months. English gardens.

B. Weltoniensis.—A dwarf compact plant, with small dark green leaves; flowers numerous, rosy-pink. Winter and spring months. English gardens.

GROUP II.—ORNAMENTAL-LEAVED KINDS.

B. Ariadne.—Centre and margin of the leaf deep green, dotted with silver, the middle portion metallic-white.

B. dœdalea.—Intense deep green, reticulated with rich brown, fringed with long pale rose-colour hairs at the margin. Mexico.

B. Elaine.—Silvery-white, centre and margin rich green, with a coppery hue.

B. Griffithii.—Leaves covered with short hairs, dark green, with an intramarginal band of pale green, with a purple margin; under side bright green, the centre and margin deep red; flowers large, white. Bhotan.

B. Iona. — Rich deep olive-green, irregularly blotched with silver.

B. imperialis.—Leaves rugose, dark bronzy or olive-green, the primary veins broadly margined with emerald-green. Mexico.

B. Jules Reine.—Centre pale green, with a dark marginal band, irregularly specked with light green.

B. Lovely.—Silvery-green, with a beautiful subdued flush of crimson.

B. Miranda.—Emerald-green, beautifully veined and tesselated with silvery-white.

B. Madame Wagener.—Rich deep green centre and margin, with a broad silvery-white zone.

B. Otto Forster.—Deep bronzy-green, tesselated and veined with silvery-white.

B. Rex.—Leaves deep olive-green with a metallic hue, and a broad intramarginal band of silvery-white. Flowers soft rose-colour. Assam.

B. smaragdina.—Leaves rugose, of a uniform emerald-green. Mexico.

B. xanthina pictifolia. — Leaves deep green, irregularly blotched and spotted with silvery-white; flowers rich yellow. Assam.

B. xanthina Lazuli.—A most indescribable leaf, the whole surface of a uniform metallic-purple, flushed with a light blue shade; flowers yellow. Assam.

Bertolonia.—A genus of small-growing delicate plants belonging to the *Melastomads.* The species are denizens of the dense forests of Brazil, but many beautiful kinds have been obtained in European gardens by hybridising. The name commemorates the Italian botanist, M. Bertoloni, who published a "Flora of Italy."

These plants are somewhat delicate, and require a close atmosphere, with abundance of heat and moisture, which can be obtained by keeping them under glasses, or in a small frame; unlike the majority of plants, the hybrid varieties are less robust in constitution than the imported species. Pot in leaf-mould, peat, and sand, in about equal parts, with the addition of a few nodules of charcoal; drain the pots well, and supply liberally with water if the temperature is high.

B. guttata. — Leaves ovate, slightly acuminate, some five or six inches long and three broad, of a uniform deep green, over which are spread numerous lines of dots of a deep rose-colour; flowers of all the species small and uninteresting. Brazil.

B. margaritacea.—The leaves of this plant are similar in shape to the preceding, but a little larger, ground-colour above intense deep green with a purplish shade; this is beautifully relieved by dotted lines of pearly-white; the reverse side a uniform rosy-pink. Brazil.

B. Marmorata. — Leaves oblong-ovate, bright green on the upper side, streaked and blotched with creamy-white, port-wine colour beneath. Brazil.

B. pubescens.—A small-growing species, with pale green leaves, which are veined with deep brown. Ecuador.

B. superbissima. — Leaves large, deep olive-green on the upper side, veined with emerald-green, the spaces between the veins being ornamented with spots and dots of rich vivid purplish-rose, under side of a uniform rosy-purple. Garden hybrid.

BEGONIA REX.

B. Van Houttei.—Similar in size and habit to the preceding; upper surface deep olive-green, veined and spotted with bright carmine. Garden hybrid.

Billbergia.—A genus belonging to the *Bromeliaceæ*, or Pine-apple family, named in honour of J. M. Billberg, a Swedish botanist. The genus consists of many very handsome flowering plants, the beauty in a great measure being due to the large highly-coloured bracts; naturally they grow upon the stems and branches of the forest trees, but always in an erect position; their leaves are produced in a rosulate manner, the bases closely imbricating, so that they form a hollow centre; this should always be kept supplied with water, and but little given to the roots. Pot in loam, peat, and leaf-mould, in about equal parts.

B. Baraquiniana.—Leaves broadly strap-shaped, tapering, and recurved at the apex, armed on the edges with numerous reddish spines; bright green, transversely barred at regular intervals with a white farina; spikes pendulous after rising above the leaves; flowers green, the calyx and stem clothed with a white tomentum; at the base of the flowers there abound very large and persistent, oblong-acuminate, scarlet bracts. Spring months. Brazil.

B. Liboniana.—Leaves ligulate, about twelve inches long, toothed with spines at the edges, dark green above, paler below; scape erect, slightly longer than the leaves; flowers numerous; sepals red, streaked with orange; petals very long, deep bluish-purple, pale towards the base. Summer and autumn months. Rio de Janeiro.

B. macrocalyx.—Leaves broadly strap-shaped, upwards of a foot long, distantly armed at the edges with small spines, intense deep green, bearing numerous spots of a pale green upon the upper side; spike erect; flowers yellowish-green, edged with pale blue; bracts very large and persistent, and of a deep rosy-crimson colour. Summer months. Bahia.

B. marmorata.—Leaves broadly-ligulate, armed on the edges with regularly-placed spines, deep green, curiously blotched and banded with brown; flower-spikes erect; flowers numerous, green, with blue points; bracts very large and, like the stem, brilliant scarlet. Summer months. Brazil.

B. miniata-rosea. — Leaves narrow, slightly recurved, spiny on the edges; the flower-spike erect, white; flowers numerous, deep rose; bracts large, bright red, over which is a tinge of blue, clothed with a white scurf. Summer months. Brazil.

B. Moreliana. — Leaves deep green, transversely barred with white, sparingly armed on the edges with a few spines; flowers numerous, rich violet-blue; bracts brilliant rose. Summer and autumn. Brazil.

B. pallescens.—Similar in habit to the last species;

leaves one to two feet long, upper side deep green, with a few oblong, greenish-white dots, under side paler, transversely barred with dull greenish-brown; spikes drooping; flowers greenish-yellow and white, violet at the extreme points; bracts large, lanceolate-acuminate, bright red in front, paler the reverse side. Autumn months. Central Brazil.

B. rhodocyanea.—Leaves recurved towards the apex, upwards of a foot long, closely armed on the edges with long black spines, deep green above, the under side slightly paler, transversely banded with irregular white lines; spikes shorter than the leaves; flowers white and blue, arranged in a dense head; these are accompanied with numerous oblong-acuminate, rosy-red bracts, which are furnished with spines at the edges. Summer and autumn months. Brazil.

B. thyrsoidea.—Leaves strap-shaped, tapering to a point, bright green; flowers numerous; both flowers and bracts rich crimson. Summer months. Brazil.

BOUGAINVILLÆA SPECTABILIS.

Bougainvillæa.—These plants belong to the natural order *Nyctaginaceæ;* they are strong-growing climbers, with small inconspicuous flowers, but they are rendered gorgeously beautiful by the large, persistent, highly-coloured, leafy bracts, which are arranged in threes, and surround the blooms.

Bougainvillæas should be potted in rich loam, made free and open by the addition of some sharp sand; they enjoy strong heat and an abundant supply of water during the summer; but during winter the temperature should be much lower, and just sufficient water given to keep the wood from shrivelling. Early in spring, prune the plants, and increase the temperature, giving plenty of water, both to the roots and also over the foliage with the syringe. These plants, as before remarked, are strong growers, and to preserve them within bounds, the root-room must be very much restricted; indeed, *B. glabra* is the only kind we have which conforms kindly to pot-culture, although the others can be grown in this manner also, but they make a far more brilliant spectacle when planted out. Stove in summer; Intermediate House during winter.

B. glabra.—This species has slender shoots, armed with a few spines; leaves small, smooth, and light green; flowers pale yellow, small, and inconspicuous, surrounded with three large rosy bracts. When grown as a pot-plant, it displays its beauties to the greatest advantage when trained upon a balloon-shaped trellis. It continues in full perfection for several months. South America.

B. speciosa.—This is a very robust plant; the stem is furnished with stout recurved spines, and, as well as the leaves, clothed with short, silky hairs; it produces dense pendulous panicles of rosy-lilac bracts, and it lasts for many months in full beauty. Tropical South America.

B. spectabilis.—A small tree or climbing plant, the stem armed with small spines; the panicles are pendulous, and the bracts of a rich deep rose-colour. Summer and autumn months. Tropical South America.

Bowenia.—Named in honour of Sir George Bowen, Governor of Queensland, a zealous supporter of botanical science and explorations. The genus contains but one species, and that is remarkable as being the only known Cycadaceous plant in the world having twice-divided leaves; thus taking us in fancy back to the time when this order of plants abounded in our own country, when the voices of the Iguanodon, the Megalosaurus, and the Hylæosaurus were heard in the land, and marsupial animals were common, which is fully exemplified by the numerous fossil remains of both plants and animals existing in the "Oolite." All these plants and animals have, however, disappeared from Europe, although both are to be found in Australia, a country which seems to abound in pre-Adamite types of both animal and vegetable life, but hitherto none have been discovered there as fossils.

Bowenia, as before remarked, has twice-divided leaves (bipinnate), and this is probably its greatest distinction as a genus; it was discovered first by the late Mr. Allan Cunningham, a celebrated botanist and collector, near the Endeavour River; but he evidently did not grasp the importance of his discovery, for he assigned to it a place amongst the *Aroideæ;* and after an interval of about sixty years, it was again found by Mr. W. Hill, the director of the Brisbane Botanic Gardens, who sent the first living plant to this country in 1863. Mr. Hill says that "most of the Australian *Cycadaceæ* grow in sandy or stony soil, which is not rich, but the Bowenia is found in very shady spots about the borders, or in dense scrubs, where the atmosphere is more moist, and the soil contains more decomposed vegetable matter, and is consequently of better quality."

For soil in a cultivated state we have found it thrive well in about equal parts of loam, leaf-mould, and peat, with some sharp sand added; the pots should be well drained. The Bowenia being a native of tropical Australia, it requires the heat of the stove; it is, like all other plants of this order, somewhat eccentric in its growth, refusing to throw up fresh leaves perhaps for one or two years, and no art of the gardener has been able to push them forward into existence for a time.

B. spectabilis.—Leaves bipinnate and spreading; leaflets lanceolate-falcate and oblique, three to six inches long, smooth at the edges, and deep green. Since the first introduction of this plant numerous others have followed, and some, instead of smooth leaflets, have produced them with spiny teeth; this form has been named *serrulata*, but the variation is common to the order, and both forms can frequently be found on the same leaf. Rockingham Bay, Queensland.

Brexia madagascariensis.

Brexia.—A small family of ornamental-leaved plants, which give the name to the small order *Brexiaceæ*. Naturally, these plants form trees of considerable dimensions, but they are generally destitute of branches; in a young state of cultivation they are admirably adapted for general decorative purposes, but they are not sufficiently hardy to withstand the vicissitudes of this climate in the open air, and consequently cannot be made available for sub-tropical gardening. Brexias are pretty easily propagated, as even a leaf taken off with a bud attached will generally root well, and cuttings taken without shortening the leaves strike very readily in sand under a glass. The plants should be potted in a mixture of loam, peat, and leaf-mould, in about equal parts, with a little sand. They enjoy a liberal supply of water during the whole season.

B. chrysophylla.—An elegant slender plant, and the most delicate of the species yet introduced; leaves long and narrow, pendent, pale green above, with a few spines on the edges. Madagascar.

B. madagascariensis.—Leaves upwards of a foot long, and about two inches broad, pale green in colour, and quite destitute of spines. Madagascar.

B. spinosa.—Similar to the preceding, but much handsomer; leaves twelve to eighteen inches long, about two inches broad, and leathery in texture, spiny at the edges, deep green on the upper side, but paler below. Madagascar.

Brownea.—Named in honour of Patrick Browne, an English physician who wrote and published an illustrated history of Jamaica upwards of one hundred and twenty years ago. The plants comprising this genus belong to the order *Leguminosæ*, but to that division which have regular, not Pea-shaped, flowers.

Browneas form small bushy trees, and thrive best when planted out in the stove, or in good-sized tubs, where they form noble ornaments; the leaves are large and pinnate, and their globose heads of flowers are not unlike the Rhododendrons at the first glance. These plants thrive best in a mixture of about two parts of loam, one of peat, one of leaf-mould, and a little sharp sand; they enjoy strong heat and an abundant supply of water, and shading from the direct rays of the midday sun. In winter, over-watering must however be avoided. Cuttings for propagation should be taken from ripened wood, and struck in sand under glass in a moist atmosphere.

B. Ariza.—This species attains a height of thirty or forty feet, and is by far the largest in the genus; leaves pinnate, leaflets oblong-lanceolate, and deep green; the flowers are deep red, produced in large dense heads. Summer months. Bogota.

B. coccinea.—Height six to eight feet or more; they are all similar in appearance; the globose heads of flowers are brilliant scarlet. Summer months. West Indies.

B. grandiceps.—This is the "Rosa del Monte" of the Venezuelans; it attains a height of six to ten feet, and, as its name implies, produces very large heads of bloom, which are some eight to ten inches across; flowers deep rosy-pink. Summer months. Venezuela and Caraccas.

Burchellia.—A small family of *Cinchonaceæ*, named in compliment to the late Mr. Burchell, who travelled in South Africa, and made extensive collections of specimens in the animal as well as the vegetable kingdom. Pot in peat and loam in equal parts, with a little sand, and drain well. Intermediate House.

B. capensis.—This plant is called the "Buffel," or "Buffalo Horn," at the Cape, on account of the hardness of the wood of its stems; it seldom exceeds six feet in height, and is much branched; these branches are clothed with opposite leaves, which are somewhat oblong, slightly hairy and deep green; the flowers are tubular, borne in closely-packed heads, rich scarlet in colour. Spring months. South Africa.

B. parviflora.—Resembles the preceding, but is neither so large nor so free-flowering as that species. Spring months. South Africa.

THE LIFE-HISTORY OF PLANTS.

By Dr. Maxwell T. Masters, F.R.S.

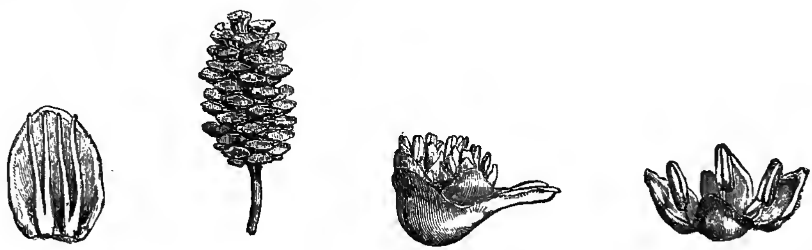
FERTILISATION.

From what has been previously said, it is clear that the pollen has to be got to the stigma in some way or other, and our present object is to see how this is effected. From the frequent juxta-position of the anthers to the stigma, and from various arrangements which seem to bring about, and really do bring about, the contact of the pollen with the stigma, it was naturally thought that the stigma or germ of any given flower was necessarily fertilised by the pollen of the same flower; but though this "close fertilisation" does occur, and in some cases is inevitable, yet "cross-fertilisation," or that by which the germ of one flower is impregnated by the pollen of another flower, is more common and, in the long run, according to the experiments of Knight and Darwin, more advantageous to the plant in the sense of producing a succession of numerous and more robust healthy seedlings. Mention has already been made of the very frequent cases where the pollen of any given flower is practically ineffective from the fact that the stigma of that flower is not ripe for its reception, or, on the contrary, the stigma may be ripe and the anthers unexpanded. Mention has also been made of "diœcious" plants like the Willow, in which the sexes are on different plants. In such cases close fertilisation is impossible, and cross-fertilisation inevitable. The extremely varied forms of flowers have often reference to these peculiarities; the arrangement, position, and mechanism of the flower being such as necessarily to prevent close fertilisation and to promote cross-fertilisation.

It is easy to conceive of several ways in which pollen might be conveyed from one flower to another; but, practically, we need here only consider two—the impulsion of the wind and the porterage of insects. Flowers that are fertilised by means of wind-wafted pollen have usually relatively inconspicuous flowers, the floral construction is of the simplest, generally devoid of brilliant colour or potent odour. The pollen itself is relatively small, smooth, sometimes provided with wing-like expansions as in Pines, and generally produced in large quantities.

Insect Agency.—On the other hand, insect-borne pollen is usually produced in flowers of more or less complicated construction, of brilliant colour, and powerful odour. The pollen of such flowers is frequently provided with ridges, spines, or other projections well adapted to adhere to the legs or backs of insects. Here then we get the clue to the reason of the bright colours, the varied and often complicated structure, the mechanical arrangements, and powerful fragrance of flowers. These are all inducements held out to insect visitors, contrivances which compel the unconscious insect to enter the flower in this way, follow this particular course and no other, leave the bloom in this prescribed manner, and so bring about the transfer of pollen from one flower to the stigma of another. No doubt the insect is profoundly unconscious of the work he has really to do in the world. His object in visiting the flower is the selfish one of providing for his own necessities, or the requirements of his offspring, or of the community of which he is a member, as in the case of bees and ants. There are hundreds upon hundreds of different variations in the mechanism of flowers correlative with the hundreds upon hundreds of variations in the conformation, and mode of life, of insects. This flower, let us say by way of illustration a Rhododendron, has upturned anthers which open at the tips, and spots on the upper part of the corolla and nowhere else. It has colour, fragrance, and nectar for the insect, which in its search for the latter is guided by the spots aforesaid, and so necessarily takes its course over the anther-pores, brushing out the pollen from them as he goes, and having rifled the flower of its honeyed treasure, and its pollen, flies off to another flower, where, if the upturned stigma over which, with gentle compulsion, he is forced to go, is just in condition to receive the pollen, fertilisation occurs; or if otherwise, no result follows. Another flower, dull in colour and unattractive, scentless by day, diffuses by night a rare fragrance to attract the night-flying insects; and so on, and so on, till actual verified truth becomes more wonderful than fictitious romance.

The Coverings of the Flower.—The so-called non-essential parts of the flower, although not directly concerned in the process of fertilisation, are thus indirectly of very great importance to it, and moreover they serve, in the first instance, to protect and enclose the more important parts. In this place we cannot do more than advert to some of the peculiarities of these "floral envelopes." In the Willow, as we have seen, they are wanting, or represented by a single scale; in the Poplar by a single cup; in the Alder (Fig. 81) by a "perianth" of four separate green lobes; in the Lily (Fig. 66) by six coloured ones of regular form; in the Foxglove (Fig. 75) by an outer green calyx of five sepals, and an inner sleeve-like "corolla," consisting in this instance of five "petals" of unequal size, growing together for nearly their whole length, and only very slightly separated at their lips. The irregular form, and the disposition of the coloured spots, the pendulous position of the flower, the arrangement of the stamens, all indicate the necessity for insect visitation, and consequent cross-fertilisation.



Bract bearing two Female Flowers, seen from within. — Ripe Catkin. — Bract bearing three Male Flowers. — Isolated Male Flower, with Perianth and Stamens.

Fig. 81.—Inflorescence of the Alder.

Dimorphic Flowers.—In connection with this subject it is requisite to mention certain cases in which two or more kinds of flower exist on the same plant; thus, in the common Violet there is the purple-coloured fragrant flower with which we are all familiar, and which, from its highly irregular form and powerful fragrance, is specially adapted for cross-fertilisation by insect agency; and there is another form of Violet flower very common, though often overlooked. In this second form of flower the petals are green, unattractive, and devoid of fragrance, they are near the ground, and little, if at all, upraised from its surface. They present little or no attractions for insects, and the petals either do not unfold at all, or only to a very slight degree. Such flowers are found to be very fertile, and produce abundance of seed, which must in this case be the result of close fertilisation. Every provision is here made for close fertilisation, little or none for cross-fertilisation. These flowers are called "cleistogamic" (from the Greek *kleio*, "I close, or shut"). In the Violet then, as indeed in many other plants, there are some flowers adapted for close, others for cross fertilisation. Close fertilisation would necessarily tend to the perpetuation by inheritance of the characters of the plant. Cross-fertilisation, on the other hand, secures the possibility of variation in the offspring, and therefore a greater power of adaptation to different circumstances. In the long run, too, as has been shown by Darwin, and as indeed is recognised by all breeders of plants, or of animals, close, or "in-and-in," breeding is objectionable as increasing the chances of debility in the offspring, and facilitating the onset and progress of disease. These injurious effects are averted and obviated by at least occasional cross-fertilisation.

In the dimorphic flower just mentioned the shape of the two flowers is so different as at once to attract attention, but the same results are brought about in some cases with much less striking changes of appearance.

Pin-eyed and Thrum-eyed Flowers.—Gardeners for ages have noticed a difference in the flowers of the Polyanthus and of the Auricula. In some the orifice of the flower-tube is seen to be filled up with a little greenish knob like the head of a pin, and such flowers were accordingly called "pin-eyed"; in others, the "eye" of the flower, or top of the corolla-tube, is filled with a conical yellow mass resembling thrums or threads, and hence the name "thrum-eyed." But, although these different appearances had been familiar for ages, and not only familiar, but made the objects of special attention in carrying out the caprice of the "florist," yet it was left for Darwin to bring out the true significance and purport of these differences of arrangement by means of direct comparative experiment. In fact, the "pin-eye" above-mentioned is nothing but the stigma of the Primrose, the "thrum" is nothing but the group of anthers. In the one flower the stigma, in the other the anthers, occupy the mouth of the corolla-tube, or protrude from it. On slitting down the corolla-tube so as to see its interior, it will be found that in the pin-eyed flowers the style is long, and so the stigma, or pin, is raised to occupy the mouth of the corolla, while the stamens are short, and low down in the tube. In the thrum-eyed flowers, on the contrary, the stamens are long, and the style is short. By actual experiment and observation Darwin proved that the most perfect degree of fertility—that is, the largest number and healthiest seedlings—ensued when cross-fertilisation took place between the pollen from the short stamen (thrum-eye) and the long style (pin-eye), and inversely. This may be thus represented:—

Thrum-eyed flower.	Pin-eyed flower.
Anthers protruding	Anthers included
Stigma included	Stigma protruding

From this diagram it may be inferred that cross-fertilisation by insect agency takes place as shown by the direction of the cross-lines, while close fertilisation may take place in the direction of the brackets.

We say *may* take place, to indicate its possible occurrence; that it does not *always* happen is shown by the circumstance before mentioned, that pollen and stigma are not always ripe at the same time. Indeed, generally there is a difference in this respect, the anthers of some flowers being expanded first (as in "protandrous flowers"), the stigma of others anticipating the fall of the pollen from its own flower ("protogynous flowers").

Close fertilisation is also prevented in those cases —of which several are recorded—in which the pollen of a flower is absolutely inert on the stigma of the same flower, though the conditions may be favourable, and although the same pollen transferred to another flower may impregnate the ovules. This has been observed by both scientific experimenters and by gardeners in the case of Passion-flowers.

While the general rule is as we have endeavoured to explain it, it must not be supposed that it is invariable. On the contrary, a flower that is habitually cross-fertilised may become close-fertilised, a flower which is usually protandrous may become protogynous, or both stamens and stigma may be ripe at the same moment. Hence, there is a possibility in any given flower of much variation in the method of fertilisation—and the plan followed in one flower of the same plant is not necessarily the same as that which obtains in another. Such facts as these furnish one explanation of the cause of the variations that we see in plants, whether wild or cultivated, and it is obvious that they require to be very carefully considered by the hybridiser, or raiser of seedlings. If he require to secure a "fixed strain" or a "pure stock," he will or should study the habit and peculiarities of the flowers, and take every pains to secure close and to prevent cross-fertilisation. If, on the other hand, his desire be to raise new varieties, then, guided by the same facts, he will practise cross-fertilisation.

Protective Adaptations.—The mechanism to secure cross-fertilisation or close fertilisation, as the case may be, by insect agency or otherwise, is, as we have seen, extremely varied. An almost equal amount of variation is seen in the arrangements which prevent the access of undesirable insects, or protect the flower from wet or other accidents. Not only is the flower often so constructed that it permits and even favours the access of some insects, but it absolutely prevents the ingress of others.

This exclusion is brought about in a variety of ways, which our space will not allow us to dilate upon. As illustrations, may be mentioned the sticky hairs to entrap and stop the progress of the unlucky insect that alights on a flower or a flower-stalk so guarded—*e.g.*, *Azalea viscosa*—the recurved bristles, the overhanging cornices, like so many rat-traps, that bar the progress of slugs and snails, of thrips and aphides, the distasteful flavours and odours which repel others. Those who wish to follow out these details are recommended to consult Müller's "Fertilisation of Flowers," and Kerner's "Flowers and their Unbidden Guests." Here we must content ourselves by indicating a few of the marvels of plant history, and which, as we have seen, are not only matters for the pure man of science, or most fascinating subjects for the observation of the amateur, but of such direct practical importance that no one concerned in the raising of seedlings, or the production of new varieties, can afford to neglect them.

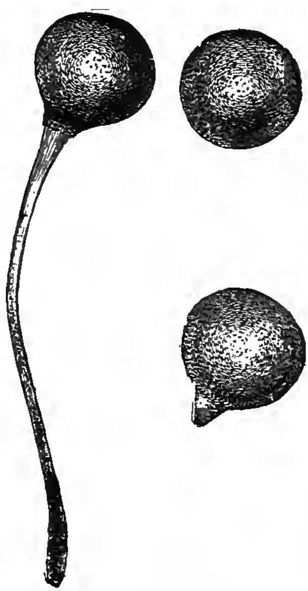


Fig. 82.—Pollen-grains, emitting Pollen-tube (highly magnified).

Inheritance and Adaptation.—In taking a general review of the subject it may be said that the varied forms of flowers and the diverse arrangements of their parts are partly hereditary endowments, partly the result of adaptation to surrounding conditions and requirements. Pre-existent flowers, of course, were adapted in the same way as those now existing, but it is necessary to bear in mind that a particular form of flower and a certain arrangement of parts may be perpetuated by hereditary descent to some extent, independently of present adaptive needs. Thus, a flower whose construction is adapted, say, to the visit of a tropical humming bird, may yet retain its form in our gardens, though it may there be fertilised by thrip, aphis, or even slug! Flowers and other parts of plants often retain by inheritance forms no longer of use, but which were adaptations to a former set of circumstances; thus, we meet with parts and contrivances which appear and perhaps really are now of no practical value. Ultimately such forms may be expected to die out and be superseded by others more in accordance with existing circumstances (indeed, we have evidences of this in the rudimentary organs and ill-developed parts we constantly meet with). These, however, are slow processes, as reckoned by human modes of computation, and do not greatly concern us from a purely practical point of view. All that we would insist on here is that the form, arrangement, colour, fragrance, movements, and general mechanism of the flower, are primarily adaptations which secure the formation and succession of numerous and healthy seedlings, on the one hand by securing the dispersal of the pollen, and its safe transport to the stigma, whether of its own, or more commonly of another plant; or, on the other hand, by preventing access of marauding insects or by insuring protection against wet, cold, or other injurious agencies. But—secondarily, they may be transmitted by inheritance, long after the necessity for their occurrence has passed away; and thus it is that the gardener daily perpetuates and by repeated selection actually brings about an enhanced degree of those changes which were at first purely adaptive, but which have now lost their significance. In such cases the gardener practically determines the form which a flower shall take—according to *his* requirements and inclination, and moulds it as it would naturally be moulded by the conditions under which it lives. Of course, there are bounds and limits to the gardener's power, he is but an agent—often a very blundering one. The facts of which we have given so bald an outline, and these indications of his power, should surely intensify the interest with which he regards the flower, and induce him still further to avail himself of the opportunities that lie in his way.

IMPREGNATION.

The Formation of the New Plant.—In whatever way the pollen makes its way to the stigma, once arrived there, if the conditions be favourable, it begins to grow. The favourable conditions, independently of a certain degree of temperature and moisture, are of course the perfect healthy development of the parts concerned. In the case of the stigma this is evidenced by the exudation from its surface of a sticky liquid. In some cases there are special structural contrivances connected with the stigma, which entrap the pollen, prevent its dispersal, and tend to secure its germination.

Germination of the Pollen.—The growth of pollen is in this wise:—The pollen-cells have a cellulose coating overlain by a structureless cuticle, and containing a quantity of protoplasm and one or more nuclei. They are in fact fully equipped cells. When the grains or cells fall on the moist stigma their cuticle cracks, and allows the cell to protrude and lengthen in the form of a tube (Fig. 82). Very often indeed there are special cracks or apertures through which the tube passes. At any rate this tube grows, and lengthening as it grows, pushes its way between the cells of the stigma and the style (Figs. 83—85). These cells are so constructed as to allow it to derive food-supplies from them, and are so arranged as to facilitate its passage. In this manner, after a lapse of hours, days, or months, in different plants, it eventually comes in contact with the ovules, one or more tubes to each ovule (Fig. 85).

Fig. 83.—Stigma of Datura, covered with Pollen-grains (magnified).

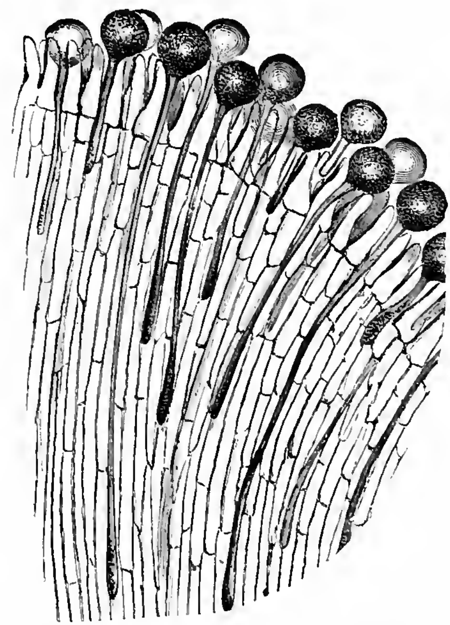


Fig. 84.—Pollen-tubes of Datura piercing Conducting Tissue (highly magnified).

The Ovule.—Within the cavity or cavities of the ovary are contained one or more small whitish bodies, visible to the naked eye when the ovary is cut across or downwards. These are the rudimentary seeds, destined to be the nursing mothers of the fertilised egg or embryo plant. The ovary therefore is the direct precursor of the fruit or seed vessel; the ovules, of the seeds; the germ within the seed, of the embryo or seedling plant.

The number, shape, size, mode of attachment of ovules, vary much in different plants; but these points, valuable as they are for purposes of discriminating one plant, or one group of plants, from another, are of little value for our present purpose. The internal variations in structure are equally of little importance for this point of view. Suffice it here to say, that in general ovules consist of a central body called the "nucellus," surrounded by one or by two sheaths, called the "coats of the ovules," which grow up from below, and leave at the top a small hole called the "micropyle," so that the extreme top of the nucellus is thus uncovered (Fig. 87). At the top of the nucellus, moreover, is one cell much larger than the rest, and which is called the "embryo-sac," because in it the embryo is eventually formed (Fig. 87).

In this embryo-sac are suspended three masses of protoplasm (not shown in the woodcut), each with a nucleus. One of these three is destined to become the egg, and may be called the germ, or "oosphere;"

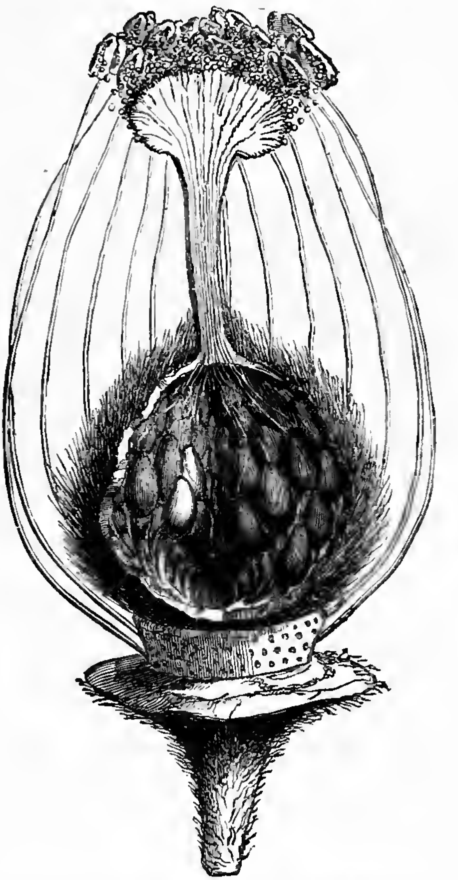


Fig. 85.—Fertilisation of the Ovule, showing the passage of the Pollen-tubes from the Stigma to the Ovules.

the other two are called "synergides," a word for which no English equivalent has yet been found. Their use will be mentioned later on. At the other end of the embryo-sac are three minute cells, each with a nucleus; these are the "antipodal cells," which in this place we may dismiss with the mere mention, as their relation to practical matters is only remote. The contents of the embryo-sac (other than the oosphere) are supposed to correspond to a prothallus, such as exists in some Cryptogams. The nucellus of the ovule, with its embryo-sac, containing oosphere, synergides, and antipodal cells, is equipped for work when stimulated by the arrival of the pollen-tube and its contents.

The pollen-tube travels down the style, as we have seen, worms its way along the stalk of the ovule, enters the micropyle, already referred to (Figs. 86, 87), and comes into contact with the embryo-sac.

Formation of the Oospore, or Egg.—Then happens a remarkable series of changes, eventuating in the formation of the egg, as we may call it, and the embryo plant derived from it. The changes in question, so far as known, may briefly be described as the passage of the end of the pollen-tube, with its nucleus and protoplasmic contents, into one of the "synergides"—in other words, the protoplasm of the pollen-tube and that of the synergid

Fig. 86. — An Ovule with Pollen-tube entering the Micropyle (magnified).

Fig. 87.—Section of Ovule of Polygonum (enlarged), showing the two coats or sheaths, the Micropyle, and a Pollen-tube penetrating the Embryo-sac.

mix, and the nucleus of both disappears, the one entirely, while the other is temporarily disintegrated. The synergid now has a uniformly granular composition, and an irregularly lobed form. One or more of these lobes come into contact with the germ, or oosphere, which, like the synergid, has up to this time been a mere mass of protoplasm enclosing a nucleus; but the oosphere now, after contact and fusion with the synergid, develops a cell-wall, and a second nucleus becomes apparent. This second nucleus is supposed to be derived originally from the pollen-tube, to be broken up, or diffused, as it passes into the synergid, and thence to the oosphere, so as to allow of its more ready passage from the pollen-tube through the synergid to the oosphere, arrived within which it is again condensed and reconstituted, so that in the oosphere after fertilisation there are two nuclei: one male, derived from without, *i.e.*, from the pollen-tube; the other female, formed as part of the germ, or oosphere, in the embryo-sac itself. After a short time the two heretofore distinct nuclei, male and female, fuse together into one, and the oosphere ripens into the oospore, or plant-egg. The process, which differs in detail in different plants, thus consists essentially in the passage of a nucleus (male) from the pollen-tube through the medium of a synergid into the oosphere, and its fusion therein with the nucleus (female) of that body. The passage of the protoplasm through the wall of the embryo-sac may be accounted for either by osmosis, or by the property which the pollen-tube is known to exert of softening, dissolving, and feeding upon the cellulose walls with which it comes into contact. It seems probable also that there may be a direct passage of the protoplasm through pores in the membrane, as happens in other cases of "continuity of protoplasm," but this has not been proved.

FERNS.

By James Britten, F.L.S.

The Platycerium, or Stag's-horn Ferns.—The genus *Platycerium* is one of the most marked genera in the fern kingdom; its distinctive character being the dichotomously-forked fertile fronds with stag's-horn-like divisions. There are but five species described in Hooker and Baker's "Synopsis Filicum," but many slightly varying forms, principally of *P. æthiopicum*, are met with now and then in British and Continental nurseries and gardens. A well-known writer on ferns speaks as follows concerning the genus now under review: "Of the whole fern family the *Platycerium* may be considered the most grand, beautiful, and extraordinary, and is thoroughly typical of the epiphytal group. Its natural position of growth is sometimes on moist rocks, but usually on the trunks and larger branches of trees. The spores becoming lodged there, germinate, and, sending out spongy fibrils, a little plant, like a circular disc, analogous to a foliaceous lichen is formed, each succeeding disc (frond) becoming larger and overlapping the preceding one. In time the older ones lose their vitality, and by this mode of growth envelop, or nearly so, that portion of the tree

Platycerium grande.

whereon they grow in a dense, thick, spongy mass, among which the roots insinuate themselves and receive nourishment."

P. æthiopicum is a native of the Guinea Coast and Angola; it has twice-dichotomous pendulous fertile fronds two to three feet in length. *P. alcicorne* is perhaps the most generally cultivated of all the Stag's-horn Ferns; it is found in the tropics and in temperate Australia. Like the last-named species, the under surface of the frond is covered with a thin, white, cottony down, but the divisions are frequently more numerous in *P. alcicorne*. *P. grande*, from tropical Asia and North Australia, is much the finest of all the *Platyceriums*. In a wild state it attains an enormous size, and an excellent idea of its aspect in its native forests can be obtained from the picture No. 420 in the "North Gallery" at Kew. The pendent fertile fronds often grow to a length of from four to six feet.

Cultivation.—Perhaps the best way in which to grow *Platyceriums* is to fix them on cones of fibrous peat in pans, the front portion of which has been cut away. If the pan has a flat back, so that it can readily be fixed against the wall of the warm fernery near the glass, so much the better. At Kew the collection of Stag's-horn Ferns is grown in pots made specially for the purpose; these are six or eight inches deep, with a flat, not rounded back, and a semicircular portion cut away from the front nearly to the bottom. Draining material is first put in, and then a mound of peat is fastened inside, and the plant firmly attached to the front on the peat. Very soon the barren fronds clothe the naked peat, and indeed the whole of the pot, and when once established, no further trouble in the way of re-potting is required. Care must be taken not to allow too continuous a supply of water to lodge amongst the overlapping shield-like barren fronds, or these will often become discoloured and unsightly. *P. alcicorne* is the hardiest of the group; it withstands several degrees of frost, and is the only one which will thoroughly succeed in the cool fernery. In the warmer atmosphere of the stove it will, however, grow much more quickly. None of the species like bright sunlight, and all like abundance of moisture at all times in the surrounding air, and a copious supply of water at the root during the period of growth. *P. grande* makes a splendid exhibition plant; it may either be grown as recommended above, or treated as a basket plant, or attached to a block of any hard durable wood—a little fibrous peat being placed behind the convex barren fronds.

The Scolopendriums.—The genus *Scolopendrium*, as understood by the authors of the "Synopsis Filicum," comprises about nine species, and is the only representative of the tribe *Scolopendriæ*. The arrangement of the sori is similar to that which obtains among the *Aspleniæ*, except that the involucres are in pairs, and open towards each other. The name of the genus is an ancient Greek word, and is so called because the numerous parallel lines of fruit resemble the feet of the *Centipede* or *Scolopendra*. According to the authority adopted throughout these papers—viz., the "Synopsis Filicum"—the genera *Antigramme*, *Camptosorus*, and *Schaffneria* are included in that which forms the subject of this notice.

S. Hemionitis, a native of Spain, South France, Italy, and the Mediterranean Islands, is, with the exception of the widely-distributed *S. vulgare*, the only European member of the genus. It has slender, slightly fibrillose stipes four to six inches long, and fronds—thinner in texture than those of *S. vulgare*—about the same length as the stipes; in outline these are oblong-lanceolate, the base being between heart-shaped and spear-shaped, with short and rounded, or prominent and almost acute lobes.

S. rhizophyllum, an inhabitant of Jamaica and Cuba, is also found (but is rare) on shaded calcareous rocks in West New England and elsewhere in the United States. Like our native Hart's-tongue, it has evergreen fronds growing in tufts; the naked compressed stipes are one to two inches long, and the fronds four to nine inches long, and about three-quarters of an inch in breadth. In outline these are lanceolate from an auricled heart-shaped or often hastate base, tapering above into a slender prolongation like a runner, which often roots at the apex and gives rise to new fronds, and these to others, hence the popular name of Walking Leaf.

S. vulgare is too well known to need description. Its glossy, bright green fronds contrast markedly with the feathery aspect which is so general among ferns. Either in a wild state or cultivated, it is a universal favourite. In ancient times it was in great repute for its medicinal properties, and in rustic practice at the present day it is used as an astringent in diarrhœa, and also as an external application in cases of erysipelatous eruptions. Countless forms are cultivated in gardens, the long strap-shaped fronds occurring in a monstrous state in almost every conceivable form. One of the handsomest and most remarkable is the variety *crispum*, which is nearly always quite barren, that is to say, does not produce spores. This has large fronds, with beautifully-waved margins. Considerably more than a hundred and fifty distinct forms have received names, and may be procured from those who make hardy ferns a specialty.

Cultivation.—*S. Hemionitis* and *S. rhizophyllum*, although growing in the open in many places in this country where suitable conditions have been provided them, are not hardy in the sense applied to our native *S. vulgare* and its host of varieties. They are excellent subjects for planting out on rock-work in the cool fernery, or for growing in Wardian cases. All require a good mellow, loamy soil, with a fair proportion of half-decayed vegetable matter—*i.e.*, leaf-mould. None do well unless well shaded; the common Hart's-tongue is never seen in such luxuriance as when growing in the sides of old wells, where abundant moisture is always present, and direct sunlight never reaches it. Given shade and continuous moisture, soil is a secondary consideration with this easily-grown and handsome fern.

The Dicksonias.—The genus *Dicksonia* is by far the most important of those included in the tribe *Dicksoniæ* by Hooker and Baker. About half the species are arborescent, with large decompound coriaceous fronds; the others have creeping rhizomes, and, with two exceptions, are at least fully bipinnate. They principally inhabit tropical America and Polynesia, but one species reaches as far north as Canada, another extends to South-western Europe, and several others are scattered throughout the southern parts of the temperate zone. Upwards of forty species are known to botanists, and of this number about half are or have been in cultivation. The following are the names of the most distinct and useful of those now to be seen in the collection of living ferns at the Royal Gardens, Kew.

D. antarctica, abundant in the humid forests of East Australia, Tasmania, and New Zealand, is perhaps the most widely grown and the most popular of all tree-ferns. It is not only one of the tallest of all the tree-ferns of the globe, but certainly also one of the most hardy, and the one which best of all endures a transit through great distances. Indeed, a fresh frondless stem, even if weighing nearly half a ton, requires only to be placed without any packing in the hold of a vessel as ordinary goods to secure its safe arrival in Europe, the vitality being fully thus maintained for several months, particularly if the stem is occasionally moistened, and kept free from the attacks of any animals. On arrival the stem should be placed in a cool house and kept constantly moist; a good plan is to fasten a piece of canvas loosely round it and keep this wet by frequent slight syringings. The matted adventitious roots of the stem are by such treatment soon stimulated to action, and a crown of foliage is soon developed. Specimens in their native habitats not unfrequently attain a height of 50 feet; they are generally found in damp places—gullies—where the sun rarely penetrates and where they are sometimes covered with snow. Mr. J. Smith, the ex-curator of the Royal Gardens, Kew, suggests that this species should be tried in suitable situations in the South and West of England, as also in the mild climate of Argyleshire, where shaded ravines and gullies may be found similar to those of Mount Wellington in New Zealand.

D. Barometz, a native of Assam, South China, the Malayan Peninsula and Islands, has tripinnate fronds which attain a height of twelve or fourteen feet (in this country); these rise from a thick decumbent caudex, which is densely covered with silky hairs. and lying on the ground has the appearance of a woolly-clad animal. This is the curious vegetable production of which, in the earlier books of travel, many fabulous stories are told. Amongst other things, it was said to be partly animal and partly vegetable, and to have the power of devouring all other plants in its vicinity. Darwin, the ancestor of the great naturalist, has some fanciful verses about the Barometz or Scythian Lamb in his "Botanic Garden."

D. Brackenridgei, a recent introduction to British gardens, is a native of Fiji and Samoa, and has a stem which attains a height of fifteen feet. It has rigid, green, glabrous, tripinnate fronds. Generally speaking, this species is met with under the name of *D. Berteroana*.

D. Culcita has a thick rhizome with so dense a covering of long brown silky hairs that it has become an article of commerce, and is used for stuffing cushions and the like; the species is a native of Madeira and the Azores, and is also found in Spain. It has tripinnate fronds twelve to eighteen inches long by a foot in breadth.

D. fibrosa is a neat small-growing tree fern from New Zealand; the rhomboid tripinnate fronds, three to four feet long, have densely pilose grey rachises and very short stipes, clothed with dense fibrillose bright brown scales.

D. punctiloba is very common in moist, rather shady places in Canada and the United States. It has pleasantly-scented, thin, pale green, ovate-lanceolate, pointed bipinnate fronds from a foot and a half to three feet in height; the strong chaffless stipes spring from slender, extensively-creeping, naked rootstocks.

D. Sellowiana is an arborescent species from South Brazil; it has lanceolate, bipinnate, leathery fronds six to eight feet long and two to three feet broad.

D. squarrosa is the most southern tree-fern in the world; it has chestnut-coloured stipes six inches to a foot long—densely clothed with soft-spreading fibrillose scales—and oblong-deltoid, rigidly leathery fronds, green on both surfaces.

Cultivation.—Of the species above mentioned, *D. punctiloba* is the only one which can fairly claim to be hardy, although *D. antarctica* and *D. squarrosa* might succeed in many places in the open air in this country if suitable positions were chosen. All the rest do well treated as green-house ferns. Several make handsome objects in the sub-tropical garden during the summer months if sheltered from winds and screened by trees, &c., from bright sunlight. *D. antarctica* is perhaps the best and most stately of all the Dicksonias for planting out in a bed in the cool conservatory, and this species requires no care as regards shading from sunlight under the conditions stated. Fine large stems and correspondingly handsome crowns of fronds are not produced unless the adventitious roots are encouraged, and this can only be done by constant syringings. Some growers, instead of cutting away the old fronds, allow these to fall and envelop the stem, thus keeping it moist and causing the matted roots to grow freely. Provided attention is duly paid to the requirements of these latter—for it must be remembered that it is by means of them that the plant obtains the greater part of its nourishment—very little root-room is necessary. Plants which through neglect or otherwise have fallen into ill-health can frequently be rapidly restored to vigour by plastering the stems with perfectly fresh cow-dung. This forms a coating through which fresh roots soon push, and the objectionable smell of the fresh dung only lasts a day or so. Good fibrous well-drained loam is the best soil in which to grow all the Dicksonias.

DICKSONIA ANTARCTICA.

The Cyatheas.—Some of the members of this genus of tree-ferns are second to none in grace and elegance, and thoroughly merit the praise which has been bestowed on them by travellers who have seen them in their native habitats. There are about eighty species, spread over the tropical and sub-tropical regions of both hemispheres. Next to *Alsophila* the genus *Cyathea* is the most important, both as regards numbers and otherwise, of the well marked tribe *Cyatheæ.*

C. arborea, a native of the West Indian Islands, is a noble species with decompoundly pinnate fronds, the stout stipes of which may be either unarmed or thickly beset with rather formidable prickles—both the varieties are abundant in Jamaica.

C. dealbata, from New Zealand, Penang, and Lord Howe's Island, is a very beautiful cool-house species, having gracefully arching, twice or thrice-pinnate fronds; deep green above, and clothed beneath with a silvery-white powder; the stipes are unarmed or slightly asperous, and the rachises and costæ are covered with a pale rusty deciduous tomentum. For conservatory decoration no tree-fern is superior to this.

C. Dregei has a stem sometimes four feet in height; the stipes are unarmed or only rough with small tubercles at their base, which is clothed with large chaffy, glossy, ferruginous scales; the fronds are bipinnate. This is a native of tropical and sub-tropical Africa and the adjacent islands.

C. Hookeri is a very distinct and peculiar species from the forest of Singhe Rajah, Ceylon; it is a slender tree-fern with a trunk not more than an inch and a half in thickness, and short black rough stipes, surmounted by elongate-lanceolate acuminate pinnate fronds, two to three feet long by four or five inches in width.

C. insignis has large handsome finely-cut fronds of a leathery texture, glabrous, deep dark green above and glaucous beneath; except in the stoutest parts of the stipes it is quite free from scales, and in this particular differs markedly from its allies. It is a native of Jamaica (where it occurs on St. Catherine's Peak at an elevation of 5,000 feet above sea-level), Cuba, and Mexico.

C. medullaris, from New Zealand, is one of the comparatively few ferns which are important from a purely economic standpoint. Its trunk attains a large size and a considerable height, and contains a soft mucilaginous pulp, which is largely used by the Maoris as an article of food. Of course, to obtain the pulp large trees have to be cut down and destroyed. In the Winter Garden at Kew there is a remarkably fine specimen of this species planted out in one of the beds; it was presented by H.R.H. the late Prince Consort, in 1856; it has twice or thrice-pinnate, dark green, leathery fronds, and stout glaucous-black stipes.

CYATHEA DEALBATA.

C. sinuata, a rare species from the wooded mountains of Ceylon, is, according to Baker, if not among the smallest, certainly among the most elegant and graceful of Cyathaceous plants, and the only one we know with quite simple fronds. It has a slender caudex—about an inch in diameter—not more than from two to four feet high, surmounted by a crown of elongate-lanceolate wavy fronds, two to three feet long and an inch to two and a half inches wide.

Cultivation.—The general remarks on the cultivation of *Dicksonias* apply equally well here. Of the species mentioned, *C. dealbata* and *medullaris* do thoroughly well in a cool house—any structure, in fact, which is kept free from frost—the rest do better with stove treatment, and require more shade than the two species just mentioned.

The Doodias.—The genus *Doodia* contains five species, which are confined to the islands from Ceylon eastward to Fiji, New Zealand, and Australia. It is a near ally of *Woodwardia*, which has already been treated in this work. The name *Doodia* commemorates the services to science of Samuel Doody, a London apothecary and cryptogamic botanist. All are cool-house ferns, and thrive in a mixture of loam and peat; shade, too, is essential for their successful cultivation.

D. aspera has erect, dark-coloured, rough stipes, two to four inches long, and oblong-lanceolate pinnatifid fronds, six to eighteen inches long by two to four inches broad; the texture is leathery, the colour dark green, and the margins of the narrow pinnæ are strongly serrated. Native of temperate Australia.

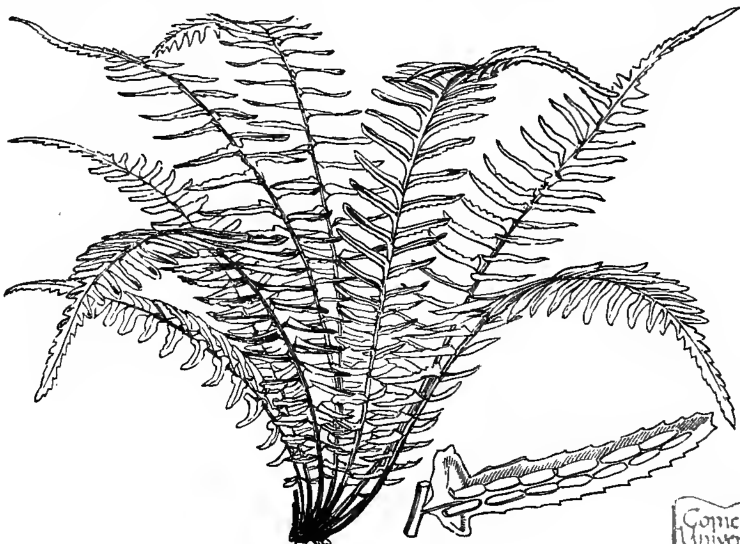
D. blechnoides has fronds similar in colour and texture to the last-named, but they differ in size, being generally about fifteen inches long by about six inches broad. It is, so far as is at present known, confined to New South Wales.

D. caudata, from Australia, Tasmania, and New Zealand, has the lower half of the fronds truly pinnate, and the upper pinnatifid or entire; the stipes are slender and smooth, four to six inches long, and the lanceolate fronds six to twelve inches long, by an inch and a half to two inches broad. The texture is less firm than that of the two preceding species; the specific name comes from the fronds being frequently terminated by a long entire point.

D. media, of which there are numerous forms, both wild and of garden origin, is found in the Polynesian Islands, Australia, and New Zealand. It is very closely allied to the last species, of which it is perhaps merely a variety.

pale green, firm-textured fronds, rather less than a foot in length, contrasting markedly with the wiry, polished blackish stipes, the bases of which are clothed with fine woolly reddish-brown scales.

P. atropurpurea has glaucous, somewhat leathery fronds, varying both in cutting and outline. In size they range from four to twelve inches in length by two to six inches in breadth; sometimes they are simply pinnate, at other times the smooth pinnæ are divided into several pinnules. This ranges from sub-arctic North America to the Andes of Mecoya,



DOODIA CAUDATA.

The Pellæas.—In general aspect the *Pellæas* closely resemble the *Cheilanthes;* the habit of growth is the same in both, but the quite continuous involucre, formed of the more or less changed edge of the frond, renders any *Pellæa* easy enough to distinguish when in fruit from *Cheilanthes*. The geographical distribution is somewhat alike in both genera; the species occur in both northern and southern hemispheres, many extending into the tropics. Probably hardly more than a dozen of the upwards of fifty species known to science, exist at the present time under cultivation in this country. The glaucous tints of several are especially pleasing, and as they require but little space and—those which are described below at any rate—succeed in a cool house, there are few of the smaller-growing ferns more desirable.

P. Alabamensis, a native of Alabama, Georgia, and Tennessee, has ovate-lanceolate, twice or thrice-cut,

where it has been found at elevations of 8,000 to 10,000 feet above sea-level.

P. consobrina is a strong-growing species, with strong, erect, naked, dark brown polished stipes, and glabrous, leathery, divided fronds six to twelve inches long by four to nine inches broad. It is a native of both North and South Africa, and the Mascarene Islands.

P. cordata.—The polished straw-coloured stipes of this species form a striking contrast to the heart-shaped segments of the glaucous, firm-textured fronds. The habit is erect, and the plant attains the height of a foot or more. It occurs from Mexico and Arizona southward along the Andes to Peru. The variety *flexuosa* is of a rather pendulous habit of growth, and is better suited than the type for cultivation in hanging baskets.

P. hastata has wiry, erect, dark chestnut-brown stipes, and twice or thrice-cut fronds, sometimes as much as two feet long by six to twelve inches in breadth. It has a similar distribution to *P. consobrina*, but is found in addition in the Cape Verd Islands.

P. ornithopus, a Californian species, has rigid, erect, polished, dark chestnut-brown stipes, and deltoid bipinnate fronds, of a leathery texture and very pale glaucous-green colour. It makes a charming pot plant for cool-house decoration, and does best in a rather light place. Well-grown specimens measure about eight or ten inches in height.

P. rotundifolia has a stout creeping scaly rhizome, and simply-pinnate dark green leathery fronds—a foot or so in length—with from ten to twenty oblong or roundish pinnæ on each side. This distinct and pretty fern, which is perhaps better known under the name of *Platyloma rotundifolia*, is one of the easiest to grow either in pots or on rock-work. It is a native of New Zealand and Norfolk Island.

P. ternifolia is easily recognised by its claw-like pinnæ. It has tufted, dark chestnut-brown, polished stipes, densely fibrillose at the base, and linear-lanceolate leathery fronds, pale glaucous-green both above and below. In height it scarcely attains more than a foot. A native of the Andes of tropical America and also of the Sandwich Islands.

Cultivation.—All the species above mentioned are cool-house plants, and will thrive under the conditions suitable for *Cheilanthes*, the cultivation of which genus has already been described.

THE ROSE AND ITS CULTURE.

By D. T. Fish.

ROSES IN OUT-OF-THE-WAY PLACES.

CONSIDERING the growing force, climbing powers, hardy constitution, matchless beauty of leaf and flower, and delightful fragrance of the Rose, it is surprising that it has been so sparingly employed in the enrichment of landscape. Valued chiefly for its flowers, it has been treated from the first as a mere flower-garden plant, and to a great extent been cribbed, cabined, and confined out of much of its exuberant vigour and natural beauty.

A more artistic and appropriate use of Roses could not well be devised than their employment in clothing the nakedness, breaking the monotony, hiding the deformity, and relieving the ponderous weight of dead walls and ugly buildings. The profuse and liberal use of hardy free-growing Roses as wall-clothers, would add a new and one of the most enlivening features to our towns and villages and general landscapes. Roses in such close proximity to dwellings would prove as valuable in a sanitary as in an artistic point of view. The Rose, from its free growth, its wide spread of foliage, and the profusion and fragrance of its bloom, is one of the most powerful neutralisers of foul odours, and strongest antidotes to their injurious and deadly influences. When the sanitary power of plants is better known, and more correctly adjusted, the Rose will be found wellnigh at the top of the list. The more free and luxuriant its growth, the more powerful its sanitary effects, and the higher its artistic value.

Roses up Trees.—There is no desire to supersede the Ivy as the natural tree-clother. The Ivy round the Oak is stereotyped into our landscapes, and become part and parcel of the rural life and sylvan history of England. But there is no natural reason why the Ivy in many cases could not be partially clothed upon with Roses.

Some of the richest, sweetest features in gardens, pleasure-grounds, and woods have been accidentally formed by Dog-roses or Sweet-briars finding their way up trees, and almost wholly hiding their boles with a prodigal profusion of gracefully depending branchlets wreathed with flowers:

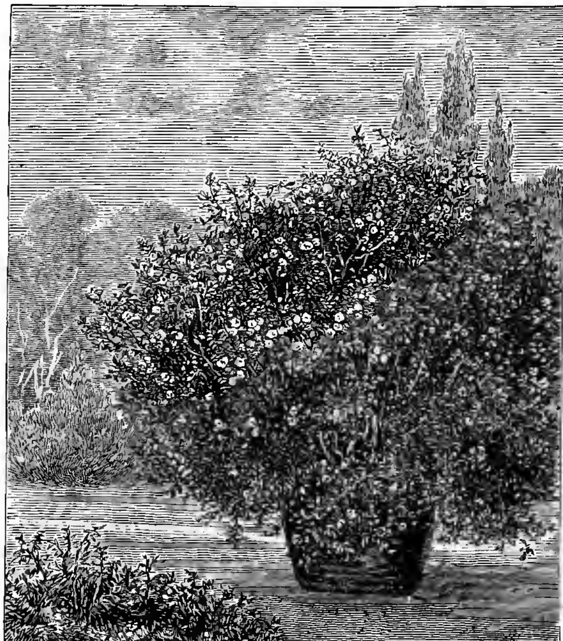
> "Their wanton foliage in the air,
> Luxuriant as the flowing hair."

Art can hardly reach higher than to imitste as servilely as possible these perfect examples.

Roses up trees labour under two disadvantages, which the cultivator must strive to remove or reduce to a minimum of evil. They are robbed of their rights alike at top and bottom. The tree-branches shut out the sunlight and the dew; the roots of the trees steal the food provided for the Rose-roots. Judicious thinning of the tree-boughs will mitigate the former evil. The latter is far more difficult to deal with. There is no remedy, and but little chance for the Roses, unless by isolating the Rose-food from the roots of the trees. Brick, stone, cement, concrete, have all been used as barriers; but these are expensive, troublesome, and not always efficient. Gross-feeding climbers such as Roses should have a square yard of soil isolated to do them justice. Failing so much, richness of root-run may partly stand for mass.

Roses in Casks.—But the richer the Rose-soil, the greater the danger that the tree-roots will find and exhaust it. Hence isolation becomes of vital importance, and tar, oil, beer, or wine casks are by far the cheapest isolators. Knock out the bottom of the cask or barrel, leaving the bung-hole for the exit of water, place three inches of drainage over the bottom, sink it into the ground till the old bottom is about level with the surface, and see that a bottom space, a foot or so deep, is left under the bung-hole for the free escape of water, fill up with the richest half-and-half of good loam and manure that can be found, and plant the Roses in it, watering the roots home. They will not disappoint the planter.

As to size of cask, that is very much a matter of taste, means, and ambition. The bigger the cask, the larger the Rose that may be grown in it, and the longer the plants will continue in health and beauty. Either six, nine, twelve, twenty-four, or thirty-six gallon casks may be best according to circumstances. There is, however, considerable difficulty in sinking the larger-sized casks near to the tree without serious injury to its roots. This difficulty may be avoided, and the cask itself made into a thing of beauty, by draping it round with a portion of the Rose run up the tree, or, better still, by planting a second specially for this purpose.



Rose in a Cask upon a Lawn.

A similar mode of planting may be adopted on lawns where the soil is unsuitable for Roses. Place one or more old beer or other barrels where a group or mass of Roses is wanted; fill with good soil; plant with Roses, and allow these to scramble or run over them till the whole are overrun and canopied with verdure and beauty. Even the height of the casks becomes an important factor in raising and diversifying the height of the masses planted thus.

Such complete methods of isolating the roots also provide special facilities for feeding them either with solid or liquid manure. The casks, especially tar and oil ones, last long in or on the soil, and while they hold together it is certain that the Rose-roots alone have the soil inside them wholly to themselves.

Roses on Walls and Chimneys.—Chimneys are at once the most bald and difficult subjects to deal with in our landscapes; and yet they are endowed with horticultural merits far beyond the average piles of bricks and mortar that cry out in all directions for floral furnishing. They not only afford good support, but also furnish much-needed warmth for some of our finest Tea and other Roses. One of the most ornamental chimneys ever seen by the writer was enwreathed with a climbing Devoniensis Rose that reached its summit, and richly draped it with garlands of beauty. Taller chimneys with less warmth, and in bleaker places, could be clothed with the more rampant and vigorous-growing Ayrshire and Evergreen Roses, or the more robust Hybrid Perpetuals, some of which will run under favourable conditions from one to three yards in a year. The Banksian Roses, again, with their neat glossy leaves and myriads of daisy-like blooms, are admirable as chimney clothers.

Church-towers are mostly bare of verdure, or venerable with Ivy. Occasionally, however, one meets with examples of the towers and walls of churches clothed upon with Gloire de Dijon, Marechal Niel, and other Roses. The first is the very best for this purpose, will climb to the top of the highest tower or wall in an incredibly short time, with its roots in the fat churchyard, and its branches and flowers looking in at the windows, forming charming and appropriate accompaniments to the sights and sounds of worship.

Roses have often been employed more or less, though far too sparingly, for clothing the gable-ends and walls of dwelling-houses. Where houses front to the west, as they often do, the southern gable-end furnishes the best possible site for the more delicate Tea-roses. The southern aspect still further improved in many styles of architecture by the projecting roof, and yet further genialised by the latent heat from the chimney, furnishes the most favourable conditions for the successful cultivation of such magnificent Roses as Marechal Niel, Lamarque, Devoniensis, Catherine Mermet, Marie van Houtte, &c.

Northern gable-ends would in most situations yield Hybrid Perpetuals in perfection in summer, or, if too cold for these, the handsome Ayrshire and other climbing Roses could be used for the northern end and eastern side of the house, while choice Tea, Hybrid China, Bourbon, or Noisette Roses could be used to cover the western side. Stables, farm buildings, factories, workshops, warehouses, and, in a word, all bare buildings could be treated and clothed exactly on the same principles as dwelling-houses, the most choice and tender Roses being chosen for the most favourable aspects.

Roofs are not quite so easy to deal with as walls, though small roofs may be clothed with Roses, at small cost, and with little trouble. Larger ones will need a rough, strong trellis of some sort raised up from six inches to a foot above them, to carry the Roses and hold them fast and taut against wind and weather. As roof Roses can hardly be too wild and free, they will need hardly any attention after being established. It is needful to state this distinctly, as otherwise visions of frequent scrambling on roofs to prune, train, or gather the Roses, with the risk of falls and of broken tiles and slates, might discourage the roof-culture of the Rose. After a first training and strong fixing of leading branches, the way at once to the most picturesque effects, and the highest results, is to leave the Roses to ramble at their own sweet will.

Roses up chimneys, church-towers, walls, or buildings of any sort, as well as on roofs and in the streets, have special difficulties of many sorts to contend against. These must be either mitigated or abolished before the Roses can be expected to thrive. The soil left by builders in such places is generally a vile compound of barren sub-soil, brickbats, concrete, or other builder's rubbish, made more utterly vile (were that possible) by being trampled and puddled into barrenness by the tread of horses and the weight of heavy cartage in all weathers. This inert and dead mass is hidden with a few inches of fresh soil sprinkled over it—a skilful trap for the unwary. Before planting Roses against dwelling-houses, or in streets, see to it that all this rubbish is bodily removed, and good earth put in its place.

The root-runs should always bear some sensible and proportionate area to the extent of surface the Rose is expected to clothe and the length of time it is to live. If a mere mushroom growth is desired, a very limited area for the roots will suffice. But for a Rose that is to last for years and cover a large space, three square yards or more of root-run will prove by no means excessive. As far as possible, too, the whole surface of the soil should be left open to sun and air, and not paved over.

Quality of soil is of more importance than quantity. Either or both, however, become almost useless if resting on a saturated base. Excessive drought is almost equally fatal to the utilisation of the feeding properties of soils by the roots. A happy mean between those two extremes must be provided. Roses may, however, be rendered almost independent of local conditions by the following simple plan:—Remove bodily or place on the top of existing soils in back gardens, areas, &c., a cubic yard or load of the best maiden loam, enriched by the addition of manure, if practicable, for every vigorous-growing Rose, such as Marechal Niel and Gloire de Dijon, planted. The further the Rose has to ramble over roof, wall, tower, or chimney, the more liberal should be the provision made for its roots. The daily overhead washing of street Roses in dry dusty weather, by attaching a hose to the main, is also of the utmost importance to their health and beauty.

Roses in Hedges, and Hedges of Roses.—Seeing that the Sweet-briar, and the common and more uncommon—for they are by no means all alike—varieties of the Dog-rose have been ever revealing to us the beauty and fitness of mixing Roses in our hedgerows, it is surprising that this happy thought has seldom or never been adapted and carried further by planters of hedges. Doubtless, while the Roses would be welcomed as things of beauty by all, and a joy to most, if not for ever, at least while the hedge lasted, yet the mere fence-maker would denounce them as a source of weakness to the resisting force or protecting power of the hedge. But this need hardly be so if a judicious selection of the more spiny and vigorous Roses are chosen. It is by no means always the weaker portion of the hedge in which the Sweet-briar or common Dog-rose forms a part of the fence, or fills the gap where the Whitethorn or Quick may have died out. And the yellow Austrian Briar, or Persian Rose, and several of the Scotch, so well named *Rosa spinosissima*, are equally formidable and still more beautiful in hedges. Another very spiny and hardy species of Rose, *R. Brunoni* (really *R. moschata* of Miller), or Himalayan Briar, has pure white flowers and thorny stems.

Several of our older Roses, as some varieties of the White, the Provence, and Moss, with their perpetual-flowering or other hybrids, are also well furnished with sharp prickles. Not a few of the Hybrid Perpetuals, such as Baronne Prévost, Madame Alfred Dumesnil, Gloire de Bourg-la-Reine, Emilie

Hausburg, Duc de Cazes, Jean Soupert, Julia Touvais, Abel Carriere, &c., are sufficiently spiny to be incorporated with Whitethorn without greatly weakening the defensive character of a hedge. The following less prickly varieties might also be used, by having their resisting powers strengthened by interlacing, diamond fashion or otherwise: Mdlle. Annie Wood, Mdlle. Marie Rady, Madame Clémence Joigneaux, Edward Morren, Souvenir de Collomniers, Duc de Montpensier, Duc de Rohan, and, in a word, almost all the Perpetual and other Roses recommended for pillars and pyramids. Other and less spiny and dense-growing Roses might be employed more as drapery on and in hedges, than as forming a part of them. Of such it may often be said in the words of Jean Ingelow—

> "The Roses that in yonder hedge appear,
> Outdo our garden buds which bloom within."

For forming hedges more for ornament than as barriers against live stock, almost any of the Roses named in the chapter on Pyramidal and Pillar Roses, and for arches, will answer the purpose. The most brilliant Rose hedge ever seen by the writer was formed of the Gloire des Rosamenes alone. The old pink and crimson China, mixed, also form a good floriferous hedge. The two Noisettes, Aimée Vibert and Fellenberg, planted alternately about a yard apart, form a hedge of red and white which few combinations can match in chasteness and brilliancy. Coupe d'Hébé, Charles Lawson, Blairii No. 2, Chenedole, Paul Ricaut, with Madame Plantier, and the Ayrshire Dundee Rambler, thrown in for whites, form a charming hedge. Other, and even richer hedges, may be formed of such Roses as the Persian yellow, Austrian yellow and copper-coloured, the crimson Boursault, the Garland, *Splendens Thoresbyana*, Williams' Evergreen and Félicité Perpetuelle, and other Ayrshire, Hybrid, China, and Evergreen Roses.

Such strikingly beautiful, vigorous, and strong Roses as the White Baroness, the Grandeur of Cheshunt, Paul's single red, white and crimson Perpetuals, will probably become important features in the Rose hedges of the future.

In specially mild localities, the most charmingly sweet and floriferous Rose hedges are formed of Chinese, Bourbon, and Tea Roses. The Cramoisie Supérieure, with its climbing sport, James Sprunt, and the pure white Ducher and Clara Sylvain, a vigorous-growing white Rose; Baronne Gonella; Setina, a climbing form of Armosa, a most profuse-blooming Bourbon Rose; Queen of Bedders, Aimée Vibert, especially the climbing variety, Cheshunt Hybrid, and Camoëns would form most floriferous Rose hedges.

Coming to the Teas, what a hedge of beauty could be formed of the two well-known Glories, Gloire de Dijon and Gloire de Bordeaux! Among others that might be used to form hedges are Beauté d'Europe, Beugere, Comtesse Riza du Parc, Duchess of Edinburgh, Francisca Kruger, Emily Duprez, May Paul, Souvenir de Paul Neron.

As to culture, provided vigorous varieties are chosen, and that these are planted with the other hedge-plants, the Roses are generally able to take care of themselves. But if planted at a later date, the roots of the Quick or other hedge-plants will prove such formidable rivals as to starve the Rose-roots. There are two modes of fostering the Roses under these adverse circumstances—the planting of them at some considerable distance from the hedge, and the isolation of the roots from those of the hedge-plants by some such methods as have been indicated. Care must also be taken that the other hedge-plants may not smother or strangle the Roses in the fierce struggle for life that is apt to be waged against them when they are planted in established hedges.

Rose hedges, if they are to prove successful, need ample support in two ways, or rather at two places—root and top. To provide the former, trench the ground to a depth of three or four feet and a width of six or nine, working in during the process a heavy dressing of farm-yard manure, and remove all roots of weeds, brambles, &c. If the natural soil is good and the subsoil fairly dry, this preparation will suffice. If not, a drain must be run along under or near to the hedge, at least a foot deeper than the soil has been trenched, and better soil substituted for the bad. Of course, in planting Roses in or against existing hedges, the preparation cannot be so thorough, but should proceed on similar principles.

Before planting the Roses for a hedge, a row of strong stakes should be placed along the centre of the space, and driven a foot or more into the solid undisturbed earth. These may vary in height, according to that of the hedge. Nothing answers better than young Larch poles with the snags and bark left on. The tops may be of a uniform height, or otherwise. By having the stakes and Roses of various heights, a more irregular or picturesque hedge will be the result. From four to eight feet will be found convenient and effective heights for Rose hedges. There is yet another, cheaper, though hardly so picturesque, way of supporting Rose hedges through their earlier stages. The stakes may be stronger, placed at wider distances apart, and bound together with rustic rails firmly nailed to them. Three rails would suffice for the tallest hedges; two for the more dwarf ones. To these the

Roses are fastened as they grow, and the whole frame-work is speedily hidden. Iron or wire can also be used instead of wood where the latter is scarce, and dwarf hedges may be got up without any special props. But few things are more offensive to good taste than an ambitious-looking hedge of Roses swayed out of all form, or laid level with the ground, by winds.

Fix the Roses to the supports at planting, somewhat loosely, and so that they may subside with the soil, and not be hung up to the stakes. And in about two months afterwards prune out all the weakest shoots, and shorten back the strong ones to from a foot to a yard, according to the strength and vigour of the plants. As this is the first, and maybe almost the last pruning in the ordinary sense of the term that the hedge of Roses will require, it is best to cut back rather severely, to insure a strong break at bottom, so as to furnish a good permanent base for the hedge. Another good plan is to tie the stronger shoots down horizontally along the bottom rail or base of the stake. Either way, a vigorous break and free growth near to the ground-line must be obtained.

About the middle of June some of the more vigorous growths might be stopped. They will break afresh, in time to ripen their second growth before the winter. The Roses may be topped rather than pruned after their first season's growth, and, if a uniform formal hedge is desired, this trimming should be repeated annually. But for a real rustic, picturesque, wildly luxuriant, and most effective Rose hedge, leave them to nature above, and the rich border for their roots below, after the first season.

Finally, choose Roses on their own roots for Rose hedges, as otherwise the plague of suckers will be incessant; and as the struggle for existence mostly ends in the survival of the fittest—that is, in the fierce struggle of a Rose hedge, the strongest—the Roses will finally succumb to the briars, and leave the astonished possessor a briar hedge in lieu of the Rose one he so carefully planted and so liberally supported above and below. On the other hand, there is no speedier or better mode of getting up Roses rapidly, either in existing hedges, woods, or other out-of-the-way places, than that of budding many Roses on existing briars, and taking some little pains to suppress the briars and encourage the Roses ever afterwards.

Roses in Shrubberies and Woods.—These are more effective when planted in considerable masses. Some of the most striking effects may be produced in both by draping a few prominent boles of trees here and there with Roses, as already shown, and forming a group of the same or other and contrasting Roses near to these, extending the one wild Rose as it were into a small colony. In all cases where Roses are introduced into shrubberies and woods, they should be very much left to nature, or if any art is employed, it should be so skilfully concealed, and so hidden beneath the highest possible examples of natural grace and beauty, as to wholly hide the art. Almost any of the Roses named or specified in the foregoing lists will answer well for these purposes. But whatever selections of Roses are made, the different varieties of the Sweet and Austrian Briars and Scotch Roses should not be forgotten.

Of the Roses best adapted for forming effective groups in woods, the following Ayrshire, Evergreen, Prairie, and Multiflora Roses will be found suitable:—Dundee Rambler, pure white; Queen of the Belgians, rich creamy-white; Ruga, flowers flesh-colour, very fragrant; Splendens, buds crimson, melting into pale flesh with age: one of the best. The Evergreen Roses are not strictly so, though most of them hold their leaves throughout the greater portion of the winter: Adelaide d'Orléans, flowers creamy-white, in large clusters; Félicité Perpetuelle, flesh-colour changing to white, large clusters; Donna Maria, pure white, very fine, not so robust as most of the others; Rampante, pure white; Williams' Evergreen, one of the freest and best. Among the best of the Prairie Roses are the following: Beauty of the Prairies, pink; Gem of the Prairies, crimson, blotched with white, the only fragrant Rose among these North American species; *Rosa rubrifolia*, Queen of the Prairies, rosy-purple. Among the Multiflora section of Roses, De la Grifferaie, deep rose, changing to blush; Laura Davoust, pink, flesh, and white, in large trusses; and *Russelliana*, rich lake and lilac, are the best.

For shrubberies, any of the sorts recommended for pillar or pyramidal Roses may be introduced, either single or in masses. Standards and dwarf standards also look well towering above dwarf shrubs. In sheltered shrubberies, too, groups of Chinese, Tea, or Noisette Roses may be alternated with other shrubs with the happiest effect; such Noisettes as Triomphe de Rennes, Celine Forestier, and Teas, as Gloire de Dijon, Bougere, and Homere, being among the best for use in quantity in such positions.

Roses in Streets.—It is a far cry from the wild woods to the crowded streets, and yet Roses may be grown in the latter. The smoothest-leaved and stemmed species and varieties of Roses, and those of the most robust and vigorous constitution, should be chosen for street culture. Smooth-leaved Roses would retain little or no dust or soot, and enable the rain or syringe to make a clean sweep of any that did settle on them. Moss Roses should also be avoided, inasmuch as this appendage would favour the collection and retention of dust. The Banksian, Chinese, Noisette, Bourbon, Tea, and their hybrids, being the smoothest-leaved varieties, will, other conditions being equal, prove also the most desirable as street Roses.

Among the Hybrid Perpetuals, the following are some of the smoothest-leaved and stemmed:—Captain Christy, Star of Waltham, Duke of Edinburgh, Victor Verdier, Duke of Teck, Etienne Levet, Charlea Lefebvre, Countess of Oxford, Mrs. Baker, Henri de Ledechaux, Perfection de Lyon, Horace Vernet, Hippolyte Jamain, and Mdlle. Eugénie Verdier. Coupe d'Hébé, Brennus, Charlea Lawson, Blairii No. 2, and Paul Ricaut are also good Hybrid Chinese for this purpose.

Roses for Banks.—Roses are also the most brilliant and serviceable clothing for banks. The better and more tender classes of Roses enjoy shelter, and few things can be more enjoyable than a sunk Rose garden, with the sloping banks that lead to it also furnished with Roses, instead of turf. The warmer banks can be clothed with Tea and Noisette Roses, the medium ones with vigorous-growing Hybrid Perpetuals, and the coldest with Evergreen, Ayrshire, or other hardy climbing Roses. The whole should be pegged down as closely to the ground as may be, as otherwise they might mar the symmetry, or partially conceal the beauty, of the Rose or other garden on the flat or level space below. Though it is here suggeated that slope and plain should be wholly devoted to Roses, this is by no means necessary, as Rose-banks look well with, and heighten the beauty of, most other flowers by their rich contrast. One of the most effective flower gardens ever seen by the writer was furnished with Verbenas only; a second with Violas; and a third with the usual mixture of bedding plants, chiefly Pelargoniums, Lobelias, Coleus, &c. All these had this in common: they were sheltered and surrounded with a sloping bank of Roses, and the Roses in each case seemed the richer part of the garden.

The Rose on Grass Lawns.—By this is not meant a bed of Roses on the lawn. These are plentiful enough, and may be appropriate or otherwise, according to circumstances. But by Roses on grass lawns is meant single plants or groups literally planted in, springing out of, and running semi-wild and free over the turf. Never does "the Rose, the glory of the day," seem more glorious than when uprising from and cushioning its wearied beauty on the green grass. It is reported of Sadi the poet that, seeing a Rose in a tuft of grass, he cried, "What! is grass fit company for Roses?" He was about to tear away the grass, when it meekly besought him, saying, "Spare me! spare me! True, I am not the Rose, but my perfume proves that I have associated with Roses." Whether the grass gains much from the Rose may be doubtful, but no one who has seen a mass of Roses on grass lawns will dispute that the Roses gain considerably from their close proximity to the turf.

Rosea in meadows differ nothing from those on lawns, unless it be in the size of the groups, and the necessity, where the meadows are grazed, of a protecting fence against browsing; for unfortunately stock of all kinds seem as favourably impressed with the sweetness of the Rose as ourselves, and show it by eating all up within their reach. But already most home meadows abound with clumps of trees and shrubs enclosed for security with stock-proof fencing. None of these can be more ornamental than clumps of Roses. These might either be formed in fresh places, or clearances might be made in existing clumps and furnished with masses of Roses.

There need not be any fear of overdoing it. The background is so cool and full of shadow, that even the bright light of many Roses will fail to splash in colour to excess.

Some of the stronger-growing Chinese, Teas, Bourbons, and Noisettes, and their hybrids, are among the most effective Roses on lawns, one of the very best being Gloire de Dijon, and its near alliea, Belle Lyonnaise, Beauté de l'Europe, and Madame Berard. The red or pink Roses that so closely resemble the Gloire de Dijon in habit as to be called Pink Glories—viz., Gloire de Bordeaux, May Paul, and Reine Marie Henriette—prove equally effective, and contrast admirably with the buff-and-gold colour of the Gloire de Dijon. The Noisette Rose, Souvenir de la Malmaison, with its deep velvety red sport Malmaison Rouge, would form rich masses either singly or combined. The dark crimson Bourbon, Queen of Bedders, also contrasts well on the turf with Setina, a semi-climbing very hardy Rose, producing a profusion of semi-white blossoms. The best of the Hybrid Teas, of the Cheshunt Hybrid class, likewise mass admirably on the grass. Such hybrids as Coupe d'Hébé and Charles Lawson can hardly be equalled by the most brilliant and floriferous Hybrid Perpetuals. The most vigorous and hardy sorts of the Baronne Prévost type of Perpetuals are best for these purposes. The Ayrshire, Evergreen, and Boursault Roses form larger masses of a more semi-wild character, one of the very best Roses for this purpose being the double white Ayrshire, a single plant of which will form a Rose-group covering an area of from ten to twenty yards.

Some of the best results in forming effective Rose-groups in meadows and grass lawns have been produced by the removal of tall and dilapidated standards from the garden, the planting of them rather thickly in good soil, and leaving them to time and nature to restore to vigour and mould into beauty. The results were astonishing. Emancipated from the enfeebling influences of the knife, they speedily ran into a veritable maze of beauty and brilliancy that delighted the eyes of every beholder. Several Sweet-briars were planted with the Roses for the fragrance of their leaves, and grew so vigorously as to tower high above and run all through and among the Roses, while Wood Violets and Primroses crowded around the sides of the group, the whole illustrating as well as realising Moir's vivid description:—

> "On a mound
> Of verdant turf with wild flowers diamonded,
> Sprang in his majesty of natural pride
> An Eglantine, the red Rose of the wood;
> Its canny boughs, with threat'ning prickles armed,
> Rich in its blossoms and sweet-scented leaves."

Roses on Housetops.—Roses on the roof are, in fact, Roses on the housetops, with their roots, however, planted in the soil, and their tops displayed for picturesque effect at a distance. But Roses on the housetop are meant to be grown on the roof, and to be as accessible as those in the garden. When the growing demands of our rapidly increasing population compel architects to utilise our wasted roof-spaces by making them flat and readily accessible, a great future will be opened up for housetop horticulture. No doubt there will be a few difficulties, cultural and otherwise; but difficulties are made to be mastered, and as the sanitation of towns improves, the difficulties in the cultivation of Roses on housetops will diminish.

Even now, by a judicious selection of sorts—those recommended for streets being the more suitable—and with careful culture, no one need despair of blooming Roses in tolerable perfection on the top of St. Paul's! Special preparation, as well as judicious selection of the plants, is highly needful; and these, with cleanliness and a plentiful supply of food, will grow Roses in all places where light can get at them.

Roses on Balconies.—The conditions on these do not vary greatly from those on the housetops, unless it be that the circulation of air is less free, and the temperature more variable. Balconies also offer better facilities for being partially furnished with Roses by plants led up from the ground. Such magnificent balcony plants as the Banksian Roses might thus be led up to any height, and wreathe balconies with their verdure and beauty. Their spineless branches and small smooth leaves present no foothold for soot or dust particles, and hence they could easily be kept clean. Where it is impracticable to lead Banksian or other Roses up from the ground for the clothing of balconies, they can be grown well in large boxes, pots, or tubs. Tea-roses, as dwarf or other standards, would also be admirably adapted for balconies. Rows of these towards the front or in any part of a balcony, the front itself being draped and partially covered with weeping Rose sprays, would bring a new, and what has hitherto been thought impossible, pleasure to tens of thousands of town houses.

It is most important that the plants should be well established and freely rooted in tubs, vases, or pots, before being placed in such novel and exposed positions. To purchase plants from nurseries, pot them afresh, and place on housetop or balcony, is one of the surest means of inviting failure. As the demand for Roses for such positions is created and extended, the trade will speedily make a speciality of keeping in stock any quantity of well-established Roses every way suited for the purpose.

Again, a few deaths or failures must not cause disappointment. These occur sometimes in numbers that are almost appalling in the best-ordered gardens. In fact, with all our advance in Rose-culture, the life of individual Rose-plants was never worth so few years'—months'—purchase as now. Hence the housetop Rosarian need not despair. Should his plants bloom well for two years he will have his reward. But if kept clean by frequent overhead syringings, heavy and copious enough to rinse off all dust and dirt, and well watered and fully fed at the roots, there is little reason why they should not live almost as long on the housetop as in the garden.

Extremes of heat and cold must also be guarded against. South balconies are like ovens when the mid-day sun's broad glare beats fiercely on or into them. Northern ones are also extremely cold. Others, and also many housetops, are full of fierce and strong artificial draughts. The Rose, though hardy, likes none of these extremes, and means must be taken to provide partial shade and shelter when needful. Neither must the roots be drought-parched, nor their runs be converted into a swamp, nor into a patch of the Arctic regions by being frozen through.

In a state of nature Rose-roots are seldom frozen. They are doubly, trebly protected, by their tops, the earth, and a non-conductor or *débris* of fallen leaves, grass, &c. But in a pot or tub on the housetop, few or none of those natural cold-resisters are present; and mats, old carpets, cocoa-fibre refuse, straw, or paper wrapped well round and surfacing their root-runs, must take their place.

The extremes of heat and cold, of drought and water in excess, the want of artificial overhead waterings, to compensate as far as can be done by art for the lack of the invigorating, feeding, cleansing, natural rains and dews — these have killed tens of thousands of town Roses, while the polluted atmospheres of which we hear so much have only killed their hundreds.

PROPAGATION.

By W. Watson.

THE RAISING OF SPECIAL GENERA FROM SEEDS.

In the last chapter we considered in a general way those conditions which play an important part in the germination of seeds, and which, if properly understood, should be sufficient to enable any gardener to succeed in the management of seeds of any particular kind. For information of a more special nature, as well as for the details of that treatment most suitable for the seeds of ordinary garden plants, such as vegetables, annual flowering plants, &c., the reader is referred to those chapters which deal with each class. It would be out of the question to attempt such information here. There are, however, one or two special classes of plants to which a few lines here may not be out of place, and the first of these is—

Coniferæ.—Seeds of all the cone-bearing family, of which the Pinus and Cupressus may be named as examples, are when procurable the readiest means of propagating these plants; but owing in some cases to the difficulty of obtaining foreign seeds, and to the trees in this country not producing them, cuttings or grafts are resorted to as the only means. The seeds of Conifers are borne in between the bases of the scales of which the cones are composed, some cones containing as many as 300 seeds. Notwithstanding their oily nature, they will keep perfectly fresh for three or four years if allowed to remain in the cone, but lose their vitality in less than a year if removed. It is usual to gather the cones before they are quite ripe, and before the scales have separated so as to allow the seeds to drop out. Some kinds, however, do not open, and it therefore becomes necessary to soak them for a day or so in water, and afterwards expose them to sunheat, or place them in heated kilns specially constructed for the purpose. For sowing the seeds, if to be placed out of doors, April is the most favourable time. It is a good plan to place the seeds in a bag, and then steep the whole in water for two or three days. After this take the seeds out and dry them gently in the sun before sowing them. The soil should be soft and rich, mellowed by the preceding winter's frost, and raked as fine as possible. After sowing the seeds cover them with a thin layer of fine light soil, and then run a light roller over the bed. To prevent the sun from drying the soil a covering of Fir branches, hurdles,

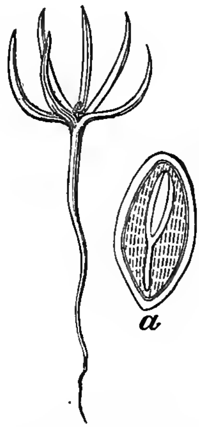


Fig. 1.—Seedling Pine. *a*, Section of seed, showing position of embryo.

Fig. 2.—Seedling of Salisburia

or straw should be placed over it. Mice and birds are fond of these seeds, and must therefore be prevented from getting at the seed-beds. Should the weather be dry it will be necessary to water the beds often enough to keep the soil moist. Germination should take place in from three to five weeks. As the seedlings push through the soil the covering should be removed so that light may reach them. For the first year or so seedling Conifers grow very slowly; they should not be transplanted until they are about four inches above the ground. When pots are used it will be unnecessary to cover the seeds of Conifers, merely pressing them into the soil so that they are partly buried. Light appears to be helpful to the germination of seeds of coniferous plants. In germinating, the radicle, or root, is the first to appear, pushing its way into the soil, to be succeeded by the appearance of the leaves from the opposite end of the seed. It is usual to plant large coniferous seeds with their thin end a little way in the soil, leaving the thicker end exposed and pointing upwards, as, for instance, in seeds of Araucarias.

Fig. 1 illustrates the position of the embryo in the seed of a Pine, and a seedling after it has emerged from the seed. The importance of planting the large seeds of Conifers with the thin end downwards is here made apparent. Fig. 2 represents a seedling of *Salisburia* (Maiden-hair tree).

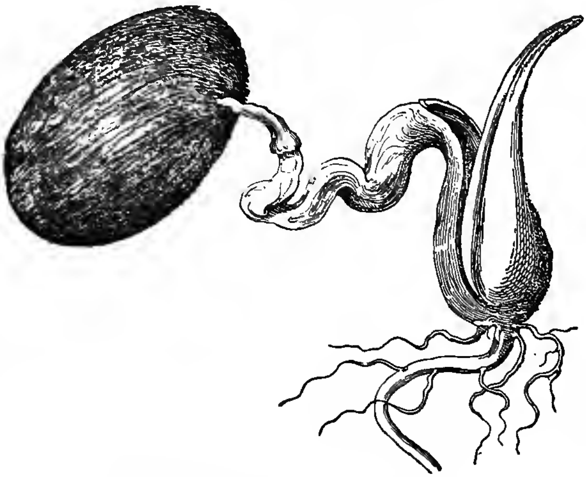


Fig. 3.—Seed of Borassus or Date-Palm.

Palms.—Seeds of the commoner kinds of Palms usually germinate freely if sown in pans of soil, and placed on a bottom heat of 80°. Some of the rarer kinds require somewhat special treatment, especially those which grow in swamps. For these it is necessary to use an open soil, and to stand the pots in which the seeds are sown in pans of water. Many Palms germinate quickly, but owing to unfavourable conditions the seedlings are weakened or fatally injured before they become strong enough to look after themselves. A regular temperature, both at the roots and overhead, is of special importance, as also is an uniformly moist soil, anything approaching drying being harmful to seedling Palms. In removing them from the seed-pans to pot them into separate pots, the roots should be carefully handled, as if broken or in any way injured it not unfrequently happens that death is the consequence.

The manner of germination in Palm-seeds is shown by Figs. 3 and 4; the seeds are still attached to the young plants, to which they will continue to afford nourishment until the plant is well established, when the seeds will fall away.

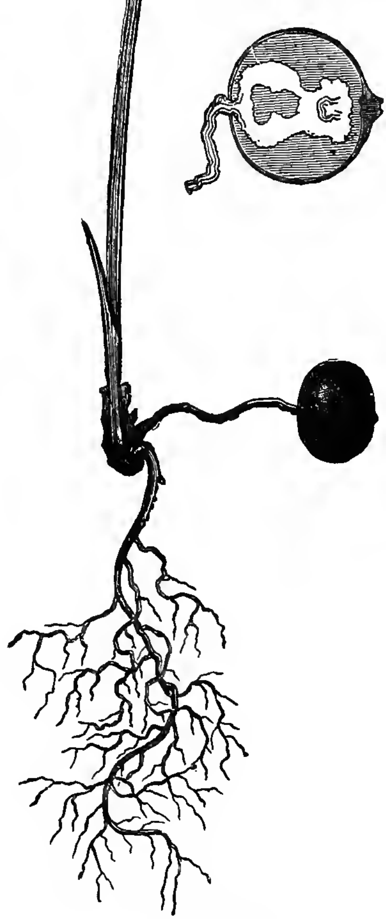



Fig. 4.—Germination of Palm-seed.

Orchids and Nepenthes.—The majority of Orchids, and the whole of the Nepenthes, are epiphytal in habit. Their seeds are very small; both families require careful management when in a seedling state. The seed of an Orchid is a singular organism, totally distinct from the seed of any other flowering plant in that it contains no embryo, but is merely a mass of cells, with a dark, thickened collection of cells, called a nucleus, in the place where the embryo might be supposed to exist (see Fig. 5, No. 2. This singular structure can only be seen with the aid of a microscope. Recently the propagation of Orchids by means of seeds has received much more attention than formerly, owing no doubt to the valuable results obtained from crosses made with cultivated kinds, the progeny of which have been raised in this country. Messrs. Veitch have devoted much skill and careful management to Orchid hybridisation and seed-raising, to which we shall refer again at some length in the chapter devoted to "Cross-breeding."

The seeds of Orchids are sown on pots filled with crocks and growing sphagnum, or, better still, upon the sphagnum growing about other Orchids. It is necessary that the seeds should be sown immediately on their becoming ripe, as, owing to their smallness and extreme delicacy, they do not retain vitality long. They should be scattered upon the sphagnum and then left to themselves, the treatment required by the plant about which they are sown being such as will afford them all they need. To prevent the risk of washing the seeds away with water, the pot and sphagnum upon which they are sown should be dipped a little way in water so as to allow it to soak upwards, and not watered overhead. The time seeds of Orchids take to germinate varies, according to the species, from three to twelve months. Seeds of *Disa grandiflora* are perhaps the easiest-managed among Orchids; they may be sown upon a mixture of chopped sphagnum and peat. Numerous varieties of this beautiful Orchid have been obtained from seeds raised in this country.

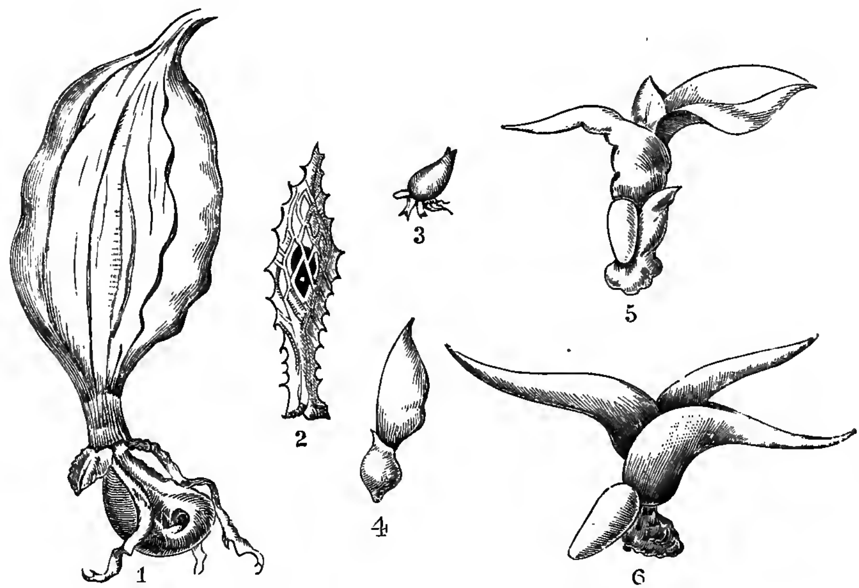


Fig. 5.—Fruit (natural size), Seed (magnified), and Seedlings (magnified) of Cattleya.

Germination having taken place, and the seedlings being large enough to handle safely, they may be removed from the seed-pot and planted in tiny pots of chopped sphagnum and crock-dust. To guard against drought and danger to the seedling, it will be found a good plan to place a number of these tiny pots together in a flat pan, filling up between the pots with sphagnum; these pans may then be suspended near the glass in a shaded house of the temperature suited to the requirements of each kind of Orchid. Patience of no ordinary kind must be possessed by any one attempting the raising of Orchids from seeds, as it takes a very long time for most of the kinds to arrive at a flowering condition. In the case of Cattleyas, for instance, it generally takes from seven to ten years, and sometimes even longer, to grow a plant from seed on to its first flowering. Cypripediums, Calanthes, Disas, and a few other terrestrial kinds are a shorter time, generally about three years, before they become strong enough to flower.

To afford some idea of the delicate nature of seedling Orchids, the illustrations in Fig. 5 have been made from living seedlings of Cattleya. No. 1 represents the fruit (natural size); No. 2, the seed; No. 3, a seedling directly after it has emerged from the seed-coats; No. 4, the same developing the first leaf; Nos. 5 and 6, seedlings of two and three years respectively. From 2 to 6 are all magnified.

Nepenthes-seeds require the same treatment as Orchids, than which, however, they are quicker to germinate, and form sturdy plants in a much shorter time. The foliage bears tiny pitchers soon after germination.

Aquatics.—All such plants as Nymphæas, Nelumbiums, Sagittarias, and others of aquatic habits may be raised from seed if sown in soil and submerged in water in the light. For seeds of tropical plants a temperature of from 75° to 80° will be necessary; for the *Victoria Regia*, 85° will be found none too high. It sometimes happens that seeds of aquatics are sown in soil and treated as for terrestrial plants; at least, several such mistakes have come to my knowledge. It was thought that the plants liked to grow in water only when strong; which seems about as likely as that fish-spawn should be hatched in dry soil, and the young fishes kept from the water till they had grown a little.

SPORES OF FERNS.

The organs of reproduction in Ferns are quite different from those of flowering plants, spores or "Fern-seeds" possessing neither coats, radicle, plumule, nor cotyledons such as are found in all true seeds, but nevertheless containing within themselves the capacity to vegetate and produce young Ferns. To distinguish flowering from spore-producing plants the term "acotyledon" (*i.e.*, without cotyledons) is applied to the latter, and to this group belong all Ferns, Lycopods, Isoetes, Marsilea, Salvinea, Liverworts, and Mosses. Of these the two last are of little horticultural interest; Isoetes, Marsilea, and Salvinea are seldom cultivated except in botanic gardens, but the plants belonging to the first two groups are of great importance as garden plants. To the Ferns and Lycopods therefore, and their modes of reproduction, and especially to their propagation from spores—an operation of some delicacy—this chapter will be devoted. Before going on to the subject of treatment it may be interesting to say a few words on what is supposed to occur during the vegetation of a Fern-spore. When a spore is placed on any warm, moist medium favourable to its growth, it vegetates by expanding in the form of a tiny thread a simple oblong cell, to which other cells are added, till a thin, green, leaf-like membrane is formed, resembling a Liverwort; this is called a prothallus. The form of this organ varies according to the species, but it is generally kidney-shaped, and about half an inch across. Along the axis of the prothallus fine hair-like roots are developed, by means of which it attaches itself to any moist surface. In addition to these roots there are also produced on the under side of the prothallus little cells, containing tiny coiled threads, which are said to move spontaneously, but most likely owing to the action of moisture on their coiled bodies. These are the fertilising organs analogous to the pollen of an ordinary flower, and called antherozoids. Close to these little bodies other cells are formed on the prothallus, and these contain organs whose functions are precisely the same as those of a pistil of an ordinary flower; they are called archegonia. As growth proceeds, the little threads or male organs come in contact with the small pistil-like bodies and fertilisation is completed. Soon after this the young Ferns begin to appear, each prothallus producing a single plant, though in a few species several plants are developed from one prothallus. By dividing the prothallus into several pieces each piece will produce a separate plant, as has been proved with *Todea superba*, the prothallus of which was cut into a dozen pieces, each one of which yielded a plant. The prothallus dies away as the young plants develop roots. It will be seen from this how different the process of spore-vegetation is from that of seeds. A microscope is necessary to enable us to perceive the wonderful movements of the fertilising organs, and to watch the development of a plant from a spore through all its singular changes. The importance of a knowledge of the above to a Fern-grower will be seen, when it is remembered that some very distinct and useful hybrid Ferns have been raised by crossing two species: as the fertilising process takes place during the development of the plant from the spores, it will be apparent how hybrids are likely to be obtained. Mr. Bause's success in raising hybrid Ferns has been the subject of some surprise even among botanists; for not only has he produced plants with characters which combine those of the two parents, but every one of his hybrids is fertile and reproduces itself exactly from its spores. Previous to Bause's experiments the only Fern we possessed of supposed hybrid character was *Adiantum Farleyense*, which, however, is uniformly barren, never producing spores.

Sterility is much more frequent in cultivated Ferns than is generally supposed. For a large proportion of the most popular kinds we are seldom compelled to employ spores in their propagation, as division and bud-producing fronds afford ready means for their increase. Many Ferns are, of course, abundantly fertile, Gymnogrammas, Pteris, some Adiantums, Cheilanthes, Actinopteris, and numerous others being well-known examples. But, on the other hand, it has been hitherto impossible to obtain plants from the spores of such Ferns as Trichomanes, Hymenophyllum, Davallia, many Polypodiums, Gleichenias, &c. We must suppose that sterility in these cases is the probable result of artificial cultivation; for the wide area over which the above plants are distributed in nature can only be explained by their spores being fertile. Sometimes we find spores producing prothallia, but not getting beyond that stage; from which we must infer that the functions of fertilisation have been weakened by some cause or other, although the spore itself is produced, and from it the prothallus is expanded, but without the capacity to produce plants. This may be considered as analogous to what we see in many cultivated flowering plants, the flowers of which are developed, but all efforts to make them produce fruits proving of no avail. Whether the sterile nature of the Filmy Ferns has caused them to assume a proliferous character in their foliage cannot perhaps be proved, but we find that many of the Hymenophyllums and Trichomanes, when grown under glasses, are proliferous to an extraordinary degree in their old barren fronds. It is possible that the failure on the part of the prothallia to produce plants may be due to unfavourable conditions as regards light, heat, or some other circumstance, and that therefore a change of treatment might prove successful. We have tried many different kinds of spores in many different ways, but, except those of known fertility, little or no success has been met with, although strong, healthy prothallia have sometimes been obtained. We have not succeeded in raising plants from the spores of Lycopodium, Selaginella, and Psilotum, though they have been tried under various conditions. Perfect—*i.e.*, fertile—spores retain their vitality for a long time acccording to various authorities; we have not tested them beyond the age of twelve months, but, unless it be for exportation, spores are not likely to be wanted to keep longer than a year. They should be kept dry and warm, as the smallest seeds of tropical plants, such as Gloxineas, are preserved. In gathering spores it is best to select those leaves, or portions of leaves, on which the spore-cases are not quite ripe; if left to get ripe the spores are often lost, as the cases generally open as soon as ripe and eject their spores. Shake the fronds after they have been gathered, so as to remove if possible all foreign spores that may have settled upon them whilst in the house. Place them in sheets of smooth paper in a perfectly dry place. In a few days the spore-cases will have burst, and the spores will be found scattered over the paper.

In preparing pots for the reception of the spores, it will be well to bear in mind that both in the soil and in the atmosphere in or near a Fernery myriads of spores are scattered; and these, if allowed to get into the pots along with the sown spores, not unfrequently vegetate first, and are either mistaken for the desired plants, or usurp the conditions supplied for them, so that these are either prevented from growing, or lost through being crowded. For spores of choice Ferns the following plan is in use at Kew:—Pots, usually four-inch, are crocked and filled with soil, the latter consisting of peat with fine crocks mixed amongst it, and sometimes a little sand. These pots are placed in large flat pans, generally large enough to hold five pots of the above size, and to allow a large bell-glass to fit inside and rest on the bottom of the pan. The pots being filled and arranged in the pans, boiling water is poured over soil, pots, and pan in quantity sufficient to make the whole quite hot. The bell-glass is then placed over the pots, and the whole is allowed to stand till the soil has again become cool. To sow the spores, the pan, &c., are carried into a shed away from the houses, the bell-glass is taken off only long enough to allow of the scattering of the spores over the soil and labelling each kind, and is then replaced and tied on to the pan. Water is poured into the pan, and this prevents the air from getting into the soil, as well as keeping the whole moist, so as to obviate the removal of the bell-glass. If properly managed it should be easy to destroy or keep out all germs from the soil on which the spores are sown, so that the first signs of vegetation under the glass should be those of the sown spores. Some Fern-spores germinate rapidly and vigorously, and for these it is not necessary to take all the trouble described above. A pot of peat soil, well watered before sowing the spores, and a pane of glass over the top, affords such kinds all the conditions they require. The temperature most suited for spore-raising depends on the nature of the Fern, but as a rule a temperature of from 70° to 75° should suit all but the coolest kinds, which may be placed in a temperature 10° lower. The spores should be shaded from bright light. As soon as the prothallia are well advanced, should they be crowded it will be necessary to transplant them into pots of well-drained peaty soil, separating the mass of prothallia into little patches of the size of a threepenny-piece, and carefully planting them about an inch apart all over the soil. The finest soil should be used, and, should the Ferns be delicate kinds, it will be well to mix a quantity of finely-sifted crocks along with the peat. In filling the pots with soil the middle should be raised above the top of the pot. When transplanted replace the pots in pans of water, and re-cover them with bell-glasses or hand-lights. If care is taken not to allow air to get into the bell-glasses till the prothallia have appeared, those glasses with a hole through their knobs are preferable to the air-tight ones for this work, as it then becomes easy to air the plantlets without any trouble.

Recently a very curious anomaly has been discovered in the reproductive capacity of Ferns—namely, that of producing prothallia direct from the frond instead of through spores, as is usual. Upon the under side of the frond, and growing out from empty spore-cases, numerous prothallia are seen, from which plants are developed just as when spores have intervened. This singular freak, to which the name Apospory has been given, is as remarkable as if a Pea-plant, instead of producing flowers and then fruit, were to develop pods at once. This remarkable mode of reproduction must not be confounded with that of ordinary proliferousness in fronds, as the latter takes place generally on barren fronds, and moreover perfect plant-buds are formed at once, whereas in Apospory the prothallia are succeeded by the usual fertilising process before plants can be developed.

GLASS STRUCTURES AND APPLIANCES.

GLASS AND GLAZING.

By William Coleman.

Although the manufacture of glass dates from a period anterior to the exodus of the children of Israel, more than 3,500 years ago, and was long carried on at Alexandria, whence the Romans were supplied, its application to the glazing of windows in Northern and Western Europe is of comparatively modern date. In the year 674 artists were brought over from France to glaze the church windows at Waremouth, in Durham; and as late as 1567, the use of glass for excluding the cold from palaces and the better class of houses was by no means common, as we learn that the glass casements at Alnwick Castle, the seat of the Dukes of Northumberland, were taken down during the absence of the family to preserve them from accident or injury. A century later the use of window-glass in Scotland was so small that only the upper rooms in the royal palaces were furnished with it, the lower parts having wooden shutters, by means of which the air was admitted or excluded. The manufacture of flint glass in England was commenced about 1557, but it was not until the end of the seventeenth century that manufacturers had made sufficient progress to become independent of foreigners for the supply of ordinary drinking glasses.

At an early period of its history in this country glass became an object of taxation, and so heavy and injurious were the duties imposed, that its use was extremely limited until these vexatious imposts were removed by Sir Robert Peel in 1845. Immediately before the removal of the duty there were fourteen manufacturers of crown and sheet glass in the United Kingdom, and they, for want of hands and convenience, at once became overwhelmed with orders. They hired foreign workmen, who, during the transition period, could earn from £4 to £8 a week in the manufacture of glass of very ordinary quality. But this in the course of a few years corrected itself. These exciting matters gradually found their level, and the glass trade is now in the hands of a few influential men, who by their perseverance and energy have out-distanced the foreigner, and have been instrumental in making one of the most important epochs in horticultural history.

Until the repeal of the duty, forty years ago, and for some time afterwards, there were only a few varieties of glass suitable for horticultural purposes; but by degrees British plate and patent plate were brought into use for the fronts of ornate conservatories. Rough plate, rolled plate, crown and, most important of all, British sheet, were extensively used. One of the worst evils which then sprang into existence was scorching or burning, for which the glass-makers were at one time held responsible; but it is now pretty well understood that *insufficient ventilation* was at the bottom of a great deal of this mischief, as it is quite certain that the glass, however imperfect it might be, was infinitely superior to the rough opaque squares which it had so recently replaced. The want of ventilation may be readily understood when we consider that small squares, say eight inches by four inches, which admitted a small stream of air at every lap, were displaced by others three feet or more in length, and ten to twelve inches in width. In many old houses every alternate sash-bar was removed in the rapid march of improvement; but it did not always follow that the ventilating space was increased to admit of an extra supply of fresh air that would compensate for the loss of the hundreds of crevices thus abolished.

Another difficulty brought about by this change from small uneven squares to large flat plates, was condensation of moisture. Under the old system this moisture could escape at every lap. Under the new system, early morning ventilation—in any circumstances advantageous—became imperative, as there is now no other means of keeping the air in motion; and every practical horticulturist knows how impossible it is to keep the tender leaves green and healthy where atmospheric or exhaled moisture is converted into scalding steam betwixt the foliage and the roof.

These difficulties have long since been overcome, not only by early morning, but by night ventilation. Houses are built upon the best principles; ventilators of ample size are worked by machinery, and nothing short of sheer neglect can result in scorching, scalding, or burning.

So far, the mode of applying glass to horticultural purposes has kept pace with the times. Even in these days there is glass and glass; but so reasonable in price are now the best qualities of British sheet that it behoves horticultural builders to use none but the best. For many years an immense trade was carried on in Belgian glass, and the Belgian agents in London could undersell the English makers. A change, however, has taken place in this respect, as British manufacturers now produce an article at all times reliable, at a price that will enable them to compete with any nation in the world.

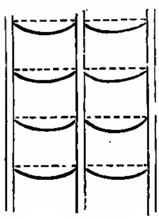


Fig. 31.—Old Glazing.

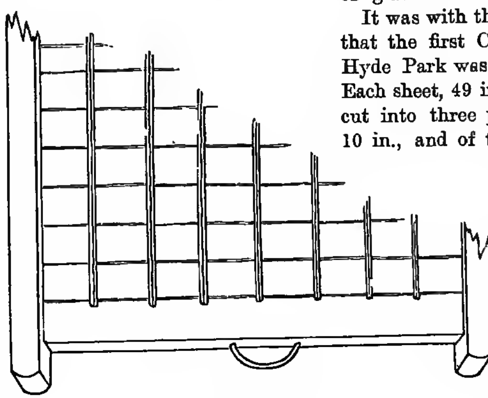


Fig. 32.—Old Sash.

Different Kinds of Glass.—Fifty years ago the glass generally used in good gardens was "Crown," of which many qualities were made; but, owing to the mode of manufacture, and the cost, small squares only could be used for horticultural purposes. In many first-class establishments, where expense was a secondary consideration, copper sash-bars were used in preference to wood. The squares were cut with elliptical ends, as shown in Fig. 31, evidently for drawing the water away from the sash-bars to the centre of the squares. Putty played a very important part in this kind of glazing, as it was used for bedding, facing, and filling in the laps, a process by which more than ten per cent. of light was excluded from the house, and many squares were split by expansion in frosty weather. In addition to this, the glass being extremely thin and fragile, breakage during hailstorms was not unfrequent.

Sheet Glass.—The sheet glass of modern make is a French invention, but the process of manufacture has been greatly improved by English makers, and the quality is now so good that it is universally used for horticultural purposes. Besides, it is extremely cheap, and, although less brilliant than crown, the immense size of the sheets admirably fits it for enclosing large areas. It is made in varying weights, from 15 oz. to 21 oz., and 27 oz. per foot. The first weight was at one time very extensively used, but 21 oz. has been found the most suitable for general purposes, and, strange as it may appear, protects the occupants of a house from the effects of frost, where they would often be injured under a roof composed of glass of the lighter weight.

It was with this kind of glass that the first Crystal Palace in Hyde Park was glazed in 1851. Each sheet, 49 in. by 30 in., was cut into three panes, 49 in. by 10 in., and of these there were 300,000, measuring over 1,000,000 square feet, and weighing 400 tons. The Palace at Sydenham has since been glazed with the same kind of glass.

Hartley's Rough Plate.—This glass was strongly recommended by the late Dr. Lindley, and others, for hot-house roofs, but it has not found favour generally amongst fruit-growers. It is prepared by rolling, a process which destroys transparency, without diminishing translucency, and on this account it is valuable for plant-houses, ferneries, and other structures where the summer shading of sheet glass is an expensive and troublesome affair. This, like the sheet glass, has been greatly improved, and is suitable for lofty roofs; but owners of collections of graceful plants object to it for side glazing, as ornamental plants cannot be seen from the exterior. Fruit-growers, too, in this uncertain climate, who force early and late, do not care to use it.

Polished Sheet.—Where glass of very superior quality is required for corridors or conservatories, this will be found suitable. It is less expensive and lighter than polished plate, and being prepared by a process of grinding and polishing, it loses its original wavy appearance, and acquires nearly all the beauty of polished plate.

Glazing with Putty.—Previous to the removal of the tariff on glass the squares were extremely small, and the sash-bars, or astragals, were so closely placed as to greatly interfere with the free passage of light; moreover, those made of deal were much heavier than is now considered necessary, notwithstanding the fact that much larger and thicker panes are now used. Add to this the numerous laps choked with dirt, or perhaps carefully closed with putty, for the twofold purpose of excluding cold air and preventing drip, and it is by no means difficult to imagine a roof of the worst description that could be devised for horticultural purposes. In such a roof it has been calculated that every 100 ft. of glazing presented from 25 ft. to 30 ft. of opaque surface, through which not a single ray of light could penetrate. Fully alive to the disadvantages under which they laboured, horticulturists introduced iron, copper, and zinc for sash-bars; but these materials did not greatly improve matters, as may be gathered from Fig 32, which is drawn from a portion of a light still in existence, made seventy years ago. At that time glazing without fore-putty had not been thought of; yet, when thoroughly well bedded, which is the great secret of putty-glazing, and two coats of good white-lead paint are laid on each side of the square, from one-eighth to a quarter of an inch broad, the first step towards improvement has been secured. One of the great evils of fore-puttying is the predisposition to drip, which is brought about by the constant pressure of moisture behind the putty when it begins to part from the tongue of the sash-bar, as it soon will when used of inferior quality, or if the wood is not dry and well seasoned. Once let into the bed, the wood swells, and frost causes the putty to expand, when, the glass being non-elastic, it naturally breaks under the great pressure. Of equal value is this omission of the fore-putty on metallic roofs, as expansion goes on more freely over every part of the bar, and there being no decaying matter to prevent it, water passes quickly away.

Metallic roofs were at one time greatly condemned on account of the loss from breakage; but this arose from what is termed hard glazing, that is, cutting the glass too large for the openings. This part of the mechanic's business is now better understood, and where one-eighth of an inch of play is left on each side, breakage is not more frequent in roofs of metal than of wood. It may not be out of place to mention that mineral or anti-corrosion paint used as a priming coat for preceding glazing has, in my own experience, proved greatly superior to lead of the best quality, and being cheaper it is worthy of extended use. Some twelve years ago a Peach-house was primed with it; the squares (14 in. by 20 in.) were well bedded, but not fore-puttied, and every part of the roof is still sound and free from drip. Since that time the roof has received the triennial course of oil and lead painting, and every inch of sash-bar is as firm and good as it was at the end of the first year. When anti-corrosion paint is used it seems to penetrate the wood like creosote, and to become part and parcel of the fibre, from which it never separates. The drawback, in the first instance, is its roughness of surface, but this becomes plain and smooth after it has received one or two coats of oil paint.

Modern Glazing.—For some time after the tariff was removed, horticulturists, at all times very anxious to get rid of perishable facing, were undecided as to the best mode of accomplishing this object. Manufacturers commenced supplying them with an article imperishable, except by fracture, at a price for quantity and quality truly surprising, and all lovers of gardening began to indulge in the possible luxury of a bit of glass. Market gardeners, private growers, and nurserymen saw their way to rapid extension; but the builders, for the nonce, found themselves nonplussed by the producers. A good article was placed within their reach, an article which would enable them to set the elements at defiance, as they could bring the vegetation of the Antipodes to grow and flourish at their very doors; but the perplexing problem, "How are we to apply it so as to get rid of this perishable oil and chalk?" presented itself. The constant hacking out of a broken square, often involving the fracture of two more in the performance of the operation, began, however, to quicken men's brains, with the usual result, and systems of glazing innumerable, some good, some bad, sprang into existence. The life of some was fleeting, as they possessed no practical value.

That many of these inventions are a great advance there can, however, be but little doubt, and we will endeavour to notice as many of the best as the limits of these pages will allow.

Beard's System.—One of the most important moves in a new direction is the system invented and patented by Mr. Beard. It has now been in use for some time, and forms the keynote on which other inventors and manufacturers have played; the object in every instance being a maximum of light, combined with a minimum exposure of perishable materials to the action of the elements. It possesses several advantages which the ordinary mode of glazing with putty does not offer, and one of the most important is the facility with which the whole of the glass can be taken out and put in again, should it be found necessary to remove the house.

In like manner, broken squares can be taken out and replaced by new ones, by any unskilled workman. Fig. 33 is a section of one of the sash-bars: *a* is the rafter-bar, which is composed of iron in the shape of a T. On these, long strips of bituminised felt, *d d*, are laid for the reception of the glass, similar strips being also placed between the upper side of the glass and the covering cap *b*. By means of hard white metal nuts, *c*, the whole can be secured in position and tightened or slackened at pleasure. The glass is thus held securely between the strips of felt, which,

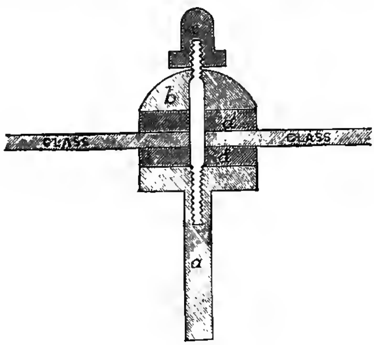


Fig. 33.—Beard's System.

being a non-conductor of heat, prevents its passage from the internal to the external bars. The former, therefore, do not become rapidly cooled in cold weather, and there is consequently decreased danger of drip from condensed moisture. The squares of glass employed are thirty inches long and twenty inches wide, and may either be placed edge to edge, which is always done in the fronts and ends, or lapped vertically, the covering bars in the latter case being made of the same length as the squares.

Mr. Beard's system of glazing may be applied to any kind of house—span-roof, curvilinear, or lean-to—but those for which it is most frequently used are generally made with fronts from two to four and a half feet high, provided with hollow columns at every five feet, which serve to carry off the water collected in the troughing that also forms the front plate from which the rafters spring. The columns can be secured either to brick or stone-work at their base, or to iron or wood where the house is not intended to remain as a fixture. The whole of the iron-work is enamel-painted, and the paint is rendered very durable by being well baked.

Simplex Glazing—Smith's System.—This system, like the preceding, is extremely simple and economical, and, judging from the materials used, promises to become one of the most useful methods hitherto introduced to the public. As will be gathered from the annexed illustrations, no putty is reqnired, and nothing but lead and glass is exposed to the atmosphere; consequently, the usual expense of outside maintenance is reduced to a minimum. Repairs of accidental breakage can be readily effected, as there are no fastenings or screws to remove at any time, and, although no putty is used and no breakages arise from change of temperature or vibration, the roof is air-tight, water-tight, and capable of resisting storms. The lead strips, Fig. 34, are made in lengths up to eighteen feet, and can be fitted to wooden or other sash-bars; Fig. 35, showing a bar ready for glazing, and Fig. 36, the same when the work is finished. By the removal of the tongues

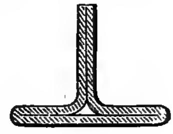


Fig. 34.

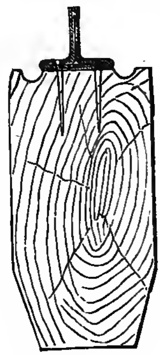


Fig. 35.

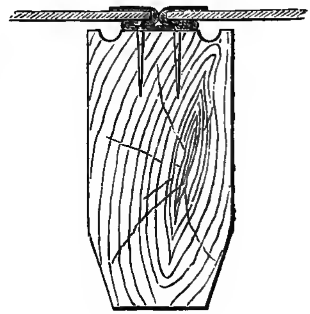


Fig. 36.

from ordinary sash-bars, as in Fig. 37, existing houses can easily be re-glazed upon the Simplex principle. It will be observed that the lead strips, which are the special feature of the system, are fastened to the wood-work by means of three-quarter-inch copper tacks, and grooves on either side of the sash-bar are provided for carrying off condensed moisture; but the utility of these is doubtful, as owing to their position they may become clogged with the dust and other matter which soon accumulate in hot-houses; this, however, is of little consequence, as existing improved modes of ventilation now carry off moisture before it has time to condense and drop from the sash-bars.

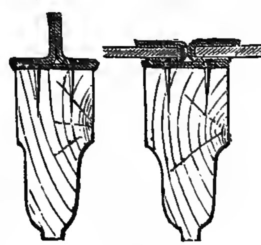


Fig. 37.

The manufacturers, Messrs. Grover and Co., Britannia Works, Wharf Road, City Road, London, give the following instructions for glazing, and as they are concise and to the point, it may be well to repeat them:—"The lead strips are to be fastened down the centre of the rafter, previously well painted, leaving the grooves clear. This should be done with three-quarter-inch copper tacks, eight-inch pitch, *i.e.*, four inches apart on the alternate sides of the upright flange. On lights, doors, and all movable parts, the tacks should be half these distances apart. The base of the lead-work should then be dressed perfectly flat on the wood, with the grooved edge of a wooden tool called the 'boat' hammered along its top. Not less than 21 oz. glass should be used, and must be cut full, so as to allow just enough room to drop in between the flanges without forcing. Before placing the glass in position, the angles which are to receive it must be well coated with best white lead paint, mixed very thick and applied with a small brush. Squares of glass which are not quite flat should be laid (contrary to the usual practice) with their hollow sides downwards; but those which will not bend without force should be rejected. Place the glass into position with the smallest possible lap, three-sixteenths of an inch, turn down the lead flanges with the 'boat,' which should be slightly greased, and dress down the lead so as to follow the surface and close up against the butt end of the glass. Wipe off the paint squeezed out, and the work is finished."

From the foregoing remarks and instructions, which are given in detail, the reader will gather that the Simplex system of glazing can be adapted to any kind of glass structures, and that any ordinary estate carpenter can erect and complete a house, or convert an existing house, and a gardener can replace all glass broken by accident. The cost, in the first instance, is slightly in advance of the best putty glazing, but this is very soon repaid by subsequent economy in maintenance and repairs, irrespective of the comfort derived from the work being always in good condition and weather-proof, and never shabby in appearance.

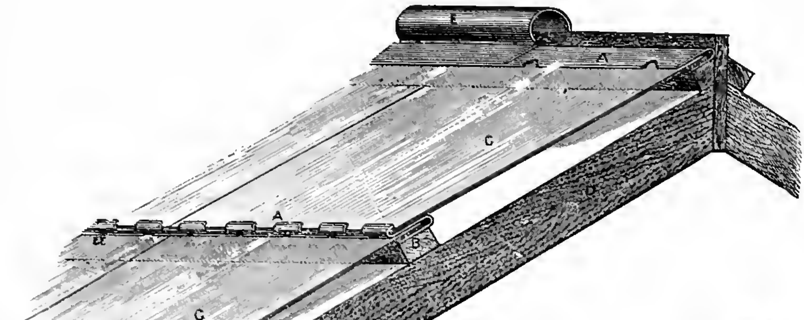


Fig. 39.—Rendle's System of Glazing.

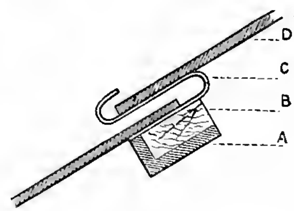


Fig. 38.

Rendle's Indestructible System.—The patent Indestructible system brought out by Messrs. Rendle and Co. has long been before the public, and is extensively patronised by the Government, the nobility, numerous public bodies, and many of the winter garden companies throughout the kingdom. So complete is this system of glazing without putty, while all the perishable materials such as wood, iron, or paint are carefully covered by the glass, that the name given to the system may be said to be fairly merited. Another great recommendation is the fact that there is no breakage from expansion or contraction, either from heat or cold, as the glass has full play in every direction; moreover, the everlasting expense of repainting, reputtying, or reglazing is completely done away with.

The chief peculiarity of this mode of constructing and glazing hot-houses is the simple way in which the squares of glass are fixed and kept in position by means of thin bent slips of zinc or copper, firmly secured to the purlins, which may be either of wood alone, or wood resting on angle iron, as is shown in Fig. 38, where A represents the iron, B the fillet of wood, C the zinc or copper clip, and D the glass.

Fig. 39 shows a small portion of a roof glazed with 21 oz. glass.

A A A, The top, middle, and bottom bars, are made in 3 ft. lengths, of either zinc or copper, and are fixed with brass screws to purlins or bearers. The bars are so constructed that all condensed steam or vapour passes to the outside through the holes marked *a*, on to the pane of glass below. The top portion of the centre and bottom bars form a series of clips and slots; the latter allow a free passage of water, and the clips secure the glass in position.

B, Purlins or bearers to which the horizontal metal bars are fixed. These purlins are two inches in depth and thickness, more or less, according to the distance the rafters are apart. When the latter are more than four feet apart, 2 in. × 1 in. × ¼ in. angle-iron, with a fillet of wood fixed inside (see Fig. 38) for screwing the bar to, will bear 6 ft.; 2 in. × 1½ in. × ⅜ in. will bear about 8 ft., which distance it is not advisable to exceed. Rafters made 4 ft. apart do not require angle-iron purlins.

The purlins are best placed from 24 in. to 30 in. apart if ⅛ glass is used, and up to 36 in. apart if $\frac{3}{16}$ glass is adopted. When 21 oz. glass, which is the best weight for all ordinary horticultural purposes, is used, the distance should not exceed 24 in.

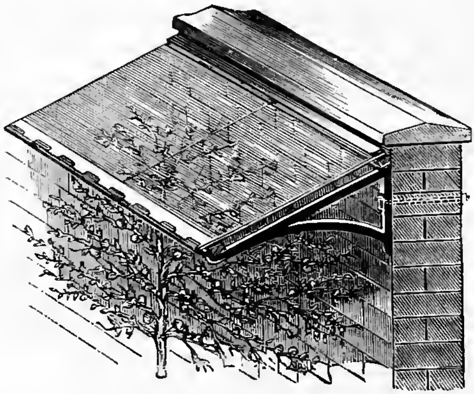


Fig. 40.—INDESTRUCTIBLE WALL-TREE PROTECTOR.

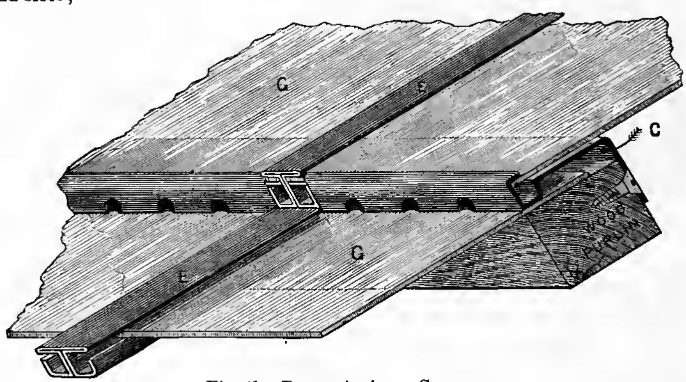


Fig. 41.—RENDLE'S ACME SYSTEM.

C, Horizontal bar, constructed with perforated channel to carry off any condensed moisture from the inside. E, vertical bar, forming the junction of two squares of glass. The grooves carry off any water that may collect at this joint to the next square below, and so on, from square to square. They also form a strong bearing for the glass. G, Panes of glass.

C C, The glass, is so cut that by pushing the top of the square as far as it will go into the top bar, the bottom edge drops over the clips of the centre or lower bars, and falls into its place, where it is kept perfectly secure by the clips. The squares of glass are lapped vertically from 1 in. to 1½ in. according to the pitch and position of the roof, where they lie in close contact with each other and repel all water.

D, Rafters. The rafters or principals should not be placed less than 3 ft. or more than 8 ft. apart for ordinary purposes.

E, Shows the usual method of forming the ridge by fixing a zinc roll to the ridge-piece, with a flange sufficiently long to overlap the top bar.

One of the chief advantages claimed for this system is the facility with which broken glass can be replaced; there is no hard putty to hack out, but all that is required is to secure the broken glass and to slip in a new pane.

The Wall-tree Protector (Fig. 40), constructed on the same principle, will explain itself. It is constructed entirely of materials that will not wear out, and is here introduced to illustrate the progress which the removal of the tariff on glass has enabled to be made in the art of applying it to horticultural purposes. The protector is supported on iron brackets, which can be easily removed by unscrewing the nut at the back of the wall. The glass is fixed on the butt-joint principle, in the patent bars, and can be removed, as all wall-tree protectors should be when danger from spring frosts has passed away. A protector of this kind has been in use for a great number of years at Eastnor, and we have neither missed a crop of Peaches nor seen a curled leaf. Neatness and cheapness are two of its chief recommendations.

Rendle's "Acme" System, of which Fig. 41 is an illustration, is perhaps better adapted to the covering of large buildings, where strength, light, and perfect freedom from drip are of paramount importance, than for horticultural purposes; but as gardeners are now looked upon as ready reckoners or walking cyclopædias, fully stored with information upon every subject pertaining to a nobleman's estate, this paper will hardly be complete if Messrs. Rendle's latest invention is left out. The diagram, with the particulars underneath, is sufficiently explanatory of the construction.

Ridge-and-furrow Glazing.—Although this system of glazing is not very often applied to small buildings, certain conditions sometimes render its

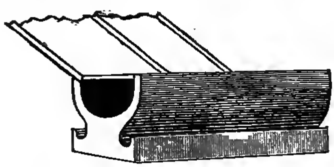


Fig. 42.—Iron Gutters.

adoption necessary. Take, for instance, an architectural conservatory or Orangery, with a Norman front of stone, pierced with large windows, near an old mansion, where an ordinary glass roof would be considered unsightly. Parapet walls hide the eaves and gutters, but they cannot be carried high enough to hide an ordinary glass roof, erected at a pitch that would carry dry. In such a situation the ridge-and-furrow mode of glazing overcomes the difficulty, as the highest part of the ridges need not exceed two feet. Iron gutters (Fig. 42), as now made, light and strong, run transversely across the house, with a slight fall from the mansion to the parapet gutter, which is large enough to receive and carry off all the water collected on the roof.

Fig. 43.—Sash-bar.

The sash-bars (Fig. 43) may be made of wood or metal, but being so extremely short, good red deal is perhaps the best material that can be used, as it generally contracts under great heat, when the metallic portion of the roof expands, and fracture of the glass in this way is avoided. The figure is a full-sized section of a bar that has been in use for many years, and it is questionable if any other form has been invented to supersede or equal it. From the way in which the lower part is bevelled or chamfered it will at once be seen how little light it intercepts, while its depth gives the greatest degree of strength. The grooves in which the glass is fixed prevent the wet from getting into the house. Putty of the best quality is required for bedding the glass in and firmly stopping the upper side of the groove after the squares are set, but this is so trifling in quantity that its external use is all but dispensed with. The gutters are cast with dove-tailed mortices, into which the bars or astragals are fixed with white lead.

Practical Glazing for Amateurs.—As many of the readers of *Cassell's Popular Gardening* may wish to try their hands at glazing, a few hints may be of service to some; the more so as lights manufactured by steam power can be obtained at prices truly surprising, and the best British sheet glass is kept in stock sizes, or can be cut to any size by all wholesale dealers.

Sashes in the skeleton form are made of wood and metal combined, the first being used for the styles and rails, and the metal for sash-bars or astragals; but while such experienced men as Gray, Ormison, and others recommend the best red deal, the amateur will not go far wrong in selecting sashes formed entirely of wood. Moulded sash-bars were at one time extensively used, but they have given way to the plain bevelled or chamfered bar, which is cheaper, stronger, and less difficult to cleanse or paint, when these operations become necessary.

Preparing.—When sashes are received from the joiner they must be kept dry, as a great deal of the durability of glazing depends upon the state of the wood at the time it is primed. If rough they may be rubbed over with sand-paper, and all knots likely to exude turpentine must be carefully dressed with the usual styptic known as painter's knotting, preparatory to the application of the first or priming coat of paint; this, composed of the best white and red lead and linseed oil, cannot be too well brushed into all the joints and angles of the rebates, as it is to form the foundation of all that is to follow. When dry, the lights are ready for glazing, but as no facing putty is to be used, they must be placed flat during the operation, and for some time afterwards, to allow the bedding to harden before they are moved.

Glass and Putty.—Unless the lights are very small, 21 oz. glass should be used in preference to 15 oz.; the difference in price is very trifling, it stands more rough usage, and it keeps plants warmer in winter; moreover, much larger squares can be used. Large squares are not, however, recommended for the glazing of portable lights, on account of their liability to accidental breakage. Squares from 8 in. to 10 in. in width and 12 in. to 16 in. in length, will be found quite large enough; indeed many, myself included, prefer having them smaller, as breakages from the houses can often be used up for repairs. Horticultural glass of different qualities runs in numbers, and becomes inferior as the figures increase. *Firsts* and *seconds* may be good enough for picture frames, *thirds* and *fourths* are generally sold for garden purposes. Good thirds, of English make, will be found excellent, and suitable for all ordinary purposes.

Putty, like all other mixtures, varies in quality; none, however, but the best is suitable for horticultural purposes, and it should be *kept for some time* before it is used. Formerly it was made by hand, but the manufacture of putty by steam power has now become a trade in itself, and the dealer who snpplies glass will not be slow to offer the best quality at a very reasonable price. If obtained in casks of one or two hundred-weight it will keep for years, and improve with age, as the oil and whitening become thoroughly incorporated. If new putty, which is generally very soft, must be used, then as much dry red lead as will give proper substance may be worked in with good effect.

Glazing.—One of the cardinal points is a good bed for the glass to rest upon; putty in sufficient quantity to squeeze out when the pane is pressed down should, therefore, be laid evenly along the rebates, as it is always better to cut off waste than to have to fill up slack places when the bedding is dressed off. Some glaziers make a practice of sprigging in the panes to prevent them from moving; but this is a bad method, as the pressure brought to bear upon the corners of panes that do not fit close, combined with contraction and expansion, is the cause of much breakage. Small triangular pieces of zinc or copper, like Fig. 44, ½ in., may, however, be used with advantage when necessary, not otherwise, as they are flat, more elastic than sprigs, and half an inch broad where they clip the edge of the glass. The laps should not exceed a quarter-inch, and the panes should fit close upon each other, convex side upwards, with a sixteenth of an inch play on each side, to allow for contraction of the sashes. The lights may be piled on each other for a few days to give the putty time to harden, another important point, before they are painted. When dry, lay on two or three coats of good oil paint, in lieu of putty; allow the paint to extend about a quarter of an inch, or the width of the shoulder of the sash-bar, over the glass on each side, and finish with stone or any other colour, according to taste.

Fig. 44.

When glazing fixed roofs, the overlaps need not exceed one-eighth of an inch, but great care must be observed in placing and keeping the glass from sliding before it is properly set. To secure this end, narrow strips of lead, bent into the form of the letter S (Fig. 45), should be inserted, two to each lap, as the work proceeds. When the squares are firm in their bed they may be taken out altogether, or being kept close to the sash-bars, no harm will be done by leaving them in. Each lap will then, provided the glass is true, present an opening equal to the thickness of the lead used.

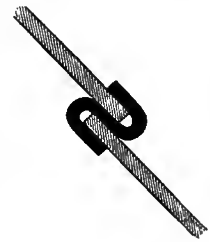


Fig. 45.

All upright glazing—*i.e.*, the ends and fronts of houses—is best performed on the butt-joint principle. For this purpose the squares are cut with perfectly straight edges, which are placed together, edge to edge, instead of being overlapped.

ROCK, ALPINE, FERN, AND WILD GARDENING.

THE IN-DOOR FERNERY.

By James Sheppard.

THE *beau idéal* of an in-door fernery is to bring more or less of nature's verdure, beauty of form, and freedom of disposition and arrangement within reach of their admirers at all seasons of the year. True, these may seldom reach up to the high art reached by nature, nor afford the pleasure derived from such lanes or groups of wild ferns as have been hinted at rather than described in the chapter on Hardy Ferneries; but the nearer we can approach to these standards of natural beauty, the more perfect will our in-door ferneries become, and the deeper the pleasure and more lasting the satisfaction they will afford. In many cases and circumstances the protection of glass will heighten the beauty and add greatly to the vigour of even hardy ferns. For example, the Royal Fern seldom looks so really royal, unless just in the very few of its favourite haunts, as in the so-called cool fernery under glass; and the same holds good of not a few other species and varieties. Ferneries in smoky, dust-fouled manufacturing towns may be kept clean by a covering of glass; and, thoroughly ventilated and judiciously shaded, such in-door ferneries may command a cooler atmosphere than that prevailing in the open air. Nor are coolness and cleanliness the only benefits derived from the glass covering; but this, by isolating the atmosphere of the fernery from the surrounding mass, enables it to be charged with moisture at pleasure; and, important as a clean, cool, moist atmosphere is to all sorts of plants, this trinity of aids to growth is the breath of life to ferns. Hence many who do not go to the expense of introducing artificial heat to ferneries, yet find one of their greatest pleasures in cultivating them under glass.

Beautiful, however, and abundantly varied as the hardy fernery may be made, and often is, under glass, yet by the introduction of more or less artificial heat, the tropical ferns and the palms and other fine foliage plants of the world become available. Even in heated ferneries it is seldom necessary to exclude all native species and varieties. For example, the native Maidenhair Fern (*Adiantum capillus-veneris*) not only luxuriates in an in-door fernery maintained at green-house temperature, but thrives equally well or better in a tropical temperature of from 60° to 70°. Nor is this all; many so-called tropical ferns and palms thrive well in green-house temperatures of, say, 45° to 55°. Thus the cool fernery under glass may be enriched from the tropics, while the tropical fernery may receive not a few hardy specimens, and the temperate or conservatory fernery may gather into itself most of the fern-wealth of the world.

The curse of in-door ferneries has hitherto been the pot-culture of ferns, and the dotting or single-plant style of arrangement. Four - and - twenty ferns all in a row on a shelf or stage, however interesting as a botanical study, are hardly more artistic than the same number of blackbirds in the well-known nursery rhyme; but plant them out in groups of greater or less magnitude, according to numbers, habits, and area, and vary and intersperse them with rock-work and a few scrambling climbers or creeping mosses or other plants of varied character, and the stately stiffness of marshalled hosts of ferns in pots vanishes like a dissolving view, and in their stead arise artistic groups, fading and melting, as it were, into each other.

But the mere introduction of rock-work and planting out of the ferns is by no means sufficient to break down the monotony of in-door ferneries. Very far from it. Such ferneries abound in which the back and front walls and ends are pocketed with rock-work with as much regularity as trees are planted in an avenue. Then, as if conscious of the unusual monotony of the base, variety is striven after by pitchforking the ferns into their pockets on the dotting system—that is to say, each plant is as unlike all others near to it as possible. Avoid all this as much as is practicable. Don't be afraid of bare walls; clothe them with climbers, unless, indeed, the house is sufficiently wide to permit of considerable masses of rock-work projecting from their ends and sides, and so clothing the walls with irregular rocks, boldly projecting here, receding there, closely hugging the walls yonder, and so on all round, no two projections or indentations being alike. If there is not room for this free-style it is better to have one bold mass of rock in the centre, instead of clothing the walls with mere burs or pockets all round.

Pockets for Rocks or Walls.—These should be as varied as possible, hardly two resembling each other in size or shape, or distance apart. Group the pockets in masses, and have irregular spaces between them. This will so far simplify the planting as to render it a very easy matter. Then boldly group the genera; or, failing these, the different species; or even several plants of one variety or species together. Each family, or member of it, will thus exhibit to the full its own character, and make its own impression. The groups should also melt into one another—not meet in a crush that prevents the light and shade of full harmony or contrast from being seen. Hence the importance of using dwarf plants for the sides of the groups, and Selaginellas, or creepers, for the dividing lines, as much as possible. In the absence of these, many of our native mosses answer, and look well, in a moist atmosphere.

The sight or sound of one thing more is needed to complete the charm of the in-door fernery—that is, water. This, which might readily become the strongest point, is usually the weakest in most in-door ferneries. The everlasting squirt or fountain mostly converts water into an eyesore, instead of its being, as it ought, one of the most attractive features in the fernery. So objectionable are these stiff, formal fountains, that if they must be introduced it would often be better to hide them out of sight, so that the sound of water in motion might be heard and none of it seen. But a few drops trickling over rocks and falling into a tank below would be far more attractive than all the formal jets and squirting fountains which degrade so many ferneries, in-door and out, to the level of a toy-shop. In larger ferneries, and where water-mains are available, waterfalls and rills of water may expand into sufficient dignity and importance to be seen as well as heard. Water in motion has other than artistic merits. It may be used to dew over or wash the plants when needful, and the motion keeps it sweet as well, and endows it with refreshing and soothing melody.

Roofs.—As a rule the roofs of in-door ferneries are very badly arranged. The glare of white-glass and white-painted rafters is altogether a too violent contrast to the verdure of the ferns to be pleasing. By using green glass for glazing, and painting the rafters with sober tones, the garish character of the roof may be subdued. But the form is almost as faulty as the colour. A great deal may be done to modify the form of the roof by a tasteful disposition of cork. This, from its lightness, may be used in considerable masses without injury to the roof, and so arranged as to give it a rustic and irregular appearance. By forming pockets in the cork, and furnishing these with drooping ferns, Selaginellas, and such grasses or rushes as *Isolepsis gracilis*, and other of the smaller drooping plants or creepers, such as the Strawberry Saxifrage, variegated Panicum, *Tradescantia multicolor*, &c., the roof of the in-door fernery might often be made the most beautiful portion of it.

As the roof of a fernery should be seen as little as possible, it matters not how plain it is so long as it is strong and well glazed, that it may bear wind and weather without letting wet in; but it is essential to have plenty of light admitted, without which no plants will do well. Many go to great expense and trouble in shading their ferneries by attaching blinds thereto during the summer, but it is much better to give the shade in a more natural manner, as not only is it more congenial to the ferns under, but climbers, if chosen suitable for the purpose, are a great ornament to any house, as by training and securing the main leaders, the side branches or laterals may be allowed to droop down in their own graceful way, when they not only afford the requisite shade, but furnish a part of the house which without them would be bare. The best climbers are the Passifloras and Tacsonias, as they make all fresh annual growth and will bear much cutting back of the shoots and thinning during autumn and winter, which is just the time the ferns need what light the short days afford; then when spring comes round they break again and re-embellish the roof. For a cold house the sorts of Tacsonias most to be recommended are *T. Van Volxmii*, *T. mollissima*, and *T. Exoniensis;* the first-named being a most brilliant, free-flowering kind, and the last-mentioned a hybrid raised from it and *T. mollissima*, the good qualities of both of which it has in an equal degree.

Among the Passifloras, *P. Campbelli*, *P. cœrulea*, *P. cœrulea racemosa*, *P. Colvilli*, *P. hybrida grandiflora*, and *P. Impératrice Eugénie* are as good as any, and will make a fine show. For a shady part of the roof there is nothing equal to the Lapagerias, and if the red and white varieties are allowed to grow together and commingle, they form a most pleasing and lovely sight for several months in the year. Passifloras and Tacsonias do well in any ordinary soil, if the borders are properly drained below; but in addition to good and free drainage, the Lapagerias require peat, which should be used somewhat rough, and have a heavy sprinkling of silver sand mixed with it to keep it porous and open. The Grape-vine is also admirably adapted for shading in-door ferneries, as it affords most shade when it is most needed, and can be close-pruned into shadelessness in winter. For this useful purpose the Black Hamburgh is the best variety. In cases where climbers cannot be used, and artificial shading has to be resorted to, the cheapest and perhaps the most efficient is a little thin limewash, in which some green paint-powder has been stirred, just to give it a tinge. This can then be put on outside the glass with a brush and made to look neat; and, if smeared over lightly, will cast a soft shadow below which will be of an agreeable nature to the ferns it falls on.

Construction and Furnishing of the In-door Fernery.—This, if formed on right principles, becomes one of the most ornamental and interesting adjuncts any one can have to a place, as by employing the skilful and experienced builder, the work may be so carried out that the rock will look quite natural and so real as to almost defy detection, except by clever geologists. This may readily be seen by any one who has visited some of the most noted private and public gardens in England, where much has been effected, as well as at the different aquaria, and the Health Exhibition lately closed, where there were good specimens of this comparatively new and charming art.

Rock-work has never been carried out in anything like the present style, and not only is it now made grand and natural-looking, but, what is of equal importance, it is so arranged by Messrs. Pulham of Broxbourne, or other specialists in such work, as to be particularly suited to plants. These they provide for by using tufa or other soft porous stone, and so constructing the rock that the pockets or recesses run far back and down, many of them extending to great depths so as to hold large bodies of soil, and thus afford the roots plenty of room and a well-filled larder. The great advantage in having these in-door ferneries is that they form refreshing retreats, where any one may roam under delightful shade, and, if kept cool, enjoy the beauties of nature on any hot summer's day, as well as in comfort in winter. There are many lofty conservatories or buildings connected with dwellings, that might easily be converted into charming ferneries by clothing the walls, and even portions of the roof, with rock-work, in which not only ferns may be grown, but other plants besides which associate well with them, of which there are many. If tender exotic kinds are desired, all that is necessary is to have a separate house or division with more warmth, which may be afforded by hot-water pipes hidden by the work, and the division so arranged that by pushing aside a large glass door the two compartments may be thrown into one. This is done in many places, and adds immensely to the interest, as there need then be no limit to varieties. What will not succeed in one house, will in the other; and by having the cool fernery at the end near the dwelling, it may at times be open to the room it adjoins. In towns and cities views from windows are anything but cheery, as the outlook is generally into yards or on to bare bricks. If these spaces were covered in so as to get a more pure atmosphere and keep out smuts and dust, they might be rendered ornamental and pleasant to the eyes of those who have so little that is tempting to look on. A small portion of rock skilfully piled, with a few plants growing out and over, would soon change the scene, and make that which is ugly and dismal a fairy glen and something to care for.

Preparation for Planting.—In preparing for the planting of ferns the great thing is to start with suitable soil, the best being about equal parts of fresh-cut turfy loam and peat, both of which should contain plenty of fibre and be well mixed up together. This may be done by chopping the two up with a sharp spade, and turning them over several times, when they will become incorporated and ready for filling the pockets. This is a work that requires great care, as, owing to their irregular, rugged shape, cavities are apt to be left, and these hollow spaces drain off the water too rapidly, and thus starve the plants. To prevent this the way to manage is to ram in the soil piecemeal as the filling up goes on, making sure all the time that it is well against the sides, till the holes are quite full; and even then there will be shrinkage after, which must be seen to when it occurs, by using a flat-pointed stick and ramming fresh soil in again. With the pockets filled in the manner referred to, all will be in readiness for the planting, but before doing this it will be necessary to study closely the features of the rock and the general look of the place, as the great point is to make the projections appear more prominent and bold, which may easily be done by a judicious and right selection of plants to put in them. In the Fernery at Wolverstone Park there is in most of the projecting parts some noble fern or palm standing out conspicuous beyond all others, thus not only forming striking features in themselves, but throwing back, as it were, and giving greater depth to the recesses or fissures behind, and making the fernery look much larger and more telling than it otherwise would. As regards choice of plants, there are so many suitable that it is almost invidious to make a selection, and yet I would specially notice a few, and give a brief description of them, as it may aid some in making choice of what will associate and look well together. For a cold house, from which the frost is excluded, I can recommend any or all of the following more striking varieties:—

For standing out by themselves nothing looks more noble than the tree-ferns and palms, and among the former *Cyathea medullaris* is one of the most striking, as it has tall huge fronds of great length, with black ebony-like stems and a stout dark trunk, that render it very distinct in appearance. *Cyathea dealbata*, though less lofty and bold, is a most beautiful fern, having a tall tree-like trunk, from the crown of which rise regularly spreading fronds of a delicate glaucous-green above and silvery-white beneath, which makes them highly ornamental and pleasing to look at. *Dicksonia antarctica* is another desirable kind that forms a fine symmetrical head, and is a grand object when it attains size and age. *Cibotium regale*, as its specific name implies, is a right regal fern and very distinct, the young stems and fronds being remarkable from having a thick silky covering of pale yellow hair-like scales, which show up in great contrast to the polished black of *C. medullaris* mentioned above. *Dicksonia Culcita*, though not a tree-fern, has grand fronds on long thick stalks rising from a densely hair-covered slow-creeping crown, and attaining, when fully grown, to a height of over six feet.

Some of the palms and cycads are equally striking and quite as desirable as the arboreal ferns, and like them should be used in certain prominent places, to give boldness and character to outlying rock or parts that want bringing out, or are suitable for a plant of large size and dimensions. One of the finest upright-growing palms is *Areca sapida* (properly *Rhopalostylis sapida*), a New Zealand species of grand aspect suitable for a low temperature. *Latania borbonica* (the correct name is *Livistona chinensis*) is a magnificent thing, with widely-spreading fan-shaped leaves, and *Trachycarpus* (*Chamærops*) *Fortunii* is a very fine kind, so hardy and enduring that in favourable situations it will stand well in the open. *Chamærops humilis* somewhat resembles the last-named, but is a much more dense, close-growing plant, sending out numerous suckers or young ones from its base. *Phœnix dactylifera*, the Date-palm, and the other varieties of *Phœnix*, succeed in a cold house, as does also *Seaforthia elegans* (*Ptychosperma Cunninghamiana*), but this being large-growing requires plenty of room. The Macrozamias, coming mostly from temperate climes, also do well in a cool fernery, where they should be used freely, and will then add quite a charm. The New Zealand Flax, *Phormium tenax*, and the several variegated forms, are likewise very desirable plants for associating with palms and ferns, as they have long, broad, flag-like leaves, and are just the thing for grouping near water, a rugged-edged pool of which should be arranged somewhere, to be constantly replenished and kept fresh by drippings or ripplings from the rocks above, the sight and sound of which also impart a sense of refreshment and a feeling of coolness on the hottest summer days.

Begonias, of the Rex type, seem to have gone almost out of cultivation, and yet they are among the very best plants for growing in masses, either on the floor-level or high up in large pockets on the rock, in which positions they show most conspicuously, and at once attract notice from even the most casual observer. When first sent out these Begonias were thought to require stove-heat, but it has since been found that they will flourish in any house from which frost is excluded, and, what is more, they will stand the constant drip or splashing from a waterfall, which continuous wetting their leaves seem to like. So telling are these Begonias, that those who have ferneries should not fail to plant a few groups, as their beautiful foliage is so bright that it quite lights up a place.

Another effective plant for associating with ferns is *Fatsia japonica*, better known under its garden name of *Aralia Sieboldi*, having large ornamental foliage, deeply cut or lobed, with a clear polished surface. *Aspidistra lurida variegata* is likewise highly ornamental, having leaves about three inches wide, and from eighteen inches to two feet long, broadly veined throughout with rich creamy-white, which shows up in contrast with the bright green.

Coming to ferns, one of the first deserving notice is *Woodwardia radicans*, which has stout stalks, rising from a massive slow-creeping crown, and bearing wide-spreading, gracefully-arching, magnificent fronds, running to a length of from four feet to six feet; each frond, when they attain age, forming a young plant at the point, by taking which off and potting or planting the same, an increase is readily effected. The proper situation for *Woodwardia radicans*, when grown in the natural fernery, is well up in a large pocket, where there is jutting rock, as then its grand fronds can droop over and down, and be seen to the greatest advantage.

Another fine plant for placing in a similarly lofty position is the *Lygodium scandens*, which, if it cannot find anything to fasten itself to and climb on, trails and depends in the most light, easy manner, and has a very pleasing appearance. *Nephrolepis exaltata* and *N. tuberosa* are also very effective ferns, the first-named being the larger and stronger of the two, although both are distinct and desirable, and of great value for baskets or clothing projecting portions of rock, over which they run quickly, and cover with their wiry, fast-creeping stolons, that send out numerous gracefully-arching, narrow, elegant fronds. It is sufficient to name the Adiantums to commend them to notice, as they are general favourites; *A. cuneatum* being most extensively grown, and to be found in every house; but besides this well-known species there are others of fine form that attain large size and are just at home in a green-house temperature, where, if planted out, they creep underground by means of fleshy, tuberous-like roots, and send up numerous tall, out-spreading fronds with black stems that have a striking appearance. Among the Aspleniums there are many specially adapted for planting out in the natural fernery, as most of them are bold and effective, and several of gracefully pendulous habit, the finest in this respect being *A. serratum*, which bears arching, nine-inch wide, smooth, deep green fronds, ranging from two feet to three feet in length. *A. bulbiferum*, likewise a valuable kind, is interesting owing to its bearing small bulbous plants on the upper surface of its fronds, which viviparous habit is common to the Aspleniums, and renders their propagation easy and quick. *A. lucidum*, *A. præmorsum*, *A. diversifolium*, *A. flaccidum*, *A. biforme*, and *A. Canariense* are all sorts to grow, and besidea these large showy varieties there are others smaller, *A. appendiculatum* being very distinct. *Davallia canariense*, known as the Hare's-foot Fern, is well adapted for planting on rock-work, and so are *D. pyxidata* and *D. dissecta*, which are the best of the green-house Davallias. *Lomarias magellanica*, *gibba*, and *chilensis* are two noble ferns suitable for conspicuous places, and there are several of the Pteris, such as *P. cretica albo lineata*, *P. scaberula*, *P. serrulata*, and *P. longifolia*, that should also be grown. *Platycerium alcicorne*, the Stag's-horn Fern, must not be left out, as it is a most remarkable kind, requiring very little or no soil, for it will live and do well on the face of moist rock. For covering the bare ground under the ferns the Lycopodiums and Selaginellas come in, *L. denticulatum* being most useful, as it spreads at a rapid rate and is of a most beautiful green.

Planting and After-treatment.—The chief points to command success are firm planting, a copious watering of the roots, and a moist atmosphere till the roots get a good hold of the fresh soil. The treatment requisite after that is to syringe heavily daily during the summer, as humidity is essential in cultivating this class of plants, and with their fronds well wetted every afternoon, they flourish and keep in luxuriant health. This surface syringing goes a long way towards keeping the roots sufficiently moist, but must be supplemented by a thorough soaking of the roots when necessary. As to air, they require but little, and all they need is sufficient to keep the temperature down to a comfortable point, beyond which it becomes arid, and leads to the ferns becoming infested with insects. The most troublesome among these are thrip and red spider, and the only way to rid the plants of these pernicious parasites is to fumigate with tobacco in the case of the first, and to wash the latter off by means of clean water. The smoking must be done with great care, as there are few, if any, plants more impatient of its fumes than ferns, especially when the fronds are in their young state, in which condition they quickly get injured. This being so, the fumigating ought to be deferred till they get a little hard, and instead of giving a strong dose of smoke it is better to venture only on a little, and repeat it night and morning for several days in succession. This persistent administration will tell in the end by destroying the insects, and leave the plants none the worse. Scale sometimes affect ferns, and if not dealt with and eradicated they increase at a rapid rate; but as they are proof against the fumes of smoke, sponging or washing by hand has to be resorted to. The easiest mode of dislodging them is to use a somewhat stiff, small brush, and brush them off, as they cannot attach themselves again; and though there are plenty of insecticides that are said to kill them, none of them are safe to apply to ferns, which, as before observed, are exceedingly susceptible of injury alike from smears and smoke. The best time to attack scale is early in spring, as then many of the old fronds may be removed; but this clearing of foliage should be very gradual, as otherwise it tends to weaken the plants, which require its assistance till the young growth begins to push forth.

Ferns, like all other plants, need a season of rest, which is partly afforded them by the winter, as there is little or no movement in vegetation during the short days; but in addition to the quiet that absence of light affords them, the soil should be kept much drier, as that tends to sweeten it, and has a most beneficial effect on the roots. Much mischief is, however, often done through keeping ferns *too* dry in the winter. Evergreen ferns especially, from the mere fact of their being such, demand a supply of water even during their semi-resting state; and few things are more destructive of freshness and vigour of frond than excessive dryness at the roots. in winter.

HOT-HOUSE OR STOVE PLANTS.

By William Hugh Gower.

Callicarpa.—A small genus of soft-wooded stove plants belonging to the *Verbenaceæ*. The name is derived from *kalos*, "beautiful," and "*carpos*," fruit, in reference to the ornamental berries, which, while singularly beautiful by themselves, become still more so when grown in contrast with the berried Solanums. Pot in loam, leaf-mould, and well-decayed manure, about equal parts, and avoid over-potting.

C. purpurea, when well grown, is one of the very finest ornaments for a stove during the autumn and winter months, and possesses a rare beauty, entirely dissimilar from any other plant. It may be grown as a shrub, as a basket plant, or trained as a standard. The flowers, of no beauty, are borne in clusters, and are succeeded by bright purple berries, about the size of a pea, and nearly a hundred together; these clusters, forming a dense raceme, from one to three feet in length, remain in full perfection all the winter. East Indies.

Carludovica.—Handsome plants, much like palms; nearly allied to the Screw Pine family (*Pandanaceæ*), and are placed with the *Cyclanthus*. Some species have long scandent stems, which ascend the forest trees by the aid of their whipcord-like roots; but the most beautiful kinds are those which are stemless; these grow upon the ground, and form dense masses of undergrowth. Pot in loam and peat, and give plenty of water with strong heat.

C. Drudei.—A stemless species, with deep green leaves, which are fan-shaped and plaited. The flowers of all the species are inconspicuous, although, in the mass, these being pure white are more conspicuous than others. Columbia.

C. humilis.—Leaves rhomboid, about a foot and a half long, and a foot broad, deeply divided or two-lobed at the apex, and rich bright green in colour. New Grenada.

C. palmata.—Stemless, throwing up petioles from ten to fifteen feet in height; these support large plaited fan-shaped blades, which measure some four feet in diameter, and are rich deep green in colour. Panama.

C. rotundifolia.—Although somewhat similar in appearance to the preceding, this is very distinct and extremely handsome.

Caryophyllus.—*C. aromaticus.*—This belongs to the Myrtle family. The cloves of commerce are produced by it, and are the young unopened flowers; these when expanded are not very showy, but it forms a very ornamental shrub, every part of which is delightfully aromatic. It may be kept to almost any desired size, but in a natural way it attains a height of from twenty to thirty feet. This plant enjoys a strong moist heat, and should be potted in loam and leaf-mould. It is a native of the Moluccas.

Centradenia.—A small genus of Melastomads, very ornamental in the plant-stove, but their flowers are not useful for cutting, as they so soon fall. The name is derived from *kentron*, "a spur," and *aden*, "a gland," and refers to the small projection on the anthers. Centradenias are of the easiest culture, but they enjoy an abundant supply of water and strong heat. Pot in a compost of equal parts of peat, loam, and leaf-mould, adding a little sharp sand.

Red spider is a great enemy to these plants, if the atmosphere is allowed to become dry.

C. floribunda.—A slender-growing twiggy plant. As its name implies, the flowers are very abundant, although small, pale red and white in colour. Winter and spring months. Central America.

C. grandifolia.—This is a very bold-growing plant for the genus. Stems winged, bearing large ovate-lanceolate acuminate leaves, which are distinctly five-nerved, bright shining green above, and rich port-wine colour beneath. Flowers on branching spikes, very numerous, white, suffused with rosy-pink. Winter and spring months. Mexico, in the neighbourhood of Chiconquiaco.

C. rosea.—It greatly resembles *C. floribunda*, more dense and compact in habit, and the under side of the leaves is rosy-red. Winter and spring months. Mexico.

Cyrtoceras (formerly **Centrostemma**).—A genus of *Asclepiadaceæ*, nearly allied to *Hoya;* indeed, the chief difference lies in the species of this family having a hairy ring in the corolla. The soil best adapted for the culture of *Cyrtoceras* is good fibrous peat, with a small portion of loam added; drain the pots well and supply liberally with water during the summer, but more sparingly in winter. These plants enjoy strong heat, and an atmosphere well charged with moisture.

C. multiflorum.—This plant is frequently to be found under the name of *Centrostemma multiflorum*. It is a very beautiful species, with glabrous coriaceous leaves; flowers reflexed, white, tipped with straw-colour. Summer months. Luzon.

Cephalotus.—A genus containing but a single species, and its affinities are very puzzling. It was originally placed in the order *Rosaceæ*, and then removed to *Saxifragaceæ*, whilst by some it is considered the type of an entirely new order, distinguished by the name of *Cephalotaceæ*.

The soil for Cephalotus should be peat and chopped sphagnum, with a little sharp sand, and the surface should be kept covered with growing sphagnum. It is a native of marshy places, and consequently the roots require to be continually moist. The usual plan in cultivating this plant is to cover it with a bell-glass, but in a moist atmosphere this will not be necessary. Intermediate House.

C. follicularis is popularly known as the "New Holland Pitcher Plant." It is a singular and most interesting object; dwarf in habit, it sits upon the ground in the shape of little rosettes, seldom exceeding four to six inches across. The leaves are narrow and spathulate, interspersed with separate foot-stalks, bearing a single small flagon-shaped pitcher, which is green, tinged with brown; these vary in size from one to three inches, furnished in front with a double row of soft hairs. Native of swampy places about King George's Sound, Australia.

Ceratozamia.—A genus of Cycads, chiefly distinguished by the two horns on each scale of its fruits; the foot-stalks of the leaves are also armed with spines.

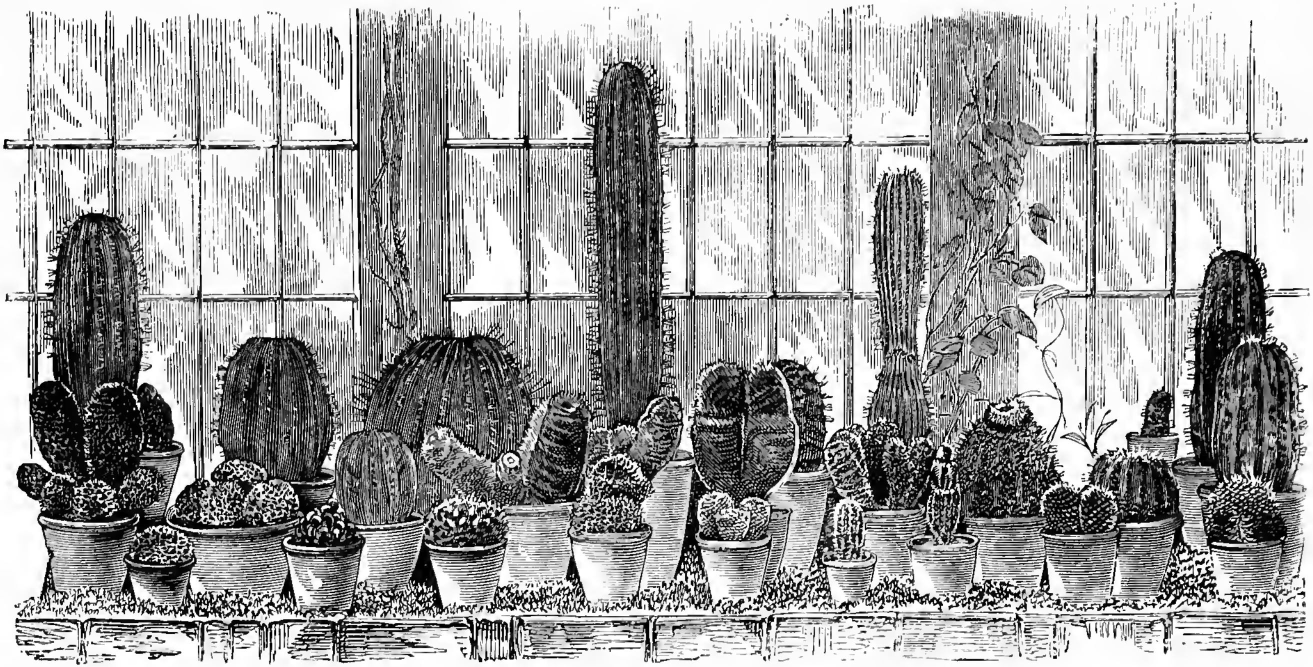
They are bold-growing plants of great beauty. For general treatment see Cycas.

C. mexicana.—A pinnate species, which differs somewhat in appearance in the sexes; in the male plant the leaves are larger and more erect than in the female. Mexico.

C. Miqueliana.—This is a slender-growing plant, bearing beautifully arched, pinnate leaves; one of the most important families of succulents. Mexico.

Cereus.—A large family of *Cactaceæ*, popularly known as "Torch Thistles." All are natives of America, and are remarkable for their singular style of growth; many of them produce large and gorgeous flowers, but they are all leafless.

There are several distinct sections of this genus; in some the stems are erect and arborescent, fluted the entire length, the edges clothed with rosettes of spines, more or less distant. The most remarkable species of this set is *C. giganteus*, which is indigenous to the mountainous parts of New Mexico. Its stout, cylindrical fluted stems often attain a height of fifty feet or more. In most cases they are simple giant-like columns, but with age branches are often produced near the apex. These, when young, grow straight out from the side, eventually assuming an erect position; under cultivation this species appears to be very slow in growth. Beside this, there are numerous smaller-growing species, with an erect columnar habit. Another section are trailers, and are usually styled "Creeping Cereus." These have cylindrical fleshy stems, which are profusely clothed



Cereus peruvianus. — Echinocactus Stainesii. — Echinocactus Visnaga. — Cereus peruvianus. — Echinocactus Pfeifferi. — Cereus cœrulescens. — Cereus peruvianus.

Mammillaria clava. — Mammillaria stella-aurata. — Astrophytum myriostigma. — Mammillaria nivea. — Mammillaria straminea. — Mammillaria bicolor. — Melocactus communis. — Echinocactus Pentlandii. — Echinocactus Scopa.

Mammillaria pusilla. — Mesembryanthemum tigrinum. — Mammillaria Willdiana v. cristata. — Cereus peruvianus monstrosus. — Mammillaria cirrifera. — Echinopsis formosus. — Pilocereus senilis. — Echinopsis Pentlandii. — Echinocactus helophorus.

GROUP OF CEREUS, ECHINOCACTUS, ECHINOCEREUS, ECHINOPSIS, MAMMILLARIA, MELOCACTUS, &c.

In the Succulent House of the Royal Botanic Gardens, Kew.

with rosettes of spines, and produce their handsome flowers in abundance, *C. flagelliformis* being the type. They form beautiful objects as basket plants, and thrive equally well in a cottage window as in the most expensive plant-house. The section represented by *C. speciosissimus* have angular stems, consisting of three, four, five, or more angles, and abundantly armed with rosettes of long sharp spines; these produce enormous flowers, which are often gorgeous in the extreme. The celebrated collection of plants of Sir E. Antrobus, of Cheam, in Surrey, formerly contained some famous examples of this section. One portion of this genus are popularly known as "Night-flowering Cactus," from the fact that their flowers only expand during the hours of darkness. The finest of these are *C. grandiflorus*, from Jamaica, and various West Indian Islands, and *C. MacDonaldii*, from Honduras. They are both climbers, the former having triangular, fleshy stems, and large white flowers, faintly tinged with straw-colour; the latter has slender, cylindrical, much-branched spiny stems, which are deep green. It produces an abundance of flowers, a foot or more in diameter when fully expanded, which are of a beautiful soft creamy-white. They are powerfully fragrant, and very short-lived, opening after sunset, and closing, never to open again, before the next sunrise.

Cereus require thorough drainage, and they enjoy full exposure to sun and light all the year round. They should be kept in rather small pots, and the soil best adapted for them is a mixture of sandy loam, old lime, and broken bricks. During the bright days of summer water freely, but entirely withhold the supply during the winter. Intermediate House.

Our readers will be able to make a good selection from the species here given :—

C. acutangulus.	C. lividus.
C. albispinus.	C. MacDonaldii.
C. azureus.	C. Mallissonii.
C. Bridgesii.	C. multangularis.
C. candicans.	C. nycticallus.
C. Chilensis.	C. Peruvianus.
C. cœrulescens.	C. Pitaya.
C. columnaris.	C. pruniosus.
C. flagelliformis.	C. pterogonus.
C. Forbesii.	C. rigidus.
C. fulgidus.	C. serpentinus.
C. gemmatus.	C. speciosus.
C. geometricans.	C. speciosissimns.
C. giganteus.	C. strictus.
C. glaucus.	C. strigosus.
C. grandiflorus.	C. tetragonus.
C. Hayni.	C. tortuosus.
C. Jamacara.	C. Tweedei.

Chrysophyllum.—A genus of *Sapotaceæ*, commonly known as "Star Apples." The order contains some very remarkable trees, such as *Dichopsis gutta*, the plant from which gutta-percha is obtained, and others useful as food in many ways. As young plants under cultivation they are extremely handsome. They thrive best in a mixture of sandy loam and a little peat; drain well, and supply liberally with water when growing. They enjoy the strong moist heat of the stove.

C. argenteum.—This species attains a height of twenty feet or more; the leaves are large, deep green on the under side, clothed with downy white hairs. Martinique.

C. Cainito, the "Star Apple," so called from the appearance of the fruits when cut across. It attains a height of about thirty feet, and forms a highly decorative object in a young state; the stems and branches are all clothed with a white tomentum. West Indies.

C. macrophyllum.—This species is at once one of the rarest and most beautiful of ornamental-leaved plants. It attains a height of a hundred feet, but as a young plant it is extremely handsome; the leaves are large, somewhat ovate, nearly a foot long, and four to six inches broad, brilliant green above, densely clothed below with silky hairs, which are bright golden-yellow when young. Western tropical Africa.

Cinchona.—This genus gives its name to the order (*Cinchonaceæ*, now generally regarded as a section of *Rubiaceæ*), which is characterised by its simple opposite leaves, and glandular stipules between the bases of the leaf-stalks; the flowers are arranged in loose panicles, but sometimes in dense heads, or corymbs, and some of the genera contain very showy species. The Cinchona is of the greatest importance to the human race, as from the bark of these trees the drug "quinine" is extracted.

C. grandiflora.—This plant, originally sent to this country from the Continental gardens under the name of *Cascarilla grandifolia*, has since been determined as the *Cinchona grandiflora* of Ruiz et Pavon. It is, however, not a true Cinchona, but correctly *Cosmibuena obtusifolia*. It is a handsome plant, with large opposite, somewhat obovate, coriaceous, dark shiny green leaves. The flowers, which are borne in terminal cymes, are tubular, with a large flat, spreading limb, divided into five obtuse lobes, pure white, and very fragrant. Summer months. New Grenada.

Cissus.—Climbing plants, belonging to the Grape-vine family (*Vitaceæ*), and, indeed, differing but slightly from the genus *Vitis*. None of its members produce showy flowers; but the species here enumerated are remarkable for the beauty of their leaves. The species here quoted enjoy an abundance of heat and moisture, and should be potted in equal parts of peat, loam, and rotten manure.

C. discolor.—This is probably the most beautiful of all the ornamental-leaved plants yet introduced to

THE PESCATORE ODONTOGLOT (ODONTOGLOSSUM PESCATOREI).

A stove Epiphyte of great beauty from New Granada, belonging to the order of Orchids. Few of the Odontoglots equal in beauty this most lovely species, to which the smallness of the plate forbids our doing justice. The panicle of large white flowers is from two to three feet high, and not much narrower, so far do the branches extend. The flowers themselves are of ample size, of a delicate semi-transparent texture, with a faint blush line along the middle of the sepals, and a stain of yellow near the base of the lip, where also are found a pair of broad deep crimson lacerated appendages. The column itself is white, with the ragged wings also stained with crimson.

THE PESCATORE ODONTOGLOT.
(ODONTOGLOSSUM PESCATOREI.)

cultivation, and its various shades and tints are really beyond accurate description. It is a fast-growing climber, with slender red stems, bearing oblong-cordate leaves, which are vinous-red beneath; the ground-colour on the upper side is metallic-green, wonderfully marbled and shaded with creamy-white, crimson, purple, peach, and rose. It is a very rapid grower, and should be pruned hard back in the autumn, as the young growths then break from near the base. Young plants struck from cuttings every year, however, produce the finest foliage. Java.

C. Lindenii.—Similar in habit to the preceding, producing large cordate-acuminate leaves of a bright shining green, variously blotched between the veins with silvery-white, which renders it at once distinct and very ornamental. Columbia.

C. porphyrophylla, though commonly classed with the Cissus of gardens, has nothing to do either with Cissus or the Vine family, but is a species of Pepper known as *Piper porphyrophyllum.*

Clavija.—A family of bold-growing plants, belonging to the order *Myrsinaceæ*, remarkable for their large and handsome foliage, and also for the abundance of their showy flowers; they have very much the appearance of, and are nearly allied to, the genus *Theophrasta*, and the name commemorates the scientific labours of Joseph Clavijo Faxardo, an eminent Spanish naturalist. Pot in a compost of two parts loam and one of peat. Stove temperature.

C. fulgens.—A handsome plant, with stout stem bearing a large head of leaves, which are about a foot long, and some five inches wide. Flowers deep orange-scarlet, rich yellow at the bsse. Summer and autumn months. Peru.

C. ornata.—This, like all the species, is an unbranched plant, assuming a tree-like form, and bearing a fine head of large and handsome foliage. Racemes produced from the axils of the leaves, and also from the stem far below the leaves; these are upwards of six inches long, drooping, and many-flowered. Flowers deep orange. Summer months. New Grenada.

C. macrophylla. — Stem stout, greyish-white in colour. Leaves large and numerous, and very strongly veined. Racemes slender, drooping, six to eight inches long. Flowers orange-yellow. Summer months. Brazil.

C. Rodekiana.—This is a superb species, with a stout erect stem, retaining its leaves for a long time. Racemes numerous, pendulous, and dense. Flowers deep orange-red. Summer months. Tropical America.

Clerodendron.—These plants belong to the order *Verbenaceæ;* some of them are stove climbers, whilst others are shrubby; the latter section require to be cut hard back after flowering, the soil reduced, and re-potted into small pots, from which they must be shifted from time to time as the pots become full of roots. The climbers require but little pruning, and this only in spring, before growth commences. During the summer months they enjoy abundance of heat and moisture, but during the winter the Intermediate House will suit them best. Pot in about equal parts of loam, peat, and well-decomposed manure, with a small portion of sharp sand added.

C. Bethuneanum—a bold-growing shrubby species, with furrowed stems; flowers rich crimson, spotted with white and purple. Autumn months. Borneo.

C. fallax — one of the showiest of stove shrubs. Leaves ample, cordate, membranous, and deep green; panicles terminal, bearing a profusion of intense scarlet flowers. Autumn months. Java.

C. fragrans — of medium growth, with sub-cordate leaves, which are serrate and slightly downy; flowers white, slightly tinged with red, and deliciously fragrant. Autumn months. China. The variety flore-pleno has double flowers, which are pure white, tinged with rosy-pink.

C. infortunatum is a bold shrub, having cordate leaves, and large terminal panicles of intense rich scarlet flowers. Autumn months. Ceylon and India.

C. myricoides — sometimes called Cyclonema myricoides—is a small-growing shrub, with opposite or whorled leaves; panicles terminal and axillary; corolla pink, limb white, lower lobe pale blue. Spring and early summer. Abyssinia.

C. splendens — a climbing plant with slender stems, and opposite, glabrous, dark green, oblong leaves, and terminal panicles of bright scarlet flowers. Summer and autumn months. West Africa.

C. squamatum — a very handsome shrubby species, with large cordate-ovate leaves, and large terminal panicles of rich deep scarlet flowers, which last long in full beauty. Summer and autumn months. East Indies.

C. Thomsonæ—a handsome climbing species, with opposite ovate-lanceolate leaves, and terminal panicles of bloom; the calyx is large, pure white, and very conspicuous; corolla scarlet. The variety Balfouriana is a form obtained from seed. It is a bolder-growing plant, with very large panicles of flowers; calyx pure white, much inflated; corolla a deep crimson. Spring and summer months.

Cochliostema. — A small genus belonging to the order *Commelynaceæ*, popularly known as Spiderworts. This genus is distinguished by the peculiar formation and arrangement of the stamens. The plant here enumerated enjoys an abundance of heat and moisture; it should be potted in rough peat, with a small portion of loam and sand added.

C. Jacobiana.—This is a plant of noble aspect. Its leaves are arranged in a rosulate manner, and these measure from two to three or four feet in length, and four to six inches in breadth; panicle large and spreading; flowers slightly fragrant; sepals rosy-pink, petals larger than the sepals, violet-blue, fringed on the edges with long purplish hairs. Spring and early summer. Ecuador.

Coffea.—This is a genus of plants belonging to the *Cinchonaceæ.* They are very ornamental shrubs, and most interesting in an economic point of view, as from their seeds we obtain the pleasant beverage called coffee, which is now so largely used throughout Europe. In our plant-stoves they produce their fragrant white flowers in great abundance, which are succeeded by the large red berries containing the seeds. Pot in sandy loam and peat in about equal parts, and treat the plants to a high temperature, well charged with moisture.

C. arabica yields the famous "Mocha coffee." It is a much-branched shrub; the flowers borne in clusters in the axils of the leaves, white and sweet-scented. *C. arabica variegata* is distinguished by its leaves, which are marbled and flaked with creamy-white and yellow markings.

C. liberica is a robust-growing plant, and is said to be of a stronger constitution than the preceding, namely, *C. arabica*.

PIPER PORPHYROPHYLLUM (CISSUS PORPHYROPHYLLA of gardens).

Coleus.—A genus belonging to the order *Labiatæ*, containing numerous species, few of which, however, are sufficiently attractive to find a place in our plant-houses. The numerous highly-coloured and fantastically marked forms (the majority of which have been obtained by cross-breeding) are deservedly popular, as they are useful as bedding plants, as ornaments for the cottage window, the greenhouse in summer, or the stove all the year round. Coleus are plants which are very easily managed. They are sometimes called "the Cottager's Crotons," from the brilliant colours they develop when fully exposed to the sun in a cottage window, and again they are known as "Indian Nettles," on account of their habit and general appearance. In winter, unless kept in very strong heat, they usually lapse into a uniform green state, and it is best to obtain young plants from cuttings every spring; and, moreover, so rapid are they in growth, that plants many feet in diameter can be obtained in a few months, so that want of space will at once show the necessity of throwing away the old plants in autumn. Loam and peat in equal proportions suits them admirably, to which add a little sand. During the summer months Coleus may be used with advantage in the green-house or conservatory, but they require the warmth of the stove during winter and spring. Their names are legion; but we select a few of the best kinds :—

C. Amazement—deep brown flaked with crimson, tipped with green.
Aurora—ground-colour yellowish-green, blotched in centre with rosy-purple.
Beauty of Widmore—purplish-bronze, flaked with rich carmine, and edged with creamy-yellow.
Bijou—ground-colour green, centre flaked with creamy-white.
Captivation—ground-colour bright green, flaked in centre with yellow, and suffused with purple.
Chelsea Beauty—rich crimson-lake, marbled with deep maroon, bordered with white and green.
Cherub—deep red, veined with maroon, edged with yellow and green.
Dolly Varden—deep green, curiously mottled and splashed with crimson, magenta, and rose-pink.
Duchess of Edinburgh—deep maroon, flaked with pink, rose, magenta, and cream-colour.
Firefly — purplish - crimson and violet-rose, with yellowish - green dots on margin.
Flambeau — deep maroon, flaked with magenta, narrowly edged with deep green.
Glow-worm — Centre brilliant crimson and purple, edged with bronzy green.
Harlequin — yellow and green ground, marbled and flaked with various shades of deep brown, purple, and bronze.
Kentish Fire — centre fiery-crimson, bordered with maroon.
Lord Oxford—rich magenta, flaked with green, edged with green and yellow.
Maggie — deep crimson, marbled and flaked with yellow, bronze, and green.
Mrs. Simpson—bright scarlet, suffused with deep velvet blackish-crimson.
Phœbus — bright scarlet, shaded with crimson—margin yellow and green.
Pine-apple Beauty — brilliant scarlet and golden-yellow.
Queen Victoria—rich bronzy crimson, bordered with golden-yellow.
Royal Purple—purplish magenta centre, bordered with deep maroon, and edged with dark green.
Sensation—brilliant rose in centre, bordered with deep maroon, and narrowly edged with green.
The Shah—lower half of leaf deep crimson, upper half rich yellow.
Sparkler—crimson-maroon, flaked in centre with rose.
Sunbeam—fiery-red, flaked with rose.
Troubadour—bright green centre, flaked with amaranth and white, edges spotted with crimson.
Turban — deep crimson, flaked in centre with purple, narrow edge of bright green.
Victory—deep brown, flaked in centre with crimson.
Yellow Gem—bright canary-yellow, veined with white.

Columnea.—A genus of *Gesneraceæ*, destitute of tubers. They are, for the most part, epiphytal in the dense woods of tropical America, and form splendid ornaments treated as basket plants; and although they grow freely when planted in free open soil, and treated to plenty of heat and moisture, they are by no means to be neglected during the winter months with impunity. The soil best adapted for Columneas is fibrous peat and sand, with chopped sphagnum and some nodules of charcoal. Some extremely beautiful species of this genus have not yet been introduced in a living state. These plants may be grown in pots, but they thrive better, and display their charms to greater advantage, when suspended in baskets.

C. aurantiaca—a slender-growing species, with opposite, smooth, bright green leaves. Like all the species of this genus the flowers are tubular, with a spreading limb. Spring and early summer. New Grenada.
C. crassifolia — a distinct and handsome species, with erect linear-lanceolate leaves, which are smooth and deep green above, but clothed on the under side with rufous hairs; flowers rosy-scarlet, the tube densely hairy. Spring and summer months. Mexico.
C. erythrophæa—this species is very showy when in bloom; flowers freely produced, tubes upwards of three inches long, increasing upwards, of a uniform deep red; calyx very large and spreading, a pale yellowish-green, blotched towards the base with rosy-red. Summer months. Mexico.
C. scandens — a smaller-growing plant than either of the preceding, and a profuse bloomer; bright scarlet flowers, in some varieties flesh-colour. Early summer. West India Islands.
C. Scheidiana—an elegant, somewhat small-growing species; flowers upwards of two inches long, ground-colour rich yellow, over which are numerous spots and tessellations of rich brown; calyx large and spreading, rosy-purple. Early summer. Mexico.

Combretum.—A genus of climbing plants, the type of the order *Combretaceæ*. They are extremely showy when trained upon pillars or the roof of the stove, and succeed still better when planted in the border; indeed, they do not generally produce a great effect when treated as pot-plants. The soil should be about two parts loam, one part peat, and a small portion of sharp sand. Other fine species are *C. grandiflorum*, *C. Pinceanum*, and *C. paniculatum*, all natives of West Africa.

C. micropetalum.—Leaves opposite, oblong-lanceolate, nearly six inches long, and deep green. Flowers produced in long dense racemes, rich bright yellow and orange. Autumn months. Brazil.

C. purpureum.—This plant is perhaps more correctly named *Poivrea coccinea.* The two genera are, however, very closely allied, and this species is generally known as *Combretum.* It is a grand ornament in the stove. Leaves oblong-lanceolate, some six inches long, and deep shining green. Flowers produced on dense branching racemes, intense deep scarlet in colour. Early summer months, lasting long in beauty. Madagascar.

Cossignia.—A family belonging to the Soapworts (*Saponariæ*), natives of the Mauritius and Isle of Bourbon, where they are called "Bois de Judas." They are small pinnate-leaved trees, with inconspicuous flowers; but *C. borbonica* has very handsome foliage. The soil should consist of peat and loam in about equal parts, with a considerable portion of sharp sand. Strong heat and a moist atmosphere are necessary to fully develop its beauties.

Crossandra.—A small family of dwarf-growing plants belonging to the Acanthads; the name comes from *krossos*, "a fringe," in allusion to their fringed anthers. They enjoy the strong moist heat of the stove.

C. guineensis.—This species is very dwarf, and more remarkable for its ornamental leaves than for its flowers. Stem and petioles bright red, leaves three to six inches long and one and a half broad, deep green above, beautifully netted with golden lines, reverse side pale red. Flowers lilac, on terminal spikes, with bright red bracts. Winter months. Island of Fernando Po, at 2,000 feet elevation.

C. infundibuliformis.—Of robust and erect habit, this species is a charming object during the dull winter months. The glume-like spikes are freely produced, and bear numerous large orange-scarlet flowers. Winter months. East Indies.

C. undulæfolia.—An old inhabitant of our plant-houses, and still very beautiful when well done. Leaves oblong-acuminate, much waved on the edges, and deep green. Flowers rich vermilion. Winter months. East Indies.

Croton.—A large genus belonging to the Spurgewort family (*Euphorbiaceæ*); from one species, viz., *C. Tiglium*, a native of India and the Indian Archipelago, the powerful medicine called "Croton oil" is obtained by crushing the seed.

The plants here introduced do *not* belong to the genus, but should be referred to *Codiæum;* they are, however, so well known throughout the horticultural world as Crotons, that for the sake of convenience that name may be retained for them; indeed, they are far more widely known by it among gardeners.

They are bold-growing, handsome-leaved shrubs, with somewhat the appearance and habit of Laurels or Aucubas, and the species and varieties have become so numerous of late years, both by the introduction of fresh forms from their native habitats and by cross-breeding at home, that their numbers are legion.

The first English-bred Croton was obtained by the writer of these lines from a cross between *C. pictum* and *C. Wiesmannii*, and is now known as *C. Queen Victoria;* and it is very remarkable that, though so many seedlings have since been raised, and so many forms have been introduced, none have resembled this plant, which is still one of the finest varieties in cultivation. It was raised in the nursery of Mr. B. S. Williams, of Upper Holloway, an establishment which has since introduced several others of the richest gems of this family. The Messrs. Veitch and Sons, and Mr. Bull, both of Chelsea, have also added quantities of fine Crotons to our plant-stoves.

In the plant-stove Crotons are indispensable, the brilliancy and the diversity of the markings of their richly-coloured leaves rendering them quite as showy as flowers. The smaller-leaved kinds are extremely useful for dinner-table decoration, and also for placing in vases, &c., for the embellishment of the boudoir or drawing-room; in the latter case, however, the rooms require to be kept warm and free from gas, or the leaves will speedily fall. For public exhibition purposes these plants are simply invaluable.

Crotons thrive well in a compost consisting of three parts rich loam, one part peat, one part leaf-mould, and a fair proportion of sharp sand; the pots should be thoroughly drained, as they enjoy an abundant supply of water; neither must the foliage be neglected, frequent sprinklings from the syringe being absolutely necessary to keep away red spider and thrip; they also enjoy strong heat and a moist atmosphere, with full exposure to sun and light.

The varieties of Crotons are now so numerous that it is extremely difficult to make a selection without omitting some desirable kinds; but those here enumerated are all of the highest merit, and will not fail to give satisfaction to all who try them:—

C. Andreanum — a bold-growing plant, bearing large leaves a foot long and nearly four inches broad; dark olive-green, midrib and primary veins rich golden-yellow, changing with age to deep crimson.

C. aneitumensis—a very free branching form. Leaves light olive-green; markings rich deep orange-yellow.

C. angustifolium—one of the oldest and best for dinner-table decoration in places where other colours besides green can be introduced; leaves long, narrow, pendulous, some straight or twisted in a spiral form, and wholly rich golden-yellow.

C. Bismarckii—a robust form, with large fiddle-shaped leaves, deep green, and banded and blotched with deep yellow.

C. Chelsonii—green narrow spiral leaves, breaking into orange, shaded with salmon and crimson.

C. Dayspring—leaves nearly eighteen inches long, under side vinous-red; surface deep olive-green, irregularly but profusely blotched with orange and crimson.

C. Disraeli—trifid or three-lobed leaves, the centre lobe much the longest; bright green, blotched and veined with yellow, changing with age to orange and scarlet.

C. Dodgeonæ — narrow leaves upwards of a foot in length, half an inch in breadth, frequently spiral; bright green, midrib and margins rich golden-yellow.

C. Earl of Derby—trifid or fish-tailed Croton, of remarkable beauty. Stems and leaves rich golden-yellow, the margins of the lobes banded with vivid green.

C. Eclipse — leaves ovate-lanceolate, nearly a foot long, and two inches broad; deep olive-green, blotched with rosy-crimson, midrib rich yellow flaked with rose, veins rosy-red.

C. elegantissimus — narrow pendulous leaves of a rich bright golden-yellow, margined with bright green.

C. Evansianus—leaves trilobate, in a young state bright green, veined with golden-yellow; with age deep olive-green, burnished with crimson, and veined with rich deep orange.

C. Excelsior—a close-habited plant, with leaves upwards of a foot long, and scarcely two inches broad; of a dark green, profusely mottled with rich golden-yellow, changing with age to deep crimson.

C. Goldei—a very fine trifid species.

C. Hanburyanus — leaves from twelve to eighteen inches long, and upwards of two inches wide, intense deep green, beautifully mottled and netted with deep yellow and rosy-crimson.

C. Harwoodianus — leaves oblong-lanceolate, petioles crimson, blades of leaves a rich mixture of green, yellow, and bronze.

C. imperator—leaves broadly lanceolate, recurved, of a light green, mottled and blotched with light yellow, midrib creamy-white, changing to bright crimson.

C. Jamesianus—stems slightly glaucous, leaves oblong-lanceolate, deep green, mottled with glaucous-green and light yellow; very distinct.

C. Kingianus—a bold-growing, large-leaved form of great beauty; leaves oblong-ovate, being nearly eighteen inches long and six to eight inches broad.

C. Lord Belhaven — large broadly-obovate leaves, rich deep yellow, marbled and chequered with bright green, the whole shaded with rosy-carmine.

C. Lord Cairns—leaves trilobate, the middle lobe being much the longest, lateral lobes irregular, deep green, blotched with light yellow.

C. Macafeeanus—rich yellow stems and petioles, broad deep green leaves, blotched and spotted with golden-yellow.

C. Macarthuri—great diversity of form in its leaves—bright green, one-half marbled, flaked and spotted with rich yellow.

C. majesticum—leaves narrow, about a foot and a half long, deep green, marked with golden-yellow, changing with age to rich crimson.

C. Mrs. Dorman—leaves upwards of a foot long, and half an inch wide, rich deep orange-scarlet, margined with a band of bright green.

C. Mortii—leaves obovate, nine or ten inches long and four broad, intense deep green, veins broadly banded with golden-yellow.

C. mutabilis — variable in form and colour, green, spotted and blotched with light yellow, increasing in beauty with age until the ground-colour becomes of a deep bronzy-olive, and the yellow passes into rich brilliant crimson.

C. pictum—this old plant has been in cultivation upwards of seventy years, and when well grown is still one of the best; leaves nine inches long and about three broad; a rich mixture of green, olive, and crimson.

C. Prince of Wales—leaves long, narrow, undulated, and spirally twisted, light yellow, the margins irregularly blotched with carmine and magenta.

C. Princess of Wales—narrow pendulous leaves, which reach two feet in length; sometimes spiral, at others plain and waved at the margins. The colouring is very rich, consisting of spots, blotches, and marblings of rich yellow, creamy-yellow, and green. New Hebrides.

C. Queen Victoria — extremely rich in colour; leaves twelve inches long and two inches broad, deep golden-yellow, marbled with creamy-yellow and green, midrib and primary veins bright magenta, when mature passing into rich bright crimson.

C. Rex.—bright-coloured linear-lanceolate leaves, bronzy-green, veined with creamy-yellow when young, passing into rich bright crimson when mature.

C. Rodeckiana — leaves linear, pendulous, about eighteen inches long and an inch broad, sometimes spiral; the colours are creamy-white and rose, irregularly blotched and mottled throughout.

C. roseo-pictus—as its name implies, a choice variety in which rose and light yellow predominate.

C. ruberrimus—leaves narrow, pendulous; bright green on the margins, with a centre of creamy-yellow.

C. rubescens—leaves lanceolate, deep green, veined, blotched, and spotted with yellow, crimson, rose, and orange-scarlet.

C. Sinitzinianus — narrow leaves; sometimes spiral, or undulated, ground-colour intense deep green, mottled with pale yellow.

C. spiralis — leaves almost as regularly twisted as a corkscrew; the ground-colour when young is a deep bottle-green, deep golden midrib, changing with age as usual.

C. Stewartii—compact in habit, the ground-colour bottle-green, flaked with deep orange and carmine.

C. superbiens—very variable. When young green, veined with yellow, darkening with age, passing into rich deep yellow.

C. tricolor—leaves linear-lanceolate, petioles crimson, midrib when young yellow, changing with age to crimson; leaf irregularly blotched with green, rosy-crimson, and yellow.

C. undulatum—leaves lanceolate-acuminate, with waved edges, deep green, mottled with creamy-yellow, which with age passes into brilliant crimson.

C. variegatum—introduced about eighty years ago. Leaves oblong-lanceolate, nine to twelve inches long, three inches broad, bright green; midrib, primary veins, and edges broadly margined with heavy gold-colour.

C. Veitchii—strong grower, large oblong-lanceolate acuminate leaves, upwards of a foot long and two or three inches broad, ground colour bright green, midrib and primary veins broadly bordered with creamy-yellow, passing when mature into pink and purple.

C. volutus—a distinct and curious form. Leaves strap-shaped, rolled inwards, ground-colour dark green, midrib and primary veins golden-yellow, suffused with rosy-pink.

C. Warrenii — pendulous form, giving one the impression of a flowing fountain of purple and gold; leaves upwards of two feet long, an inch broad, linear and spirally twisted.

C. Wiesmannii—one of the earliest and best. Leaves about twelve inches long, and an inch wide, ground-colour a rich green, the midrib and veins striped, a part of the leaf flaked with bright yellow.

C. Williamsii — a superb form; leaves large and obovate, from twelve to eighteen inches long, and waved at the edges; profusely mottled with magenta; but with age the colours pass into a rich bronzy-green and deep crimson.

C. Wilsonii—slender, pendulous, upwards of a foot and a half long, an inch broad, ground-colour brilliant green, irregularly flaked and mottled with deep yellow.

Curculigo.—A genus belonging to the order *Amaryllideæ*. Most of the species have much the appearance of young pinnate-leaved Palms in the young state. They should be grown in peat and sand, and as they enjoy an abundance of heat and moisture, the drainage should be ample.

C. recurvata striata.—Leaves elliptical and spreading, longitudinally plaited, and like the species (*C. recurvata*) deep green, but differing in having a broad central band of white, running from base to apex. East Indies.

C. recurvata variegata.—The leaves of this variety are broader than the preceding kind. They are much plaited, and profusely banded with broad, pure white stripes. East Indies.

Curmeria.—A small genus of dwarf Arads (now included under *Homalomena*), well deserving general cultivation for the extreme beauty of their leaves. The soil should be peat and loam, in about equal parts. They enjoy a strong moist heat.

C. picturata.—A dwarf-growing species; leaves elliptic, spreading horizontally, from nine to twelve inches in length, six inches across in the widest part; rich deep green, midrib bordered with silvery-white, on each side of which is a flaked band of greenish-white. Columbia.

C. Wallisii.—Leaves oblong-ovate, deep velvety olive-green, irregularly blotched with emerald-green, changing with age to grey. Columbia.

Cyanophyllum. — A genus of Melastomads, bearing, as a rule, small and inconspicuous flowers,

CROTON QUEEN VICTORIA.

but remarkable for the extreme beauty of their leaves. These plants should be grown rapidly, and confined to a single stem. The soil best adapted for them is peat and leaf-mould, in about equal parts, with the addition of a small portion of rich loam, and some sharp sand. They enjoy abundance of heat and moisture. Besides the species here enumerated *C. Baumanii* and *C. Siamense* are handsome plants.

C. magnificum.—A bold-growing plant, with opposite leaves, which are broadly-ovate acuminate, sometimes thirty inches long, and nearly twelve inches broad, deep velvety-green above, with prominent white ribs, under-side vinous-red Tropical America.

C. spectandrum is similar in habit to the preceding, yet very distinct.

Cycas.—This genus gives its name to the order (*Cycadaceæ*); they are plants having the venation of ferns, and produce their seeds in cones, somewhat resembling Conifers, to which latter family they are nearly allied. A coarse kind of sago is obtained from these plants, which has led to their being erroneously called Sago Palms. Pot in loam and sand, and drain well. Stove.

C. Armstrongii—leaves long, arched, the pinnate leaflets closely set, very long, and of a deep shining green, mid-rib pale green.

C. circinalis — stem stout, bearing an enormous head of pinnate leaves, three, six, and even twelve feet long; leaflets somewhat falcate, and bright shining green.

C. inermis — stem slender, whole plant smooth, leaves pinnate, leaflets coriaceous in texture, and very deep green.

C. media—stem tall and stout, leaves pinnate, petioles armed with sharp spines, leaflets closely set, long and narrow, and bright green.

C. Normanbyana — leaves beautifully arched, petioles spiny at the base, where they are somewhat downy, leaflets long, narrow, and bright green.

C. revoluta—a bold and handsome species, with stout cylindrical stems, usually three to four feet high, but reaching ten, or even twelve feet, with age; these carry enormous heads of pinnate leaves, from three to six feet long; sometimes as many as fifty to sixty of these intense deep green leaves are borne at one time, presenting a majestic appearance.

C. Riuminiana—stem stout and rough, leaves pinnate and feathery, six or eight feet long; leaflets closely set, tapering to a fine point, with a bright line of green, the naked portion of the petioles being armed with spines. Philippines.

C. Rumphii — a slender-stemmed species, bearing a beautiful crown of leaves, which are three to six feet in length.

C. siamensis—distinct but similar in appearance to circinalis.

CYCAS REVOLUTA.

Cyrtanthera.—Handsome Acanthads, with much the appearance of Aphelandras, and requiring the same treatment. Intermediate House.

C. catalpæfolia.—A shrubby plant, attaining a height of about six feet. Flowers numerous, in large branched racemes, deep yellow. Summer months.

C. chrysostephana.—Dwarf, compact and handsome. Leaves some six inches in length. Flowers in dense cymes, upwards of two inches long, rich bright golden-yellow. Winter months.

Cyrtodeira.—This genus comprises a few species (now included under *Episcia*) of plants belonging to the order *Gesneraceæ*. Of late years the genus has not been considered a good one, but as *Cyrtodeira* has become familiar to the horticultural fraternity, we have retained the name in these pages. Crytodeiras are small-growing, handsome plants, destitute of tubers, and having ornamental leaves and bright and beautiful flowers. They should be treated as basket plants, and suspended from the roof. The soil in which they thrive best is a mixture of peat and sphagnum moss; they enjoy abundance of heat and moisture.

C. chontalensis.– Stems prostrate, and dull red in colour. Flowers solitary, tubular, with a large five-lobed, flat spreading limb, white, tinged with lilac, and stained with pale lemon in the throat. Summer months. Nicaragua.

C. cupreata vividifolia.—This is a superior form of the old *Achimenes cupreata*. Flowers large, bright scarlet. Spring and summer months. New Grenada.

C. fulgida.—Leaves opposite, three to six inches long, deep olive-green, midrib and primary veins metallic-white, bordered with emerald-green; flowers intense deep red. Spring and summer months. New Grenada.

THE ORCHARD-HOUSE.

By William Coleman.

PLUMS, CHERRIES, FIGS, PEARS, APRICOTS.

The Plum.—Plums form most beautiful objects when grown under glass, either as bushes, pyramids, or cordons; or they may be planted out, as is often the case, in large gardens, and trained to a trellis under glass, like Peaches and Nectarines.

When the trees are newly potted they are apt to make a too vigorous growth, but by constant pinching they soon become very proliferous and fruitful, so much so that in course of time they become one mass of fruit-bearing spurs, which require annual thinning out with a pruning-knife, to let in light and air, as well as to insure fruit of the finest size and quality. As the soil and mode of potting in no way differs from that recommended for Peaches, it is unnecessary to enlarge upon this part of their culture. All they require is firm potting in sound calcareous loam, an abundance of water when they are in growth, and frequent syringing during the time they are swelling off their fruit. The Plum being subject to green and black aphis, the house in which they are grown should be well fumigated two or three times shortly before the trees come into flower. They should also be again fumigated as often as fly puts in an appearance after the fruit is set, but never during the time they are in flower. The coolest end of the orchard-house suits them best, and an abundance of air is needful to insure a good set of fruit. If it can be obtained, soft water, or water free from lime, should be used for syringing purposes, otherwise the fruit will be disfigured by a deposit, which no after-attention can remove. In fine, warm seasons, a succession from one set of trees can be secured by placing a portion of them out of doors after the stoning process is completed; but such kinds as Golden Drop and the Impératrice section should be kept in-doors, where the fruit will attain colour and quality not often met with on open walls, and under good management it will hang until it becomes a perfect sweetmeat. Good ordinary Plums can, as a rule, be obtained from trees in the open air; but choice kinds, including the Gages and Golden Drop, do not even in the best localities always come to perfection, although they may set plenty of fruit. Therefore, as space in the orchard-house is generally limited, the best kinds only should be selected for culture under glass. Good trees, well set with flower-buds, can now be obtained at reasonable prices; or maiden trees may be potted and plunged in the open quarters of the garden, where, under a regular system of pinching and watering, they will, in one season, make handsome fruiting pyramids, bushes, or cordons, fit for forcing the following year.

Plums being extremely numerous, the following list includes the cream of the varieties best adapted for giving an early, mid-season, and late supply of fruit. The varieties are arranged in their order of ripening :—

1. Early Greengage.
2. July "
3. St. Etienne.
4. Peach.
5. Royal Hative.
6. De Montfort.
7. Oullin's Golden.
8. Denniston's Superb.
9. Greengage.
10. Bryanston Gage.
11. McLaughlin.
12. Transparent Gage.
13. Jefferson.
14. Kirke's.
15. Angelina Burdett.
16. Washington.
17. Jodoigne Greengage.
18. Lawson's Golden.
19. Coe's Golden Drop.
20. Late Greengage.
21. Reine Claude de Bavay.
22. Blue Impératrice.
23. Ickworth Impératrice.
24. Late Rivers.

Cherries.—These, like Plums, require a cool, airy part of the orchard-house, particularly through the early stages of their growth and until after the fruit is set. From this time until the fruit begins to change for ripening, the trees will make satisfactory progress together, but as soon as this stage is reached the syringing of the Cherries must be discontinued, otherwise the fruit will crack and perish. As all stone-fruit trees rejoice in a strong calcareous loam, firm potting in well-drained pots, and plenty of water, their treatment and root-management will not differ from that recommended for Peaches and Plums. They also submit to close pinching through the growing season, and soon become so fruitful as to require liberal thinning after, but not before, the stoning process is over. The Cherry can be successfully grown as a close pyramid, bush, cordon, or trained under a trellis some eighteen inches below the glass, when, independently of its fruit, its flowers alone form one of the sweetest and most delightful pictures that can well be imagined.

When it is known that Cherries ripen on open walls early in June, it is not difficult to conceive that ripe fruit may be obtained from early kinds in pots in April and May without forcing. Indeed, forcing with fire-heat or anything approaching confinement is at all times fatal to the crop. Therefore all that is needed is a constant circulation of air in a house that will range from 40° at night to 50° by day before the flowers open, and 45° at night to 55° by day until the fruit has passed the stoning period. The only time when fire-heat is really necessary is during the flowering stage should the weather be dark, damp, and unfavourable to fertilisation. At such a time the most gentle circulation with ventilation is beneficial not only to the Cherry, but to all stone-fruit trees.

Like the Peach, the Plum and the Cherry should be carefully fertilised on bright sunny days when the temperature has reached the maximum. Up to and after the flowering, daily syringing is necessary, but a cold, wet, sloppy state of a house in which such low temperatures prevail cannot be too strongly deprecated, as an excess of moisture is quite as injurious as the want of it. Cherries and Plums should be removed from the house to the open air as soon as the fruit is gathered, and if potting be necessary the trees should be shifted into larger, or reduced and replaced in the same-sized pots, as soon as the wood and flower buds are properly formed and the foliage shows signs of changing for ripening. If plunged out of doors where the pots will be safe from frost, the trees will have the benefit of autumn and winter rain, and be in better condition for fruiting, with infinitely less trouble than if kept under glass, where the most skilful management will hardly keep them in proper order as to ventilation and moisture.

Fig. 12.—Greengage Bush-tree.

In course of time they almost cease making wood, and the spurs require thinning out with a fine-bladed knife just before the buds begin to swell. At this time they should be well washed with soap-water, provided the weather is mild, and in wooded districts a fishing-net will be needed to protect them from the depredations of birds. Being subject to black and green fly, they must be well fumigated just before the flowers open, and again at intervals after the fruit has set. Another enemy about this time must also be looked for in the form of a small, black, lively grub, which speedily destroys the crop. Its whereabouts can always be discovered by the curled or joined-together appearance of the leaves, and its destruction can only be wrought by hand-picking or pinching before it attacks the fruit.

A great number of fine varieties of dessert Cherries are now in cultivation, and all of them do well under pot culture; but for general purposes a few of the good, old, well-known kinds are still in favour with growers who have to provide for rich men's tables, and as these growers have paid for their experience, the amateur will not go far wrong if he follows in their wake. Although Dr. Hogg has divided Cherries into a number of sections, we need not here do more than throw them into two—the Dukes, and the Hearts, or Bigarreaus. The first section will give a supply throughout the Cherry season, and the second is well worthy of extensive cultivation under glass, where, independently of their safety from birds and insects, the large Bigarreaus and Blacks attain quality rarely met with in fruit from open walls.

Duke Cherries.

Archduke. — One of the best; ten days later than May Duke.

Duchesse de Pallwau.—A large, robust variety of the May Duke.

Empress Eugénie.—An early variety of the May Duke.

Late Duke.—An excellent late subacid Cherry.

May Duke. — Too well known to require description.

Nouvelle Royale.—Very late.

Planchoury.—Will hang till September.

Royal Duke.—Large, juicy, and agreeable; succeeds the May Duke.

Heart and Bigarreau Cherries.

1. *Bigarreau Jaboulay.*—Large, rich, and delicious. The earliest Bigarreau known, and ripens before May Duke.
2. *Bigarreau Napoleon.*—Large, rich, and prolific; very late, and an abundant bearer. One of the best for exhibition.
3. *Black Tartarian.*—Large and handsome. Tree a great bearer. One of the best for exhibition.
4. *Black Circassian.*—Equal to the above. One of the best Black Cherries known.
5. *Early Rivers.*—Very early; rich and fine.
6. *Elton.*—Large, rich, and excellent. One of the best old Cherries in cultivation.
7. *Governor Wood.*—Very large, tender, delicious. A great bearer. Worthy of extensive cultivation.
8. *Montreuse de Mezel.*—The largest Bigarreau known.

The Fig.—As the culture of the Fig under glass will be treated of separately in detail, it is only necessary to say here that this fruit will succeed in the orchard-house, and give at least one crop annually. The bush or pyramidal form is the best, and all the trees should be grown in pots, as they can then be placed close together in the driest part of the house, or in any dry airy shed, where they can be covered up during severe weather in the winter. In the open air in this country it invariably happens that the embryo fruits formed near the points of the shoots get killed by severe frosts; but when the trees are stowed away, and the pots are well tucked up in dry fern or straw, no ordinary frost will injure them.

Fig. 13.—Bush Pot Pear.

Fig. 14.—Pyramid Pear.

The fruit will commence swelling when the trees are excited in the spring, and give the earliest ripe fruit, while the first spring growths, if pinched at the fourth or fifth leaf, will very often produce a second, or successional crop, in September. Where space is limited, such kinds as the Brown Turkey and White Marseilles, two of the very best, may in fine seasons be removed to the open air in July to mature the crop of fruit. Figs, it must be borne in mind, require copious syringing to keep them free from spider, and plenty of water at the roots during the season of growth, otherwise the fruit will drop just before it begins to ripen. Head-room being abundant, a few trees may be grown as standards, or they may be trained against back walls, provided they can have an abundance of light and full exposure to the sun. Where these conditions cannot be secured it is useless trying to produce fruit worth eating, as Figs are more partial to heat than any other fruit yet mentioned.

The insects to which the Fig is most subject are red spider and brown scale, but these rarely do much mischief in a temperate house where watering and syringing are attended to. In hot seasons, favourable to wasps, some kind of protection is necessary, as these rapacious insects soon make short work of the fruit. To counteract their depredations the ventilators may be covered with Haythorn's hexagon netting, and trees in the open air can be encased in bags placed over them and secured to the stems, an arrangement which will not interfere with the application of water to the roots.

The Pear.—In cold and unfavourable localities, where the blossoms are frequently destroyed by spring frosts, or the temperature is too low to bring the fruit to perfection, choice varieties of Pears are well worthy of a place under glass. If grown in the mixed orchard-house, the trees should be placed where they can have an abundance of dry air during the time they are in flower, otherwise, being extremely impatient, perfect fertilisation will not take place.

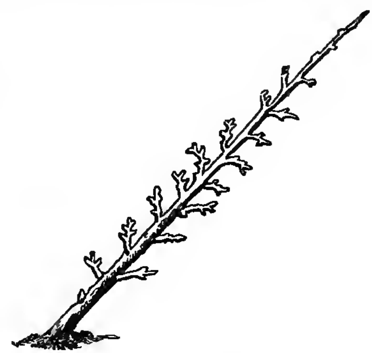


Fig. 15.—Cordon Pear.

The annexed Figs. (13, 14, 15) are fair representations of the bush, pyramid, and cordon forms which are most suitable for pot culture. Their management is extremely simple, as trees worked on the Quince stock, properly prepared and set with flower-buds, can be obtained from any good nursery at a very cheap rate. These, if potted in October, and wintered and treated as Plums, will give a few fine fruit the first year, and when thoroughly established, Pears equal to those obtained from the Channel Islands will be produced without the aid of fire-heat. Indeed it is questionable if fire-heat is not injurious after the blossoms have set and the fruit begins to swell. The soil which suits Pears on the Quince stock is a sound, sandy loam, with a little burnt earth or lime rubble added, to keep it sweet and pervious to water after it is firmly rammed into the pots. Some add rotten manure, but unless the soil is naturally poor and hungry, it answers best when applied as a mulching at short intervals throughout the growing season.

The Pear being a free liver, it should have an abundance of water at all times, and good diluted liquid during the time it is swelling off its fruit; moreover in dry, warm localities, the pots should be partially plunged in the beds, not so much to economise the use of this element as to prevent the roots from being baked in hot seasons.

There is now an excellent pot made by Mr. Matthews, of Weston-super-Mare, with numerous holes in the sides, which is well adapted for fruit-trees which require plunging through the summer months.

The roots of the Quince being fine, they do not hasten to escape like those of the stocks used for Peaches and Plums, but the facilities which these perforations seem to give, and the impossibility of the roots becoming water-logged, result in conditions highly favourable to the production of very fine fruit, as the trees cannot easily get out of order. In course of time they may require re-potting or shifting into larger pots or tubs; but when well managed, a tree will remain fruitful for many years in a fourteen-inch pot.

The mode of manipulating the summer growths is bound up in the usual term—incessant pinching from the time the trees get into free growth until the end of July, when, unless the locality is cold and wet, relief may be given to the other occupants of the house by removing them to a warm, sunny place in the open air to ripen up their fruit.

Where those fine old sorts, Brown Beurre, Passe Colmar, and Glout Morceau never attain their full size and quality on open walls, a rough, cheap orchard or Pear house will be found one of the most profitable structures imaginable. Provision for abundant ventilation is imperative, and the means of supplying gentle warmth will insure a good set of fruit in unfavourable seasons, when, owing to the continued absence of sun, or the presence of too much cold moisture, the petals of the flowers are liable to damp, and the pollen does not ripen and become fit for its office; at all other times fire-heat is a dangerous superfluity.

It is hardly necessary to say that the best-proved kinds only should be grown in quantity, while newer kinds can be speedily tested, and multiplied if found worthy companions to the following varieties:—

1. Williams's Bonchrétien.	12. Beurre d'Aremberg.
2. Beurre d'Amaulis.	13. Passe Colmar.
3. Beurre Superfin.	14. Winter Nelis.
4. Louise Bonne of Jersey.	15. Josephine de Malines.
5. Gansel's Bergamot.	16. Prince of Wales (Huyshe).
6. Thompson's.	17. Knight's Monarch.
7. Brown Beurre.	18. Easter Beurre.
8. Marie Louise.	19. Ne plus Meuris.
9. Glout Morceau.	20. Beurre Rance.
10. Pitmaston Duchesse.	
11. Doyenne du Comice.	

All the above are excellent varieties, succeed well on the Quince stock, and ripen in the order in which they are numbered, their season extending from September to March. When the amateur chooses his varieties he should select those which have been worked near to the ground, as it is advisable to bury the whole of the stock in the soil. For pyramids and cordons the stems should be clean and straight, and free from canker or enlargement where they are worked.

The following twelve sorts of Pears, being large and handsome, are well adapted for exhibition purposes:—

Beurre Diel.	Durandeau.
Beurre Superfin.	Glout Morceau.
Beurre Easter.	Louise Bonne of Jersey.
Bonchrétien.	Marie Louise.
Doyenne du Comice.	Pitmastou Duchesse.
Duchesse d'Angoulême.	Souvenir de Congrès.

The Apricot.—Apricots are sometimes grown in the orchard-house; but when subjected to the treatment recommended for other kinds of trees in the mixed orchard-house, they are capricious and uncertain, and less profitable than Peaches, Plums, or Pears.

Where the house is divided into sections, and each kind can have a department, the Apricot can be induced to carry good crops of fruit. Like all stone-fruit trees, the Apricot succeeds well in a strong calcareous soil, to which a liberal quantity of old lime-rubble has been added. It is a gross feeder, and takes copious supplies of water throughout the season of growth, and is benefited by exposure to the elements from the time the fruit is gathered until the end of October, or a month later, when the autumn is fine and mild. From the time the trees are housed until the blossoms begin to swell, an abundance of air is necessary, to keep the buds in check; otherwise, being one of our earliest and most impatient fruit-trees, they will burst into flower before the danger of injury from spring frosts has passed away. Where houses have a flow and return pipe running through them, sharp morning frosts can be warded off; but too much fire-heat is quite as fatal to the crop as the want of it. In spring, when the buds show signs of swelling, give the trees a dressing over on fine days with the syringe, but carefully avoid having much moisture in the house when there is danger of frost. At such times it is best to keep the atmosphere as dry as possible, and to give an abundance of air wherever the temperature reaches 40°. Brought on in this way, the blossom will be hardy, and capable of withstanding cold, provided the air is dry. It will not, however, set well, if at all, in a damp atmosphere.

The trees can be trained as cordons, pyramids, or bushes, and be kept close and compact by incessant pinching at the fourth or fifth leaf throughout the season; indeed, this constant pinching, next to liberal ventilation, forms the mainspring of success in Apricot culture. When the fruit is set, and syringing can be followed up, the fruit will soon attain the size of Hazel-nuts, a period at which the thinning of clusters should be commenced, but the final thinning should be deferred until stoning is complete. If the crop is satisfactory, mulch with good rotten manure, and give weak liquid two or three times a week; but avoid forcing the trees into grossness at any time, as vigorous growth is often the cause of the fruit falling when it should be taking the last swelling for ripening. As the Apricot season cannot be greatly prolonged, there is little advantage in growing a number of varieties. Therefore the best sorts only should have a place under glass. Of these the Old Moor Park still stands at the head of the list. The Peach-Apricot, a large early form of the Moor Park, is also excellent, and preferred by many, as it is less subject to paralysis; but when grown under glass, this sudden collapse of the branches, to which wall-trees are subject, disappears.

FLORISTS' FLOWERS.

By Richard Dean.

The Verbena.—This has for many years been a favourite florists' flower. The genus is divided into three sections, viz., Green-house Herbaceous, Hardy Annuals and Biennials, and Hardy Herbaceous Plants: but it is the former with which this paper more particularly deals. It is from such introduced species as *V. melindres*, *Tweediana*, and others, that the fine garden Verbenas of the present day have sprung. These species were of somewhat straggling growth, had small-sized, ill-shaped and pale-coloured flowers; but the capacity for improvement of the flower being manifest, it was taken in hand by the florists, and seedlings were found to show improvements upon the types. Seedlings from the finest of these showed still further advances, and in a few years these became rapid and striking; and in course of time, so fine were some of the varieties, that it became a practice to name them and send them out, as is common with florists in respect of other flowers. It is nearly, or quite, fifty years ago when a perceptible improvement was made, and then such well-known raisers as Messrs. Sankey, Smith, Edmonds, Perry, Eckford, and others, who took up the work in succession, brought this flower to the perfect state in which we see it at the present day. We say perfect, because the habit of growth is all that can be well desired: it is free, robust, spreading, and hardy; the trusses of bloom numerous, bold, and symmetrical; and the individual pips forming the trusses large, stout, finely shaped, and in many cases richly coloured. The production of new varieties is not so frequent as it was a few years ago, nor is the Verbena so much used in flower-garden arrangements as it formerly was, since the bedding-out system declined. But the Verbena makes one of the most charming of summer beds, as it is so free, and at the same time so continuous in bloom, that it may be said to be always in flower. It is of but few summer bedding plants that this can be said.

Cultivation in Pots.—One great aim of the florist in improving the Verbena is to make it as acceptable as possible for exhibition purposes. This favourite flower can be seen on the exhibition table both as specimen plants growing in pots, and as cut flowers in bunches. Plants that are to be grown into specimens for the exhibition table are invariably raised from cuttings, struck in the months of August or September in the previous year. Cuttings made of stiff young growths are the best, and six or eight should be put into 4½-inch pots, using a nice light sandy compost, and pressing it firmly about the cuttings. As a matter of course, the pots should be provided with efficient drainage. The pots are placed in a cold frame, kept cool, moist, and close for a few days, shading them from the sun, and then giving air as required. When well rooted the lights are removed by day, as long as the weather is fine, and put on at night. When frost threatens on the approach of winter, the plants are placed on a warm shelf of a green-house or vinery, near the glass, where they are kept rather dry and as cool as possible during the winter, and only barely protected from frost. About the middle of January they are potted singly in small pots, in a soil made up of equal parts of light sandy loam, leaf-mould, and some well-decomposed manure, with a liberal portion of sand. They are kept cool for a time, and early in March they are placed in a very mild heat, where the plants soon begin to grow freely. They are then cut back tolerably close, and as soon as they begin to break freely potted on as required;

the plants are not allowed to become pot-bound at the roots, and as they branch freely, every shoot is pinched back until about seven or eight weeks before they are wanted in flower. It is usual to water the plants overhead every morning in fine weather, which tends to keep them healthy and clean. From the first of May they should occupy a cold frame, which ought to be closed at night when the weather is cold. The flowers open much better in a cool atmosphere than in heat. If plants are not wanted for show purposes until the end of August and September, cuttings taken in March will make good specimens if grown on in the manner just recommended. Plants that are required for ordinary green-house decoration need not be grown so large as those wanted for the exhibition table. Verbenas in pots under glass are very subject to attacks of insects, and should be well fumigated with tobacco-smoke to keep them free from these.

In some parts of the country Verbenas are grown to a great size for exhibition in August. They are sometimes trained to flat wire frames, or what is more natural, the leading shoots are tied out to neat stakes, and thus present a symmetrical and striking appearance. We have seen them tied to sloping oval wire shields made of stout wire, and in this way a flat mass of flower is presented to view; but they look unnatural, notwithstanding.

Culture in Beds.—When Verbenas are employed in flower gardens of large size, great numbers are required, and propagation by means of cuttings has to be done on a large scale. "One of the best modes of striking and wintering the Verbena consists in placing the cuttings in a cold frame early in August, without using pots or pans. A layer of half-rotted leaves, some nine inches in depth, is placed over the surface of the frame, and firmly beaten down, and over this a compost made up of equal parts of loam, leaf-mould, and sand, sifted through a moderately fine sieve, placed on the leaves to the depth of four inches, and beaten down firmly with the back of a spade. Into this are put the cuttings, which are selected from the shortest and least-drawn of the young growths round the sides of the beds—shoots that have not borne flowers. They are placed in lines about one and a half inch apart in the lines, the lines about two and a half inches apart. Then a good soaking with water is given, and the lights of the frame are kept close and shaded with a mat through the day, but on warm, calm evenings drawn off for a few hours. The cuttings root under such circumstances without making any growth, or without becoming drawn. When rooted they are pricked off into pans or pots, a few crocks only being used at the bottom for drainage. A good layer of old Mushroom dung is then placed over the drainage; the pots are filled up with loam and finely-sifted leaf-mould, with a slight addition of sand. The rooted cuttings are pricked into these about two inches apart, and placed for a few days in the cold frame and kept close, and then fully exposed night and day, except during continuous rains." The plants grow rapidly, and should be kept free from blossoming as they grow. The plants are placed in their winter quarters about the middle of October, by which time they have become strong and healthy. They can be wintered in any cool, dry, airy place from which frost is excluded—on the shelves of a vinery, a green-house, &c. In the matter of watering, the soil in the pots or pans should not be allowed to become dry, nor yet to be kept otherwise than just moist, through the winter months. There is, however, more injury likely to arise from drought to such plants as Verbenas than from a little overdose of water. The plants being thoroughly furnished with strong healthy roots, they are less likely to suffer from water than weaklings struck in heat in late autumn or early spring. Another mode of propagation is to keep some plants in pots all through the summer and winter, placing them on a warm, dry, airy shelf in a green-house, keeping them pretty dry at the roots, and then placing them in a brisk bottom-heat in early spring, to induce growth from which to obtain cuttings for striking in pans of wet sand. Cuttings struck in August, and potted off singly into pots, are grown in this way also for spring use.

The plants thus obtained, they can be bedded out in May, or even earlier, for the Verbena is fairly hardy. Verbenas root freely and deeply, and should be provided with a good depth of soil. It need not be very rich. The refuse soil from a potting-bench, when carefully sifted, suits them well. If the soil be too rich, the Verbena, being naturally a free-growing plant, is apt to grow too much to foliage when it is too richly fed, and the plants are late in getting into bloom. It is a good plan to put all strong-growing varieties into rather poor soil, and when the shoots begin to grow, the surface of the bed should be top-dressed with a rich compost, and the shoots pegged down into it. The aim of the gardener should be to get the shoots so placed as that the bed may be covered, and then the bed will soon be a mass of lateral growths yielding trusses of bloom. Some pinching back is necessary to secure a regular and symmetrical blending of the plants, and this accomplished, nature may be left to do the rest. The beds should be gone over about twice a week to pick off the decaying trusses. It is a law with nearly all seed-bearing plants that if seed-pods are being formed, it is done at the expense of bloom. And the beds always look the fresher and neater for the operation.

Raising Verbenas from Seed.—It is a practice of some raisers of seedling Verbenas, to sow the seed in autumn as soon as it is ripe, doing it in pans of light soil, which are placed in cold frames, and kept close for a time, and then carried to a warm green-house, where they germinate, and are wintered on a dry shelf till the spring arrives. That practice has now almost given way to one which advises that the seed be sown at the middle or end of March, in any convenient-sized pots or pans, using a good, rich loam, sowing the seeds thinly, covering with a quarter of an inch of a light compost, and placing the seeds in a temperature of from 60 to 70 degrees, and keeping the soil constantly moist. It should on no account be allowed to become dry. As soon as the young plants are large enough to handle, they should be picked off two inches apart in other pots of fine soil, be kept close for two or three days, and then hardened off by placing them in cold frames. Strong heat is injurious to the Verbena unless it be very moist, as it induces red spider, and when this pest affects the plants, it is very difficult to get rid of it. As soon as the weather will admit of its being done, the seedlings should be planted out, if possible by the beginning of May, and it is best to do this in a bed or beds. The bed must be kept clear of weeds, and the leading growths pegged into position to keep them from being blown about by sweeping winds. When they come into flower, the work of selection begins. All inferior varieties should be pulled out, and a mark placed against any that are particularly good. These will give the cultivator something worthy of producing seed, and his aim should be to produce the very finest varieties he can. In order to test the value of seedlings fully, the plants should be placed in much richer soil than that we have recommended for use in flower beds.

There are many who raise seedling Verbenas for bedding purposes, who do not trouble themselves about making any selection of the best, or of gathering seed for raising their seedlings. But gardeners should also be florists. They should seek in every way to improve the flowers they grow, and in doing so they will find additional pleasure in their work. The possibilities of nature may be fitly designated as infinite. She is pregnant with undiscovered secrets, and she is never slow in revealing some of them to those who seek to bring forth new forms of beauty with which to delight the eyes and gladden the hearts of the children of men.

Zinnia.—We have no hesitation in placing this among the florists' flowers, for it is one of those things the florist has greatly improved during the last quarter of a century; and in our day the Zinnias take a high place among the most popular of the half-hardy annuals. Not only do their large, bold, and striking flowers adorn our gardens during the summer months, but at flower shows held during the months of August and September there can be seen stands of flowers of such size and beauty as to frequently call forth the remark from visitors, "Why, they are as large as Dahlias!" The flowers certainly do rival in size and symmetry the Pompon or Bouquet Dahlias.

There does not appear to be any common name for Zinnia. The genus is named after J. G. Zinn, a German professor of botany, but whether he introduced the flower to cultivation in Europe is not stated. There were originally several species of Zinnias known in this country, natives of Mexico and Peru, but except in old botanical gardens it would be difficult to find them. *Z. elegans*, the Elegant Zinnia, the forerunner of the fine varieties now cultivated, was introduced to this country about 1796; and its rich-coloured variety, *coccinea*, or the Scarlet-rayed Zinnia, not until 1829. By crossing this on to the different coloured forms of *Z. elegans*, there was first of all originated a section of fine single varieties; eventually some of these, owing to a great extent to the higher system of cultivation given to the flower, and also in some measure to that tendency to assume the double form seen in so many cultivated subjects, became semi-double. It is to the Continental florists, and especially those of Germany, that we are indebted for the splendid double forms so much appreciated and of such high decorative value, so carefully selected and improved before they reached their present high character. Something else has also been gained: the original forms of *Z. elegans* were in some instances of a loose, ungainly habit of growth; but by means of selection a better character, more compact and symmetrical, was developed, to the advantage of gardeners. The fine double varieties took such a hold upon the popular taste that the single forms are not now nearly so much grown as they were, which is, perhaps, not to be wondered at, though many admire them still, and most justly so. The best varieties of the single Zinnias are *alba*, white; *aurea*, deep golden; *coccinea*, scarlet; *kermesina*, crimson; *purpurea*, purple; and *sulphurea*, sulphur-yellow. Of the double Zinnias there are as many as a dozen varieties; the best we have seen are *alba*, *atropurpurea*, *aurea*, *carnea*, *coccinea*, *kermesina*, *lilacina*, *rosea*, *purpurea*, and *sulphurea*. Attempts have been made to secure a section of striped varieties, but it is very difficult to make these forms permanent; they appear to revert to the self character after a time.

The Zinnias come under the denomination of half-hardy annuals, and it is necessary that the seeds be raised in a little warmth. We have known seeds to germinate when sown out of doors in light warm soils late in April or early in May, but it is necessary to cover the seeds with inverted flower-pots, or some such contrivance, in order to secure a successful germination. The best time to sow is at the end of March or the beginning of April, in pots filled with a good light compost, made up of leaf-mould, loam, and sand, and taking care the pots are well drained, also plunging them in a bottom-heat of some sixty degrees. Failing bottom-heat, the pots can be placed in a frame, or on a shelf in a greenhouse, covered with panes of glass, and kept shaded from the sun. The seeds germinate in a comparatively quick period, and when the seedlings are about an inch high they should be placed singly in small pots, using the light compost previously recommended, and kept in a close shaded frame until they are established. Then a little air should be given, increasing the supply as the weather is fine, so as to harden off the plants preparatory to being planted out. This should be done about the first week in June. Now Zinnias, as a rule, do not transplant well; therefore there is a great advantage in growing them singly in pots, as a preparatory measure; and when transplanted, advantage should be taken of showery weather to do this. If it is done during a period of dry weather, the plants should be liberally watered until they become well established in the soil. The young plants are somewhat brittle, and at all stages of growth they are liable to injury from the wind; therefore, the position in which they are to flower should be as far as possible sheltered from its full force. Still, the position must be an open one. The Zinnia, when once established in the soil, is an excellent hot-weather plant—the more sunny the weather, the better and more numerously does it flower. They are plants that flourish under roasting influences.

The soil forming the bed must be deeply stirred and rich. It is obvious that a strong-growing plant like the Zinnia needs a deep soil in which to root, and plenty of nutriment for the roots to feed upon. If the weather should prove hot and dry for a long time, the plants will derive great assistance from a little mulching being placed about the roots. The Zinnia is a valuable plant for cutting from, and the act of taking the flowers prevents the decaying blossoms from becoming unsightly. Under any circumstances, these should be removed.

In order to have fine flowers for exhibition, it is necessary to remove some of the buds, so that the strength of the plants may go to form a few instead of many flowers. The plants need also to be well looked after in the matter of watering, and some liquid manure should be given twice a week, taking care to well mulch the roots with short dung.

But lest any of our readers might be discouraged in attempting to raise Zinnias from seeds in the open ground, we need to add to what we have already written by stating that the seeds should be sown on a sunny border sloping to the south, at the end of May, in a rich, fine, and fairly firm soil. Little groups of three or four seeds may be sown at distances of about two feet apart, or a little less, covering the seed lightly, and leaving the rest to nature. All the plants in the groups should be pulled out with the exception of one, which is left to grow into size.

Under the name of *Zinnia Haageana*, or *mexicana*, there was introduced a few years ago a large single yellow form of dwarfer and more prostrate growth than the varieties of *Z. elegans*, and certainly not nearly so valuable or useful. From this came a double yellow-flowered form, also a useful garden plant, and similarly treated. But these have made but little headway in the public estimation. A little later there was introduced from the Continent *Z. Darwinii*, a hybrid obtained by a German firm, and said to have originated from a cross between the double *Zinnia elegans* and the double form of *Z. Haageana*. There were several varieties of this, but, though small-flowered and neat, they will never take the place of, or rival, the *elegans* section in our gardens.

The Anemone (*Wind Flower*).—This was for many years a favourite flower with the florists, and time was when large collections of named varieties were cultivated by them, and stands of the flower were found on the exhibition table. Unhappily, beautiful as is the Anemone, and in many extremely handsome and varied forms, it has almost ceased to be grown, and many fine named varieties have become lost to cultivation. But there are indications that it is again rising in the popular estimation, and it is now to be found in many more gardens than it was ten years ago.

The Anemone, according to Linnæus, is a native of the south-east of Europe. We are also informed that M. Bachelier, a French gentleman, brought it from America to France in the seventeenth century, where he cultivated and very much improved the species, since which time it has attained its present degree of perfection. An interesting story is told respecting M. Bachelier's Anemones. He had secured a collection of great beauty, and would not part with a root for love or money. For ten years he contrived to keep the treasures to himself, until a wily senator paid him a visit, and, walking around the gardens, observed that the cherished Anemones were in seed. Letting his robe fall upon the plants as if by accident, he so swept off a number of the little feathery seeds, which his servant, following close upon his heels, brushed off his master's robe, and secretly appropriated; and before long the niggardly florist had the mortification of seeing his highly prized "strain" in the possession of his neighbours and rivals.

There is no doubt that the improvement in the flower was due in great measure to the florists of Holland, France, and Flanders. Large quantities of Anemones are grown in Holland, and annually imported to this country in a dry state during August and September. When planted, they swell largely and in congenial soil make large roots that produce strong plants flowering superbly. There are double and single varieties, of great and diversified beauty.

ANEMONE NARCISSIFLORA.

The genus *Anemone* comprehends a large group of species and their varieties. We are now dealing with *Anemone coronaria*, the Poppy Anemone of southern Europe. This is the florists' Anemone, and it is the varieties of this species he has tended with so much care for years past. It would be difficult to enumerate the variations in colour this gay spring flower assumes. So sportive is its nature in this respect that there is a marked diversity of the mixing of the whole with the various shades of scarlet, carmine, rose, red, violet, blue, slate, &c., in each individual flower raised from seed, by which are produced the double, semi-double, and single varieties; and few of them fail to claim our admiration. It is matter for wonder that this beautiful flower should have decreased in cultivation to such an extent, for it is not difficult to grow, thriving well in ordinary garden mould when of a sandy quality and tolerably rich, although it is always the practice of the florist to prepare, as in the case of the Ranunculus, a special compost for the Anemone.

We will in a few words set forth the ingredients of a compost that is within the reach of all:—Take fresh earth from a common, or some other pasture land, that is of a light or sandy quality, whether of a yellow hazel or the darker colour does not matter. It should be taken not more than four or six inches deep, with the turf adhering to it. Such soil will be sweet, and fit for immediate use;

first having beaten out the earth from the turf, and clearing it of such harmful insects as wire-worm, grubs, &c., about one-third of its quantity of well-decomposed horse or cow manure should be added, mixing it well together, throwing out the stones, but not attempting to sift it—using it coarse and rough.

About the beginning of September is the proper time to prepare the bed for planting; and if it occupies a moist position, the soil of the bed should be raised a few inches above the ground-level, laying at the bottom of the bed the coarsest portion of the compost by way of drainage. The bed in which the roots are to be planted should be one foot in depth, therefore it will be necessary to remove some of the garden soil to make room for it. It is well to make up the bed two or three weeks prior to planting, in order that the soil may settle down somewhat solid.

"There are two seasons for planting," observes Mr. Carey Tyso—"the middle of October, and the end of January. The early vegetation of such roots as are left in the ground would intimate that the former is the most *natural* season, and undoubtedly October-planted tubers make stronger plants, throw up more flower-buds, bloom earlier, and, when the season is favourable, produce finer blossoms, than those planted in spring. The main drawback is, that the blossoms expand before frosts have ceased, and hence a large amount of care and protection is necessary." And now to return to the bed. The authority above quoted gives the following directions for planting:—"Rake the surface level, and mark the bed in cross rows. Plant five roots in a row when the bed is three feet four inches in width, which will allow six or seven inches apart. As the tubers are varied in form and size, the hand, or a trowel, should be used to make the holes two inches deep, and large enough to admit the root to rest evenly on the soil, avoiding much pressure, as the limbs of the tubers are often slenderly attached to the crown, and are easily broken off. Anemone tubers are formed of irregular fleshy bunches, having a number of small protuberances, called crowns. These crowns are distinguishable as tufted apices, or obtuse points, often a shade darker than the surrounding skin. They are frequently found in clusters near the centre, and sometimes singly, at the extremities of the projecting limbs. They are easily recognised by the practised eye; but as amateurs have been frequently known to place them upside down, some attention to this matter is needful. The base, or lower part of the tuber, is known by the remaining fragments of the fibrous roots of the former year—unless, indeed, they have been very carefully cleaned away. The direction to plant the roots *right side upwards* seems very trite, but it is not in this case altogether superfluous.

Supposing the tubers have been planted in October, it is a good plan to place over the bed during winter a layer of about two inches depth of decaying leaves, which will protect them from frost; but as the foliage comes through the ground some alteration should be given, to enable the rising leaves to come through it. The leaves and foliage come through the ground in a folded form. It is a good plan to watch for their appearance, and then, by loosening the soil, enable them to come up through it without sustaining injury. When the flower-buds appear they may be thinned out if fine flowers are wanted. Water must be applied to the bed in dry weather; a thorough soaking twice a week in the cool of the evening is better than frequent surface sprinklings.

It sometimes happens that the Anemone will make a second growth after the foliage of the first growth has died away. Thus it was that the old florists used to cover their beds after flowering to prevent rain getting to the roots, and so encouraging this second growth. Their aim was to thoroughly mature the tubers; and dryness is a preventive of second growth. When the foliage is quite withered and dry, the tubers should be carefully lifted, and if the soil does not readily fall away from the roots, it is well to leave them a week or so before the final cleansing. The tubers should be kept in a dry room, and occasionally looked over to prevent any harm from mildew.

The tubers of the Anemone admit of division, and in this way particular varieties can be increased. Generally the place of division is clearly indicated, but not always so. The division of a single tuber into two parts is as much as should be attempted, or they will be materially weakened.

The Anemone seeds very freely indeed. The seeds are of a woolly and clinging character, so it is a good plan to put them into a vessel with some sharp white sand, and rub both together until they are well mingled, and then they can be sown. The seeds can be sown in the open ground, and a bed should be prepared of a nice yellow loam, with some leaf-mould and road-grit. The seed should be sown thinly, and covered lightly with the compost. The bed must be kept free from weeds. Water is necessary in times of drought, and when the young plants, which will appear in about a month, are large enough, a slight top-dressing of rich soil will greatly help them. If encouraged in this way the plants will grow until November, and many will flower the following April. The best varieties can be lifted out, and placed in a bed by themselves. From April to the end of May is a good time to sow.

The Ranunculus.—This name is given to a somewhat large family of plants, four species of which, at least, were mentioned by Pliny. Why the name, signifying a young frog or tadpole, was given to the family is not apparent, for it does not appear satisfactory to have alleged as a reason that one of the species grew in marshy places. If any species would justify the name it is *R. aquatilis*, the Common Water Crowfeot, which grows thickly in many ditches and ponds; but this does not appear to have been noticed by the Romans. The Persian Ranunculus is the Ranunculus of the florist. It is said to be a native of the Levant, and the Turks cultivated it, under the name of *Tarobolos catamarlale*, for several ages before it was known in other parts of Europe. Their account of its introduction is somewhat traditional, and is to the effect that a virgin, named Cara Mustapha, first noticed among the herbage of the fields this hitherto neglected flower, and decorated the garden of the Seraglio with it. The flower attracted the notice of the Sultan, upon which he caused it to be brought from all parts of the East where varieties could be found. This collection of Ranunculus flowers was carefully preserved in the Seraglio gardens alone, and only through bribery did at last some few roots find their way into other parts of Europe. The Persian Ranunculus was imported into this country, and cultivated by Gerarde as early as the year 1596. It is not, unfortunately, so largely grown as it was a few years ago, for it is deservedly esteemed for the symmetry of its double blossoms, the brilliancy of its colours, and the great variety it displays. In a well-selected bed, such as we saw at Manchester a few years ago, could be seen scarlet, purple, crimson of every shade, yellow, white, and dark, with others which are denominated selfs, and bi-coloured sorts, with white, yellow, buff, or crimson grounds, beautifully edged, spotted, mottled, shaded, or striped in infinite variety. The sight of a well-cultivated collection in full bloom presents to view a charming open-air scene, and well calculated to fill the spectator with admiration and delight. Unhappily many of the fine varieties of twenty years ago have become hopelessly lost, though fanciers of this flower yet keep up select collections in different parts of the country. They are also largely grown in France and Germany.

There are two distinct sections of the Ranunculus of the florist. One is known as the "Turban," which is quite distinct, and confined to a very few varieties. The Scarlet Turban is much grown round London for cutting and bunching for market flowers, these large, full, handsome double flowers being much appreciated. The other varieties of the Turban are the Black, Citron, Crimson, Golden, Spotted, White, and Yellow; but it is possible these are resolvable into about five distinct varieties. These have coarser and broader leaves than the Persian varieties, the petals of the flowers are coarser, and the plants are of a hardier character. The other type is the Persian, of which the English and Scotch Ranunculuses are improvements and additions. Many of these are not so double as their originals, and, hence, many are seed-bearers.

The foundation of all good culture is the adaptation of the compost or soil to the natural habits of the plant. Experience teaches that the Ranunculus delights in a rich, soft, brown loam. If, therefore, the natural soil of the garden in which it is intended to plant the flower be unfavourable, the top spit of a pasture of rather heavy and tenacious loam, but not clayey quality—say one that will grow Buttercups—has been found to suit the Asiatic species. To this maiden soil it is necessary to add some fertilising agents. Decayed stable and cow-dung, in equal quantities, constituting about one-third, added to two-thirds of loam, will, when mixed and thoroughly incorporated, form a compost for the main depth of the bed, reserving a portion of the loam sufficient to make a top layer of soil two inches deep, to which a smaller portion of manure may be added. The old growers of the Ranunculus always condemned the practice of placing the tubers in contact with fresh manure, on the ground that it engenders disease in the roots and consequent injury to the plants.

The usual practice is to grow the flower in a bed in an open and exposed part of the garden, and pointing east and west. This is how one of the most successful growers of the past generation directed that the bed should be formed:—"Remove the earth fifteen inches deep, and from three feet to three feet four inches wide, and fill the bed with the prepared compost to within two inches of the surface, leave it thus a month, and then add the reserved top soil. These operations are best done in autumn, that time may be allowed for the earth to settle. Another method, where the subsoil is light and very porous, may be adopted. Excavate the bed fifteen inches deep, lay in the bottom three inches of mingled manure and loam, and then saturate it with manure-water; cow-dung, well stirred in water, will answer the purpose. Next add three inches more of compost, and saturate that layer; proceed to add two more similar layers, making a foot deep in the whole, and after a week's settling, add three inches of good healthy pulverised loam, with but little manure, in which to plant the tubers." The rule was to make the surface of the bed level, and not more than an inch or two higher than the paths, in order that the roots might be kept cool and moist; and as the Ranunculus thrives on a firm bottom, the compost should not be disturbed at the time of planting more than is just needful for the operation. During the winter the surface will be benefited by being pointed up rough with a fork, to be pulverised by frosts; but this should not be done more than two inches deep. It is well to margin the beds with shallow boards, to keep the soil from washing down into the paths. As a bed well constructed at the commencement will admit of several successive plantings, with an annual addition of fertilising materials, it is worthy of the particular care of the cultivater, though the preparation at first may involve some little trouble and expense.

The best season for general planting is the last fortnight in February. The plants have not then to contend with what is sometimes detrimental to their well-being—the severities of the winter. In some favourable seasons, such for instance as the winter of 1884–85, the roots may be planted with advantage in October; they will have more time to vegetate and establish themselves, will make stronger plants, will bloom more vigorously, and about a fortnight earlier than if planted in spring. But a certain amount of hazard always attends autumn planting, and the dried roots will keep well and plump if wintered in a cool, dry place.

One of the best Ranunculus growers of the day thus sets forth the method of planting:—"In fine weather towards the end of February rake your beds perfectly level, and divide them into six longitudinal lines for mixed roots, allowing four inches from the outside row to the edge; or, for narrow sorts, mark your rows transversely at distances of five inches asunder, and plant six roots in a transverse row. Then with a small hoe draw drills one and a half inches deep, and plant the roots with the claws downwards, with pressure sufficient to secure them firmly in the soil, so as to be one and a half inches from the crowns to the surface, in order to secure a firm site for the tubers. Some growers do not draw drills, but after raking the soil loosely they press the tuber with the thumb and finger into the soil to the required depth, and rake on them the surrounding soil. But this can be done only in favourable weather, and when the soil is light and friable, and with attention not to break the claws of the tubers. When planting on a small scale, a dibble, with a shoulder at the precise depth, may be used, but in the case of larger quantities it is an inconvenient method, and planting at the bottom of a drill with moderate pressure, and without disturbing the subsoil, is attended with similar advantages to the use of the dibble, and in practice will be found to have some points of preference. If the top soil is light after planting, it may be gently beaten with the back of the spade. This operation, however, must be only done in dry weather, and may be repeated just before the plants come up."

The plants make their appearance above the soil a month or five weeks after planting, and when fairly through the earth, it is a good plan on a fine drying day to gently press the soil about them, as it becomes loosened by frost, the action of worms, &c. It is customary to gently tread down the soil between the rows, and, after this is done, a top-dressing is placed on the surface. This consists of rich compost, principally of decomposed manure. It acts as a protection to the young plants from cold, drying winds, and also as a source of nourishment to the roots, carried down by the agency of rain. As late frosts will sometimes injure the plants, and more particularly cold cutting winds in April and May, a few sprays of Laurel, or some evergreen Fir, can be stuck into the ground on the exposed sides of the plants, and these will be found a great protection. Genial showers in April and May are very helpful to the plants. The Ranunculus flourishes best in a moist soil, and if May be a dry month, water is necessary, which should be given just as the buds are appearing. This is a critical time, and from lack of moisture we have known plants fail to bloom after they have thrown up their flower-stems.

Water from a pond or brook is better than from a well, or, failing this, water that has been for a few hours exposed to the sun. It should be applied morning and evening, according to the temperature, between the rows, from a watering-pot with a long spout, and not over the foliage, except in cloudy and showery weather.

To have seed of good varieties it should be saved only from flowers of the best quality as to shape and colour of marking. Should there be some semi-double flowers possessing good qualities, the pollen from these might be used for the purpose of impregnation. The most approved method of fertilising is by gathering the semi-double flowers, and applying the pollen by lightly beating it on the pericarp of the flowers to be fertilised; but if semi-double flowers are scarce or valuable, then the application of pollen may be made in the usual way with a large camel's-hair pencil. The operation should be repeated for several days in fine sunny weather, when the plants are uncovered, shade being inimical to fertilisation. The stems having seed-vessels should be supported with sticks to prevent the stalks from breaking down, which would deprive the seed of the necessary nutriment. The seed should be gathered when it turns brown, and kept loose in a drawer in a dry place. The drawer should be left open to admit air, as the seed-pods are liable to mildew for some time after gathering. Ranunculus-seed, if well saved, will retain its vitality two years.

The best time to sow seed is October or February. It should be separated from the stalks, and, when detached, will have an appearance resembling bran, and in the centre of those seeds possessing the vital principle a small brown speck is observable. A free, light soil is necessary, and the seed must be sown in boxes or pots, on a level surface, about an eighth of an inch apart, watered through a very fine-rose watering-pot, and covered with a sprinkling of fine dry mould thrown over them, only just sufficient to cover the seeds. It is necessary to keep the soil moist by gentle waterings with soft water, and the best place in which to put the seed-boxes is a cold frame, where they can rest on a thick layer of ashes. The seeds will come up in about a month, and then care is necessary to prevent slugs and other insects from destroying them, and also to keep drying winds from playing upon them. If a growth of green spreads over the surface of the soil, it should be removed, and a little fresh soil added. About the second week in May the boxes may be plunged up to the edge in the open ground, where the plants can have only the morning sun. At the commencement of July the foliage will begin to turn yellow, water must then be given sparingly, and the roots suffered to go to a state of rest; the roots should then be taken from the seed-boxes, and stored away in dry sand. The next season they can be planted in the usual way; but as some of the roots will be very small, and have one or two claws, it is wise, as a precautionary measure, to plant these in boxes of fine soil in October, about an inch apart, and keep them growing through the winter in a green-house or cold frame, protected by mats in very cold weather.

In the case of a wet season the roots may be lifted as soon as the foliage turns yellow; but if the weather be dry they may remain in the ground until it turns brown. The Ranunculus is apt to vegetate again immediately after it is brought to a state of rest; care is, therefore, required when the weather is moist at this season to select and take up the roots as they ripen, and not to wait until the whole are fit. Some varieties are especially prone to vegetate immediately. Such should be lifted with soil attaching, potted in dry earth, and kept in a cool room until matured.

We have already described the process of raising seedlings. There is a method of increasing any particular fine variety, by a division of the roots. Unlike the Tulip and other bulbs, the root of the Ranunculus usually attains maturity in one season, and it may be divided into two or more perfect tubers, fit for planting at the ordinary time as directed.

So many of the fine named varieties have become lost, that were we to give a list of what we know to be good flowers, scarcely one of these might be obtainable. Our advice to a young beginner would be to obtain some roots of Persian or Scotch Ranunculus in fine mixture, grow them as directed, and then by saving seed, according to the rules we have laid down, endeavour to improve the strain under cultivation. We are never weary of pointing out the great and peculiar pleasure that accompanies the raising and blooming of seedling plants.

THE HARDY FRUIT GARDEN.

BY D. T. FISH, ASSISTED BY WILLIAM CARMICHAEL.

VARIETIES OF THE APPLE.

THESE are so numerous that the difficulties and dangers of selection are very great. So long ago as the days of the Commonwealth there were said to be five hundred varieties in this country. Now, including synonyms, there are probably fully five thousand. Some of our nurserymen grow from a thousand to fifteen hundred named varieties. Hence the difficulty of picking out, say, fifty or a hundred of the best, especially as tastes so widely vary that it may almost be said that what is one man's favourite Apple is another man's aversion.

And then qualities vary almost as the tastes of their eaters, and the sizes, colours, and forms of the Apples. Yet there are a few Apples of such exceptional excellence as almost to have established their claim to universal esteem. For example, at the latest great show of Apples, out of eighteen dishes shown for flavour, six were Cox's Orange Pippin, five Ribston Pippin, and two Margil, leaving five dishes to be made up from all other sorts. On the same occasion the first and second prizea were awarded to Cox's Orange Pippin, and the third to Ribston Pippin.

It is, however, quite a mistake to grow too many varieties. Site and local climate powerfully affect the Apple, and it is but seldom that more than fifty, or at most a hundred, will thrive almost equally well in any given locality, unless in such favourable counties as Kent, the home of the Apple and other hardy fruit. It is also, as a rule, far more profitable to grow a dozen, score, hundred, or thousand trees of one variety than one or more each of a hundred or a thousand sorts. Should our lists prove too long, it would puzzle many readers to make a judicious selection from them. Were they too short, not a few might miss favourite sorts, or fail to obtain a sufficiency of variety. Hence we will endeavour to hit the happy mean, and also the desire for novelty and keeping abreast of the times, by first of all naming some of the newer sorts worthy to rank among the best, and some old ones of the highest merit that may have been re-named, or are less known than they deserve to be.

New Varieties.—The Fruit Committee of the Royal Horticultural Society of London has done good service in limiting the number of new Apples by refusing to certificate any that are not better than or different from old ones. So strictly is this rule enforced in reference to Apples, that only three were certificated in the three years preceding 1880, and, so far as the writer knows, not more than one a year since.

The very latest addition to our list is the Sandringham, a large, handsome fruit, of new shape, for culinary purposes, and of that pale green colour that mostly denotes high quality in Apples. This fine Apple was certificated at the Apple Congress last year, and received the highest credentials of merit at the great fruit show at the Crystal Palace, October 9th, 1884.

NEW VARIETIES.

Mr. Gladstone—an excellent early dessert fruit; ripe in August; red and crimson; highly flavoured; flesh tender, juicy, and sweet. Though Mr. Gladstone is not exactly new, it is seldom met with, and is a very welcome addition to the early very high-coloured dessert varieties, the flesh being tender and specially high-flavoured.

The Schoolmaster is another fine Apple, almost equally useful for dessert and cooking. It is large and conical in form, with a russety olive-green colour, and is in season from October to January.

Worcester Pearmain—this is one of the highest-coloured and most beautiful of all Apples, almost the whole skin being covered with dark crimson. It is of medium size, conical, a good bearer, and the tree of free growth; a beautiful dessert fruit; in season from August to the end of October; flesh juicy, crisp, and tender, of sparkling flavour.

Bramley's Seedling—a large mid-season and winter culinary Apple of great merit, raised near Nottingham.

Werder's Golden Reinette—this is probably one of the most delicately tinted and highest flavoured Apples in cultivation. It is somewhat of the type of the Blenheim Pippin, and one of the most rich and valuable dessert fruits, remaining in season from October to February.

Beauty of Hants — this seems so distinct and superior to Blenheim Orange—and that is saying a great deal—as to have received a separate name.

Mrs. Barron — a superior strain of the fine Apple, Yellow Bellefleur, one of the largest and handsomest Apples in cultivation; in season from October to February. This fine Apple is named in compliment after Mrs. Barron, of the Royal Horticultural Society's Gardens, Chiswick.

The Herefordshire Beaufin adds a higher-coloured and, it is said, better variety to a limited family, that furnishes the finest of all Apples for preserving whole.

Queen—October, November. A very showy culinary Apple, bearing a striking resemblance to Cox's Pomona, which is also one of the best Apples in cultivation; clear yellow, almost covered with bright crimson; flesh white, tender, and juicy.

Dr. Hogg — November to February. Good culinary, and excellent for dessert; rich golden, striped with crimson; flesh white, juicy, tender, and sweet.

Lady Henniker—October to February. A very large culinary Apple, but also useful for dessert; yellow on the shaded side, covered with broken streaks of crimson; flesh fine in texture, perfumed, with a good flavour.

Lord Burghley—December to May. Medium-sized; very showy; green, changing to yellow, red, and crimson on the sunny side, with a distinct Pine-apple flavour, and yellow flesh; juicy and tender; an excellent dessert Apple.

Lane's Prince Albert, as well as several of the foregoing, has had the honour of being figured in the *Florist and Pomologist* of 1884. It is said to be a cross between the Russet Nonpareil and Dumelow's Seedling, one of the best kitchen Apples, and hence is almost equally good for dessert or culinary use, from October to April. It is one of the most prolific Apples known, as well as extremely beautiful. The skin is bright green, and changes by keeping to a pale yellow, streaked with crimson of several shades on the sunny side.

Peasgood's Nonsuch — November to January. An excellent dessert fruit; greenish-yellow, covered with red, with darker crimson streaks; flesh crisp, sweet, with a delicate perfumed flavour. This has also proved a formidable rival to the French Paradise as a free-rooting, dwarfing stock.

St. Edmund's Pippin—October to December. An excellent dessert Apple; greenish-brown, resembling the Golden Russet, but distinct; flesh bright, aromatic, tender, and juicy.

Annie Elizabeth—will keep a year or more; large; pale yellow streaked with crimson; culinary and dessert; flesh white, crisp, and tender; sparkling flavour.

To these may be added Tyler's Shernel, Prince Bismarck, September Beauty, Beauty of Bath, and Gasgoigne's Scarlet.

Several revivals of old, or actually new, varieties are being introduced by two of the leading horticultural periodicals of the day—the *Florist and Pomologist*, and the *Gardeners' Chronicle*:—

Calville Rouge Præcox—a very showy Apple, in season in October and November, and useful for dessert or culinary purposes, and worth growing for its beauty alone; decidedly the finest of the brilliant Calville coloured series, which are generally useless unless for ornament.

Jacob's Strawberry Apple, re-christened Lady Sudeley, in honour of one of our largest Apple growers, and also to distinguish it from other Strawberry Apples, of which there are several. This is one of the best and most showy of early dessert Apples, lasting from the end of July to September. It is so beautifully streaked with crimson on the sunny side, and of such a full size, as to render it a favourite for exhibition.

Old Varieties.—From these examples of meritorious novelty we turn to a few of the older varieties which our forefathers enjoyed, and which excited the interest and fired the enthusiasm of the poets and philosophers of the olden times. Should this brief research among the venerable Apples of the past bring about an Apple Renaissance, modern cultivators can lose little and may gain much thereby.

Alfriston—this is a great favourite in many parts of the country, and has at times been confounded with the Newtown Pippin, a high testimony to its merit. November to April. Very large; greenish-yellow, tinged with orange, and striped with russet; flesh yellowish-white, crisp, and tender; much relished by some for dessert, and one of the richest kitchen sorts.

Baldwin — November to March. One of the finest of the American Apples, not so good in England; very large; yellow and deep orange, striped with bright red; a rich, yellow-fleshed culinary Apple.

Catshead—October to January. One of the largest, oldest, and best of all kitchen Apples, of the Codlin type.

D'Arcy Spice, or Essex Spice—November to May or even June. Small; green, changing to yellow and orange when ripe; dull red on the sunny side; flesh greenish-white, crisp, juicy, sugary, flavour rich and vinous beyond that of almost any other Apple; should be universally cultivated. It is sometimes called Spring Ribston Pippin, but has no Ribston blood in it.

Duchess of Oldenburgh—May to September. Dessert and culinary; large; smooth; greenish-yellow, flaked with bright red, glowing into crimson; flesh white, crisp, and brisk.

Leathercoat—November to March. A capital dessert Apple, several hundred years old, much like a Russet, but different; nearly covered with dark russet, with portions green; high-flavoured; brisk, juicy, and sweet; fruit small.

Lemon Pippin—October to April. This is another fine old sort, all too seldom grown. Medium-sized; pale yellow, tinged with green, changing to lemon as it ripens; flesh firm, crisp, and briskly flavoured; dessert or culinary.

Paradise (French Paradise)—August to October. This has become so popular as a stock that the Apple is seldom seen. It is, however, a good Apple, almost as suitable for dessert as for cooking.

Paradise, White, or Lady's Finger, is a great favourite in Scotland, though it seldom keeps in season more than six weeks—through September and part of October; smooth rich yellow, spotted and freckled deeply with diverse colours on the sunny side; flesh crisp, juicy, and sugary.

Margaret—early, red on one side, striped colour permeating. This is one of the oldest and earliest of English dessert Apples, ripening at the end of July; greenish-yellow, bright red next the sun, and striped all over with red; flesh greenish-white, vinous, brisk, and juicy; a wonderful favourite with children and aged people.

Ravelston Pippin—August. An old dessert Apple of great merit, much grown in the North; greenish-yellow, almost covered with red streaks and russety spots; flesh yellow, sweet, richly flavoured—soon, however, mealy.

Striped Beefing — October and June. One of the oldest and best Apples in cultivation for baking whole and general culinary purposes; light green, broken with stripes and patches of deep red; flesh yellowish, crisp, and slightly acid. This fine sort was rescued from comparative oblivion some forty years ago, and is now becoming common.

Tom Putt—November. One of the showiest of culinary Apples, and had the honour of a coloured plate in the *Florist* of the current year. Brilliant crimson nearly all over; the flesh, which is yellowish, being stained with red to a considerable depth.

Red Ingestre—October. A small dessert fruit of first-rate quality; golden-yellow, crimson and orange on the sunny side; excellent flavour, juicy and brisk.

Yellow Ingestre—September, October. Much like the Golden Pippin; clear yellow, spotted with pink; highly flavoured, crisp, brisk, and delicate.

Red Streak—no list of the older Apples would be complete without a notice of this Apple, although doubtless the general name included a good many more than one variety. It was, and is, one of the most beautiful Apples to be found, streaked so liberally with red that the colour only differs in the depth of its brilliant tones. It has a rough flavour, and its yellow flesh is firm and crisp; though, with our choice selection of Apples ancient and modern, few would be prepared to sing its praises thus—

"Let every tree in every garden own
The Red Streak as supreme."

The Winter Quoining, or Queening — November to May. This is one of the oldest of English Apples, and is equally useful for table or kitchen. Pale green, almost wholly covered with red; flesh delicately perfumed, tender, soft, and sugary.

Keswick Codlin—August to October. Hardly ever fails of a crop, and is one of the best kitchen varieties.

Dutch Mignonne — this is one of the most delicious of dessert Apples; in season from December to April, or even later; fruit large, yellowish, streaked nearly all over with crimson and russet; flesh crisp, juicy, aromatic, sweet, and pleasant.

Fearn's Pippin — a well-known, much-appreciated Apple in London and other large towns, equally useful for dessert and culinary purposes: dull green and red on the shady side; bright crimson and russety dots on sunny side; flesh white, crisp, brisk, and sweet. November to February.

Doctor Harvey—this is one of the oldest and best of all English Apples, and has been continuously cultivated for over 250 years. It is in season from October to February as one of the finest cooking and a much-relished dessert Apple. Large, greenish-yellow, becoming quite yellow when ripe; something like Cox's Orange Pippin; flesh white, juicy, sparkling, and perfumed.

Mère de Ménage—one of the largest and most beautiful kitchen Apples; in season from October to January; skin red; flesh firm, crisp, and juicy.

Ledington—this is a very large, pale crimson Apple, with russety dots, that comes into season from September to December. It is largely grown in Kent, and often shown about London as Stone's Apple. The tree is one of the most fertile, and hardly any Apple is more popular in the London markets; the flesh being firm, close, tender, and sub-acid.

Special Qualities.—Several other Apples deserve notice for some special quality; space will only permit us to note the following:—

Winter Greening, or *French Crab*.—This is a first-rate culinary Apple, of rather sharp flavour, that may be kept sound for two years. The writer has frequently kept it for that period alike in sand and on the open shelf.

Lady's Delight.—October to January. Culinary and dessert; the fruit splashed, lined, or painted with a unique disposition of yellow, green, and red; flesh aromatic, white, juicy, tender, and sweet; and the habit of tree drooping as a Weeping Willow.

The Fairy.—This is a seedling of the Siberian Crab or Cherry Apple. It fruits in clusters of from three to six, about double the size of the Siberian Crab; bright crimson on a lemon ground; flesh yellow, with a rich aroma, crisp, juicy, brisk, and slightly acid.

Bedfordshire Twin.—This is worth growing for the peculiarity that nearly all the fruit are produced in pairs; December to April; yellow, dotted with russet, streaked with red; fair-flavoured, a little acid.

Pomme d'Api, or *Lady Apple*.—October to April. Small; yellowish-green, changing to yellow, and brilliant red on the sunny side; tender, sweet, juicy, and perfumed. This, as well as the Fairy, should be eaten with the skin, as the latter is more richly perfumed than the flesh. It does well as a cordon near the ground or on walls, and immense quantities of the Lady Apples are annually imported from the Continent and America, and temptingly displayed in boxes done up in different-coloured tissue-paper, that almost equal—they can hardly rival—in brilliancy this, the smallest of all cultivated Apples. There are several varieties of the Lady Apple, but none equal to the Common, or Red, Api Rouge of the French. This is not only one of the smallest, but possibly also the oldest of all our cultivated Apples, there being good grounds for assuming that the Lady Apple may be the Appiana of Pliny.

Harvey's Wiltshire Defiance.—October to January. Excellent for dessert and culinary purposes, and worth growing for ornament. A five-sided Apple of great distinctness and beauty; sulphur-yellow, thickly dotted with russety dots, splashes, and spots; flesh yellow, vinous, and highly flavoured. Five ridges or angles proceed from the eye, right round the Apple, until they are lost in the base, which gives it a striking appearance.

Dessert and Kitchen Apples.—But space warns us to proceed from novelty, antiquity, and curiosity to utility; and hence we hasten to submit two dozen each of dessert and kitchen Apples, selected and proved by Mr. Carmichael, one of the best growers of fruit in the kingdom.

Select List of Dessert Apples.

American Mother — fruit medium size; skin golden-yellow; sweet and juicy and richly flavoured. October.

Boston Russet — fruit medium size, with the flavour of the Ribston Pippin; a fine dessert variety and good keeper. March.

Browolee's Russet — fruit above medium size, juicy, sweet, and highly flavoured; an excellent late variety. January to May.

Claygate Pearmain — fruit medium size; richly flavoured; an excellent variety; the tree bears freely. November to March.

Cobham — fruit large and handsome, with a rich and excellent flavour. September to January.

Cockle's Pippin—fruit medium size and richly flavoured, and highly aromatic. In use January to April.

Cornish Gilliflower — fruit above medium size, juicy, sugary, and highly aromatic; one of the best dessert varieties; the tree is not a strong grower, but bears freely on the points of the shoots. November to March.

Court Pendu Plat — fruit medium size, handsome, and excellent; and an abundant bearer and good keeper. December to May.

Cox's Orange Pippin — medium size, very handsome, and richly flavoured; one of the finest dessert, and a great bearer. November to February.

Jefferson — medium size; handsome; flesh tender and richly flavoured; a fine October sort.

Kerry Pippin — below medium size; a first-rate early sort; the tree forms a good pyramid, and great bearer. In season September and October.

King of the Pippins—medium size; very handsome; a valuable sort and a great bearer. In use October to January.

Lord Burghley. (See New Varieties.)

Mannington's Pearmain—medium size; juicy, sweet, and highly flavoured; one of the best late sorts. November to March.

Newtown Pippin — above medium size; an American kind of great excellence, but requires a wall or warm situation. In use January to May.

Reinette du Canada—above medium size; handsome and excellent; a valuable sort, suitable for kitchen or dessert. In use November to April.

Ribston Pippin — medium size; a well-known and much-valued kind. It ought to have the protection of a wall to bring it to perfection. In use October to March.

Rosemary Russet—medium size; juicy, rich, and highly aromatic flavour. In use from December to February.

Scarlet Nonpareil — below medium size; handsome and well flavoured; the tree forms a fine pyramid, and is also an abundant bearer. In use January to March.

Sturmer Pippin — medium size; this is a very valuable late-keeping kind and richly flavoured. In use from February to June.

Washington — fruit large, very handsome, rich, aromatic, and melting. In use September and October.

Welford Park Nonsuch — fruit medium size, handsome, and richly flavoured; the tree forms a fine pyramid, and bears freely. November.

White Calville—fruit large, very uneven in form; flesh white and delicate; a valuable dessert and sauce kind; the tree is tender and requires a wall. January to March.

Worcester Pearmain—(already described).

Select List of Kitchen Apples.

Alfriston—fruit very large; flesh white and briskly acid; the tree is a good bearer and forms a handsome pyramid. In use November to March.

Annie Elizabeth—fruit large and firm; flesh white; an excellent late kind, and bears abundantly. In use till June.

Baumann's Red Reinette—fruit very large and handsome; bright crimson on exposed side; flesh firm and slightly acid; a good keeper, and bears abundantly.

Betty Geeson—fruit large; the tree is a great bearer, and ought to be planted extensively. In use November to April.

Blenheim Pippin — fruit large and handsome; a very valuable and highly esteemed sort, but a shy bearer till the tree gets old; one of the best for kitchen or dessert. November to February.

Cellini—fruit medium size; beautifully coloured and handsomely shaped; it bears abundantly; a good culinary and dessert sort. October and November.

Cox's Pomona—fruit large; the tree forms a good pyramid, and is a great and constant bearer. November.

Dumelow's Seedling—fruit large, firm, and briskly acid; one of the best culinary kinds; the tree forms a handsome pyramid, and is a great bearer and good keeper. In use November to April.

Ecklinville Seedling — fruit large and handsome; the tree forms a good pyramid, and is a great bearer. In use during November.

Frogmore Prolific — fruit large and handsome; flesh white, juicy; tree vigorous, and a prodigious bearer; it ought to be grown extensively for profit, as it is a sure bearer. September to December.

Golden Noble—fruit large, exceedingly handsome in form; the tree is a good bearer. October and November.

Grenadier — fruit large; a beautiful yellow colour and ribbed; a very valuable sort; the fruit comes in immense clusters, and a great bearer; this is one of the best of the Codlins. In use from September to December.

Hambledon DeuxAns—fruit large; flesh white, firm, and well flavoured; it is also an excellent keeper. January to May.

Lady Henniker — (already described).

Lord Derby — fruit very large and good; the tree is a great bearer. In use November and December.

Lord Suffield—fruit large; flesh white, tender, and briskly flavoured; the tree is a great bearer, even in a young state; a valuable early sort. August.

Nelson Codlin—fruit large and handsome, of first-rate quality; the tree is a strong and vigorous grower and a good bearer. In use from September to January.

Peasgood's Nonsuch—fruit large and handsome; extra fine, and free-bearing. In use from September to November.

Prince Albert. (See New Varieties.)

The Queen (Saltmarsh's)—fruit large and handsome; flesh tender. In use during November.

Small's Admirable — fruit medium size; the tree forms a fine pyramid, and bears freely. November and December.

Stirling Castle — fruit medium size; a valuable early sort; the tree is a constant bearer—hardly ever fails in producing a crop. In use September and October.

Tower of Glammis — fruit large, firm, and briskly flavoured; the tree is an excellent bearer. November to February.

WinterHawthornden—fruit very large; a first-rate culinary variety, much superior to the old Hawthornden. December and January.

Supplementary List of Dessert Apples.

Adams' Pearmain — One of the finest of this fine class; pale lemon, red streaks next the sun; flesh richly perfumed, crisp, sugary, juicy. In season from December to March.

Ashmead's Kernel—an excellent dessert Apple. In season from November to May. Greenish-yellow, tanned brown on sunny side; small; richly flavoured.

Beachamwell's — December to March. Small; yellow and russet; flesh rich and sugary; yellowish-white.

Braddick's Nonpareil—one of the finest of this well-known class of Apples. In season from December to April. Green, brownish-red next the sun; highly aromatic, rich and sweet.

Calville's Blanche d'Hiver—January to May. Large; a delicate yellow, tinged with green; unevenly ribbed; flesh crisp, juicy, rich, and sweet; excellent for eating, and also admirable for cooking; needs no sugar for culinary purposes.

Coe's Golden Drop—this is an improvement on the old Golden Pippin, and is one of the most delicious of dessert Apples, coming in for use from November to February.

Cornish Aromatic—October to January. A first-rate dessert Apple; large; yellow and russet; red next sun; with, as its name implies, a crisp, aromatic flavour.

Devonshire Quarrenden—August. One of the finest and most beautiful of all early dessert Apples, and of such a deep crimson colour that it often penetrates into its flesh, which is crisp, sweet, and breaking with a flavour almost unique among Apples.

Duke of Devonshire—February to June—one of the latest and richest of Apples. Greenish-yellow, reddish on the sunny side, veined with russet; highly aromatic; yellow flesh, crisp, and slightly acid.

Early Harvest—July and August. Refreshing, crisp, juicy, and tender; a well-known popular favourite.

Early Nonpareil—September to January. Rich, juicy, tender; greenish-yellow, deep yellow when ripe; a most useful small Apple.

Golden Harvey, or Brandy Apple—December to May. Small; rough russet, occasionally reddish next the sun; sub-acid, rich, aromatic, firm; one of the best for stewing in sugar whole for dessert.

Golden Reinette—October to January. One of the richest and best; greenish-yellow; richly flavoured, sweet.

Golden Russet—December to March. A fine old variety; richly aromatic, crisp, and sugary; rather under medium size.

Lamb Abbey Pearmain—December to May. One of the longest-keeping and best; skin yellowish-orange, streaked with red next the sun; flesh yellowish-green, with that rich, juicy, sweet, and aromatic quality that nearly always distinguishes that coloured flesh.

Lodgemoor Nonparsil—January to May, or even June. Small; rich, sugary, highly aromatic.

Margil—November to March. Small, richly perfumed, highly flavoured; one of the finest of Apples.

Northern Spy—December to May. Large, handsome; yellow, streaked with crimson on the sunny side; richly aromatic, white, tender, and sweet; one of the best of the American Apples, which thrives well in Britain.

Old Nonpareil—January to May. Highly flavoured, crisp, juicy, and sweet.

Oslin—one of the best and most aromatic of summer Apples; a great bearer; ripe in August; green, changing to pale brown; flesh yellowish, firm, crisp.

Pearson's Plate—December to March. Small; roundish; greenish-yellow, red on the sunny side; flavour brisk, juicy, sugary.

Pine Golden Pippin—October to December. This is the richest flavoured of all the Golden Pippin strain; flesh yellowish, brisk, and highly perfumed.

Red Astrachan—August, September. Very prolific and showy; one of the best and most popular; almost wholly red; flesh white and rich-flavoured.

Sam Young—November to March. A delicious little Apple; bright yellow and russet, red next the sun; richly flavoured, juicy, and tender.

Scarlet Pearmain—September to January. Much like the Worcester Pearmain; bright crimson next the sun, with stripes of deeper crimson; flesh white, streaked slightly with pink, juicy, and crisp.

Summer Golden Pippin—August. A first-rate early Apple, with most of the qualities of the Golden Pippin.

Sykehouse's Russet—November to February. Small; richly flavoured.

Wyken Pippin—December to April. First-rate flavour; small; pale green, with orange on sunny side; flesh crisp, sweet, tender, and juicy.

Supplementary List of Kitchen Apples.

Alexander (Emperor)—September to December. Very large; greenish, bright red on sunny side; the flesh yellowish-white, juicy, aromatic.

Beauty of Kent—October to February. Very large; first-rate; greenish-yellow, rich red next the sun; crisp, tender, sweet, and juicy.

Bedfordshire Foundling—November to March. Large, roundish, ribbed; dark green, orange on sunny side; flesh yellowish, sub-acid.

Bess Pool—December to April. Excellent for either kitchen or dessert: large; yellow, red on side next the sun; rich, sugary, vinous, tender, and juicy.

Brabant Bellefleur—November to April. Excellent for culinary and table purposes; yellow, tinged with brownish-red next the sun; flesh juicy, rich, sub-acid.

Dutch Codlin—August, September. A capital early Apple.

Forge—October to February. Golden, with crimson on sunny side; yellowish-white flesh; tender, sweet, juicy, and richly perfumed; a very useful Apple.

Gloria Mundi—October to January. Very large; yellowish-green, slightly tinged with red; flesh pale, tender, and juicy.

Gravenstein—October to December. Large; straw-colour, red-streaked on sunny side; flesh pale yellow; aromatic; suitable either for table or dessert.

Hawthornden, New, or Winter—December to February. This fine large Apple supersedes the common Hawthornden, as it bears equally well, keeps better, and the fruit is larger; green flesh, specially tender and juicy, breaking.

Hoary Morning—October to December. This is one of the largest and best kitchen Apples; yellow, splashed with red stripes, covered with heavy bloom, giving the appearance of dew on the fruit; hence its name; flesh yellowish-white, sub-acid, brisk, rich, and juicy.

Jolly Beggar—August to October. Pale yellow, orange next the sun; flesh delicately white and well flavoured; very prolific.

Lewis's Incomparable—December to February. Kitchen or dessert; large, handsome; faint yellow and deep red; flesh yellowish, crisp, juicy, rich, and unique flavour.

London Pippin—October to January. Yellow; flesh yellowish white; very pleasant flavour; also called Five-crowned Pippin from the prominence of the five ridges round its sides.

Manks' Codlin—September to November. Very excellent kitchen Apple; pale yellow, with a faint blush of red next the sun; flesh yellowish-white, slightly perfumed; very compact, crisp, and firm.

Mère de Ménage—October to March. Red, with darker red overlaid; flesh firm, juicy, slightly acid; cooks well.

Norfolk Beaufin—November to July. Dull green, deep red next the sun; flesh greenish-white, crisp, juicy, sub-acid.

Norfolk Bearer—December to February. Green, yellowish-crimson on sunny side; flesh crisp, tender, with a sharp flavour.

Northern Greening—November to April. Green, brownish-red on sunny side; flesh greenish, sharp acid; a first-rate cooking Apple.

Omar Pasha—December to April. Yellow, dotted with russet; flesh white, crisp, sub-acid; very excellent.

Roundways' Magnum Bonum—December to April. Lemon, with patches of crimson; flesh richly aromatic, yellowish-white.

Round Winter Nonsuch—November to February. Green, with patching of deep red; flesh yellow, juicy, slightly acid.

Royal Russet—November to May. Yellowish-green, covered with russet; flesh greenish-white; richly aromatic; excellent for stewing in sugar as dessert.

Rymer—October to December. One of the finest cooking and sauce Apples; yellow, rose, and deep scarlet; flesh yellow, sub-acid, juicy.

Waltham Abbey Seedling—September to January. Large, handsome, and of first-rate quality; generally yellow; flesh yellow, sweet, tender, and richly flavoured; retaining its colour when cooked.

Warner's King—November to February. This is synonymous with D. T. Fish and several others; green, yellowish as it ripens; flesh crisp, tender, juicy.

Winter Majetin—January to May. Green, with brownish-red next the sun; flesh greenish-white, brisk, crisp, first-rate.

Apples for Ornamental Effect.—Few trees can excel the Apple in the graceful beauty of its habit, its profusion of delicate pink blossom, the form and colour of its fruits, nor the rich golden glow of its autumnal tints; and given such varieties as the following, as well as the Crabs and not a few of the cider varieties, with some of the highest-coloured varieties in the foregoing lists, such as the Worcester Pearmain, Red Streak, and Tom Putt, they are well worth growing for their beauty alone; and there are few ornamental trees or shrubs that can match them in shrubbery or pleasure-ground.

The Tulip Apple is only of second-rate quality as a dessert fruit; in season from November to April; but is worth growing for ornament alone. Its deep purple colour covers the entire fruit, unless where it is densely shaded, and it is an enormous bearer.

Malakorna, October to December, is a very showy striking variety, of a bright dense crimson colour, and is so productive as to make the tree glow with scarlet, the fruit being only second-rate, though pleasant.

The Red and White Astrachans are also highly ornamental; the former bright scarlet, the latter white as wax, and both bearing a bloom as thick as that of the Plum. The fruits ripen in August, should be eaten off the tree, and are not of the highest quality.

The Violet Apple, or *Violette*.—October to March. Culinary; yellow, striped with red; very dark red where exposed to the sun; the whole fruit being profusely covered with a dense blue-violet bloom, which renders it highly ornamental.

Mars Red.—A highly ornamental cider Apple, of a very bright red colour, richly streaked with crimson.

Chaxhall Red is another highly ornamental cider Apple, of a deep crimson colour, streaked with deeper lines; one of the best and most beautiful of cider Apples.

Cherry Norman.—This is something after the form of the Lady Apple, and is also a cider variety, though not bad eating; golden-yellow, with bright pink cheeks on the sunny side.

Foxley.—Grows in clusters of three; yellow; reddish-orange next the sun; excellent cider Apple.

The Crab Supreme is a larger Crab than the common Siberian, with a more upright habit.

Mr. Bigg's Everlasting is almost ever-fruiting and ever-green, the fruit and leaves both remaining on during mild winters to the next year.

There are many other of the cider Apples almost equally beautiful with the few named above, while all the Siberian and most other Crabs are highly ornamental in the shrubberies and home plantations. Not a few Apples, such as the New Hawthornden and the Lincolnshire Holland Pippin, are also distinguished by the abnormal size of their blossoms, while the blossoms of the Garland Crab (*Pyrus coronara*) are still larger, of the most delicate rose-colour, and perfumed with violet odour. The leaves of not a few Apples, and most of the Crabs, are distinguished by the richness of their autumnal hues, while the Golden-leaved Crab is one of the most ornamental of variegated trees.

Cider Apples.—Though cider-growing pertains more to agriculture than gardening, our list of Apples would hardly be complete unless a few cider ones were included. This is the more needful, as there seem no insuperable obstacles to prevent every amateur or cottager from making his own cider, if so disposed. Though a certain percentage of semi-acid, harsh, or austere fruit may be needful to give briskness to cider, yet it is quite a mistake to assume that cider can only be made from these. Almost any Apples can be converted into cider, and not a few of the makers throw the whole of their varieties into a heap to mellow or slightly ferment, quite irrespective of times of ripening, or varying percentages of sugar or verjuice. They are then crushed or put through a mill, the juice pressed out and placed in casks either for fermentation or being kept sweet, as the grower or consumer may prefer. But it will probably surprise a good many readers to learn that such popular fruit for dessert as the following are almost equally popular for the making of good cider:—Cockle Pippin, Redstreak, Devonshire Quarrenden, Downton Pippin, Forge, Golden Pippin, Golden Harvey, Early Harvest, Crimson Queening, and one or more Pearmains and Reinettes. Morris's Apple and Tom Putt, both much used for cider, are also good eating varieties.

The following dozen may be relied on either for mixing with the sweeter sorts already named, or for making good cider, though more acid, without such saccharine additions:—Bittersweet, Coccagee, Clubbles Wilding, Dymock Red, Foxwhelp, Hangdown, Jersey Chisel, or Royal Jersey, Red Cluster, Slack my Girdle, Siberian Bittersweet, Tanner's Red, White Styre.

Nothing could be easier than to add three or four dozen or scores to these lists; but these, with the sweet sorts that may be used for cider, will suffice for general readers.

Apples for Seasons.—With the object, however, of rendering our general lists more useful to the uninitiated, we purpose making selections from our selections for different seasons of the year; different-sized gardens, as cottagers' or amateurs'; various trees of different sizes and shapes, as cordons, bushes, pyramids, espaliers, and walls; and for different climates. By such means it is hoped that every one may the more readily find what they want with a minimum of trouble, and those with moderate-sized gardens be provided with the pleasing and cheap luxury of Apples all the year round.

DESSERT APPLES.

From *July to September:* Early Harvest, Margaret, Mr. Gladstone, Kerry Pippin, Devonshire Quarrenden, Summer Golden Pippin, Red Astrachan, and Worcester Pearmain.

September to December: King of the Pippins, Scarlet Crofton, Mother Apple, Golden Reinette, Wormsley Pippin, Cox's Orange Pippin, Collins' Early Nonpareil, Scarlet Pearmain, Paradise Pippin, Ribston Pippin, Cox's Golden Drop, and Red and Yellow Ingestre.

December to March: Margil, Adams', Mannington, and Claygate Pearmains, Beachamwell, Scarlet, Braddick's, and Pitmaston Nonpareils, Golden Pippin, Golden Aromatic, Harvey's Wiltshire Defiance, Margil, Sykehouse's Russet, Cobham, Ashmead's Kernel, Ribston Pearmain, and Sam Young.

March to June: Newtown Pippin, D'Arcy's Spice, St. Edmund's Pippin, Aromatic Russet, Sykehouse's Russet, Boston Russet, Cornish Gilliflower, Cockle Pippin, Wyken Pippin, Melon Apple, Lamb Abbey Pearmain, Lord Burghley, Duke of Devonshire, Northern Spy, Sturmer Pippin, Calville Blanche d'Hiver, Reinette du Canada, and Old Nonpareil.

Several of these will keep sound till the end of June, and may even considerably overlap the earliest summer Apples, such as the Early Harvest, Margarets, or Juneatings, that mostly ripen early in July.

KITCHEN APPLES.

Though there are no culinary Apples that ripen till August, yet there is no difficulty in having a supply all the year round, for there are several varieties that will keep sound for more than a year, and one—the French Crab, or Northern Greening—that will keep for two years. At the end of a year this Apple is quite as good, or even better, for culinary purposes than on the day it was gathered. The Norfolk Beaufin will also keep well for twelve months, and the newest Apple, Annie Elizabeth, promises to keep still longer. As several kitchen Apples are fit for use at the end of July or August, there is therefore little difficulty in keeping up a constant supply.

August to November: Keswick Codlin, Dutch Codlin, Duchess of Oldenburgh, Lord Suffield, Emperor Alexander, Frogmore Prolific, and Golden Noble.

November to March: Warner's King, Cellini, Cox's Pomona, Gloria Mundi, Waltham Abbey Seedling, Stirling Castle, Lord Derby, Forge, Flower of Kent, Queen, Lane's Prince Albert, Kentish Fillbasket, and Small's Admirable.

March to August or later: Blenheim Orange, Alfriston, Bess Pool, London Pippin, Betsy Geeson, Hambledon Deux Ans, Dumelow's Seedling, Mère de Ménage, Tower of Glammis, Lewis's Incomparable, Reinette du Canada, Norfolk Beaufin, Annie Elizabeth, and Northern Greening.

Apples for Cottagers and Amateurs.—It is hardly kind to those who want a couple, half a dozen, or dozen of Apples only, to set before them a list of a hundred or more varieties; hence our selection of two, six, a dozen for those of the most limited space or means. The best two Apples for the cottager are Cox's Orange Pippin and Cellini. Either are good for eating, and almost better still for cooking, yielding a maximum amount of quality in puddings, pies, or simply stewed, with a minimum of sugar. They are also so fine and handsome as always to command a free sale at the highest prices. Add to these the Claygate Pearmain for eating, and Cox's Pomona or Warner's King for kitchen use.

Mechanics and amateurs who may have room for six or more, may either plant two each of the foregoing or add Lord Suffield, Frogmore Prolific, and Waltham Abbey Seedling to their culinary varieties; and Ribston Pippin, Scarlet Nonpareil, and Cockle Pippin to their dessert sorts. In districts in which the Ribston is prone to canker, the Boston Russet may be substituted for it.

In cool localities the better position for the Ribston Pippin and such fine sorts as the Scarlet Nonpareil, Golden Russet, Sturmer Pippin, Pearson's Plate, Cornish Gilliflower, Court of Wick, Golden Pippin, Golden Reinette, Adams' Pearmain, Braddick's Nonpareil, Margil, &c., is on the walls of the cottage, dwelling-house, or outbuildings.

Those who require more than a dozen or so of varieties are referred to our lists, from which it is impossible for them to draw blanks, dip into them where they may.

Several of the finest dessert Apples likewise prove the very best for culinary purposes, while only a very few Apples are fit for stewing whole to form an exquisite sweet for the dessert, such as Golden Harvey, Golden Pippin, and a few of the harder and smaller Nonpareils. In using such dessert Apples as the following for cooking, no sugar should be added to them. Should any be needed, it must be added to taste in eating—the best way of using sugar for all Apples.

Dessert Apples for Culinary Purposes.—Claygate, and most other varieties of Pearmain, Cox's Orange Pippin, Ribston Pippin, King of the Pippins, Golden Russet, Boston Russet, Reinette du Canada, Court Pendu Plat, Harvey's Wiltshire

Defiance, Lemon Pippin, Newtown Pippin, Northern Spy, Welford Park Nonsuch, Calville Blanche d'Hiver, Washington, Sturmer Pippin, &c.

Apples for Trees of Different Shapes.—The idea of selecting varieties for moulding into different forms and sizes is comparatively novel, and is likely to be carried further and to greater perfection in the future. Still it may prove helpful to our readers to select some of the best sorts for moulding into cordons, pyramids, and bushes, for the clothing of espaliers or walls, or conversion into orchard trees. To make the matter more clear we refer the reader back to our illustrations of each of these forms of Apple-trees.

Cordons.

These are at once the smallest and the simplest of all Apple-trees, and yet they admit of great variety in practice. The primary idea is a single rope or stem of leaves and fruit proceeding from a single root. But it is obvious that a cord or rope may proceed in single or double lines and in different directions from the ground or root-stock. Hence we have single, double, multiple, vertical, horizontal, oblique, spiral, zigzag, diamonded, or other cordons. The following varieties have been proved suitable for cordons:—

Dessert Varieties. — Coe's Golden Drop, Cox's Orange Pippin, Pomme d'Api, King of the Pippins, Duke of Devonshire, Scarlet and other Nonpareils, Devonshire Quarrenden, Early Harvest, Lord Burleigh, Northern Spy, Small's Admirable, Reinette du Canada, Golden Reinette, Mr. Gladstone, Oslin, Scarlet Astrachan, White Paradise or Lady-finger; and, in warm situations, Calville Blanche d'Hiver or Ribston Pippin, Ribston Pearmain, and Claygate and other Pearmains.

Kitchen Apples.—Cox's Pomona, New Hawthornden, Lord Suffield, Jolly Beggar, Keswick Codlin, Manks' Codlin, Bedfordshire Foundling, Blenheim Pippin, Cellini, Mère de Ménage, Forge, and Tower of Glammis.

But of course the stock has a great deal to do with the adaptability of any particular variety of Apples for cordons. Hardly any Apple makes a good cordon on the Crab, while almost any variety will readily yield to this unique and useful form on such dwarfing and fertilising stocks as the English or French Paradise.

Pyramids, Cones, or Pillars.

The following varieties answer well for this form of tree:—King of the Pippins, Court Pendu Plat, Cox's Orange Pippin, Court of Wick, Devonshire Quarrenden, Duke of Devonshire, Early Harvest, Oslin, Kerry Pippin, Margil, Red Astrachan, Mannington's and other Pearmains, Scarlet and Old Nonpareil, Sykehouse's Russet, Wyken Pippin, Worcester Pearmain, Reinette du Canada, Golden Reinette, Sturmer Pippin, Golden Harvey, and Ashmead Kernel.

Kitchen Apples for Pyramids.—Cox's Pomona, Bess Pool, Cellini, Keswick Codlin, Manks' Codlin, Prince Albert, New Hawthornden, Lord Suffield, Jolly Beggar, Duchess of Oldenburgh, Warner's King, Dumelow's Seedling, Blenheim Pippin.

Bushes, Vases, &c.

This is a most convenient form for small gardens, and some of the varieties almost grow naturally into this form.

Dessert Varieties for Apple-bushes.—Cornish Aromatic, Cockle Pippin, Golden Harvey, Gravenstein, Cox's Golden Drop, Reinette du Canada, Court Pendu Plat, Melon Apple, Peasgood's Nonsuch, D'Arcy Spice, Worcester Pearmain, Early Harvest.

Kitchen Varieties.—Brabant Bellefleur, Emperor Alexander, Jolly Beggar, Manks' Codlin, Keswick Codlin, Lord Suffield, Cox's Pomona, Hawthornden, Waltham Abbey Seedling, Cellini, Blenheim Orange.

Espaliers and Walls.

For these purposes Apples on Crab-stocks are often preferred, as it has been the common practice to plant such trees at distances of from ten to fifteen or even twenty feet apart. This system answers well for such modes of horizontal training, but for what are called multiple-cordons or U-shaped vertical espaliers, distances of four feet apart will suffice, and these small trees should be worked on the Paradise.

Dessert.—Ashmead's Kernel, Adams' Pearmain, Boston Russet, Cobham, Court Pendu Plat, Golden Russet, Lamb Abbey Pearmain, Newtown Pippin, Northern Spy, Ribston Pippin, Ribston Pearmain, Washington.

Kitchen.—Baumann's Red Reinette, Bedfordshire Foundling, Blenheim Pippin, Brabant Bellefleur, Ecklinville Pippin, Frogmore Prolific, Forge, Golden Noble, Lewis's Incomparable, Prince Albert, Stirling Castle, Royal Russet.

Apples for Orchards. — These should be vigorous growers, and are mostly tall or dwarf standards worked on the Crab. This enables the same sorts to grow with a vigour and to a size quite unknown to the similar varieties worked on dwarfing or fertile stocks.

The following varieties are among the most suitable for orchard culture:—Alfriston, Beauty of Kent, Blenheim Pippin, Cellini, Cox's Pomona, Dumelow's Seedling, Emperor Alexander, French

Crab, Gloria Mundi, Hambledon Deux Ans, Hoary Morning, London Pippin, Lord Derby, Norfolk Bearer, Golden Reinette, Nonsuch, Royal Russet, Small's Admirable, Striped Beaufin, Tower of Glammis, Waltham Abbey Seedling, Wormsly Pippin, Winter Majetin, Rymer.

Apples for Warm Localities.—*Dessert.*—Devonshire Quarrenden, American Mother Apple, Cox's Golden Drop, Cornish Aromatic, Golden Reinette, Margil, Melon Apple, Pitmaston Nonpareil, Ribston Pippin, Ashmead's Kernel, Claygate Pearmain, Cornish Gilliflower, Court Pendu Plat, D'Arcy Spice, Lamb Abbey Pearmain, Golden Harvey, Golden Pippin, Sam Young. *Kitchen.*—Lord Suffield, Cellini, Cox's Pomona, Emperor Alexander, Lemon Pippin, Lord Derby, Mère de Ménage, Calville Blanche d'Hiver, Waltham Abbey Seedling, Alfriston, Brabant Bellefleur, Lane's Prince Albert, Royal Russet.

Apples for Cooler Localities and Scotland.—*Dessert.*—King of the Pippins, Oslin, Ravelston, Red and Yellow Ingestre, Cockle Pippin, Court of Wick, Court Pendu Plat, Golden Reinette, Red Astrachan, White Paradise, Sykehouse's Russet, Nonsuch. *Kitchen.*—Tower of Glammis, Warner's King, Yorkshire Greening, Keswick Codlin, Bedfordshire Foundling, Brabant Bellefleur, Manks' Codlin, Dutch Codlin, Hawthornden, Rymer, Royal Russet, Nelson Codlin.

MANURING IN THEORY AND PRACTICE.

By John J. Willis.

NITRATES AS PLANT-FOOD.

Although plants are unable to assimilate the free nitrogen of the air, experiments demonstrating the fact that nitric acid is capable of perfectly supplying vegetation with nitrogen have been carried out by Boussingault.

Two seeds of a dwarf Sunflower (*Helianthus argophyllus*), were planted in each of three pots, the soil of which, consisting of a mixture of brickdust and sand, was freed from all nitrogenous compounds by ignition and washing with distilled water. To the soil of pot A, Fig. 7, nothing was added save the two seeds and distilled water, with which all the plants were watered from time to time. With the soil of pot B were incorporated small quantities of phosphate of lime and bicarbonate of potash, in order that the plants growing in it might have a soluble mineral supply. Finally, the soil of pot C received the same mineral manures as pot B, and, in addition, a small quantity of potassium nitrate (saltpetre).

The seeds were sown on the 5th of July, and on the 30th of September the plants had attained the relative size and appearance seen in the diagrams, where they are represented in one-eighth of their natural dimensions.

Nothing can be more striking than the influence of the nitrate on the growth of plants, as exhibited in this experiment. The plants A and B are mere dwarfs, although both carry small and imperfectly developed flowers. The plant C, on the contrary, is scarcely smaller than the same kind of plant would be when grown under the best conditions of garden culture.

We gather from Boussingault's experiments, as from those of Lawes and Gilbert, that without some compound of nitrogen in the soil, however much there may be in the atmosphere, vegetation cannot attain any considerable luxuriance, notwithstanding all requisite ash constituents are present in abundance.

The plants supplied with nitrate of potash assimilated sixty-six times as much nitrogen from the manure as was acquired by A and B from external sources.

The Soil as a Source of Plant-food.—The next question to consider is the amount of plant-food contributed naturally by the soil itself in a virgin state.

We learn by the study of geology that the earth upon which we live has passed through great changes, extending over vast periods of time. All soils have been produced by the disintegration of rocks, which, through the influence of rain, frost, and air, have gradually crumbled to pieces. The diversity of soils greatly depends upon the character of the primitive rock from which they have been derived. Small particles of pulverised rock, by the help of living animals and of vegetable growth, have been broken down into continually smaller fragments, and lastly into a dust-like powder; and this substance, when mixed with decaying animal and vegetable matter, forms a soil capable of growing plants. The elements taken from the soil in its virgin condition were returned to it on the decay of the plants which it had nourished, or on the death of the animals which fed upon the plants produced.

Each year, as time went on, a certain portion of the vegetable growth died, leaves and branches fell, and portions of the roots decayed, causing the surface soil to become rich in carbon and nitrogen. The atmosphere of the soil, which at first differed but little from that which existed above it, became highly charged with carbonic acid, which decomposed the mineral substances contained in the soil; and in this manner year by year more and more of the nitrogen, collected by each generation of plants, became available for the generation that succeeded it.

In order to start with definite notions on the inherent quality of soils, let us take, as an example, some ordinary arable soil, of a clayey nature, in fair cultivable condition. Such a soil, when all roots and vegetable débris have been removed, will contain in the first nine inches of the surface mould a quantity of organic matter containing about 3,000 lbs. of nitrogen and 30,000 lbs. of carbon per acre. This nitrogenous organic matter of the soil has been derived either entirely from the decay of vegetable growth, left in the land by preceding generations of plants, or possibly, to some extent, also from past applications of organic manure. In a fertile soil the formation of nitrates is always in progress, and it is very important for gardeners to bear in mind that the nitrogenous capital of a soil, which represents to a considerable extent its fertility, depends, as a rule, on the bulk and composition of the previous plant residues. The present condition of a soil is thus, in great measure, a consequence of its past fertility, which fact may be exemplified by another of the Rothamsted experiments.

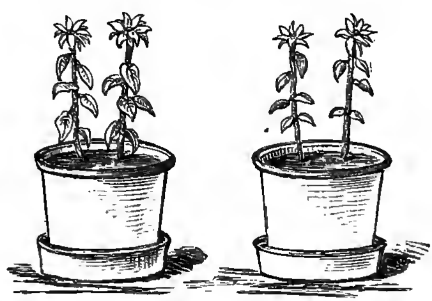


Fig. 7.—Sunflower Plants, showing effects of Potassium Nitrate.

Accumulation of Plant-food in Soils.—In one field wheat has been grown continuously for forty-one years (1844—1884), and during the last thirty years the manuring has not been changed on any of the plots to which reference is about to be made. The range of produce has been very considerable, rising from an average of 14 bushels of dressed wheat and 12 cwt. of straw without manure (Plot 4), to an average of 32¼ bushels of grain and 32¾ cwt. of straw on the highly-manured Plot 7.

In October, 1881, samples of soil were carefully taken from each plot in the field and analysed, the results being given in the following table:—

Produce of Land continuously cropped with Wheat during Thirty-eight Years. Also the Percentage of Nitrogen and Carbon, and the quantity of Nitrogen as Nitrates per Acre, found in the Soil at the end of that period.

Plot 4	Plot 5	Plot 10	Plot 6	Plot 7	Plot 2
Average Annual Produce (Grain and Straw) per Acre, 1852—81.					
lbs. 2,227	lbs. 2,394	lbs. 3,450	lbs. 3,954	lbs. 5,710	lbs. 5,695
Nitrogen per Cent. in First Nine Inches of Soil, Oct., 1881.					
0·092	0·098	0·103	0·111	0·121	0·184
Carbon per Cent. in First Nine Inches of Soil.					
1·010	1·033	1·095	1·205	1·267	2·132
Nitrogen as Nitrates per Acre in First Twenty-seven Inches of Soil.					
lbs. 16·3	lbs. 25·1	lbs. 33·8	lbs. 29·4	lbs. 40·1	lbs. 51·8

Reference to the results shows that the percentage both of nitrogen and carbon in the soil is greater according to the weight of crop annually produced; the quantity of nitrogen and carbon in the first nine inches of soil is more than one-fourth larger on Plot 7, yielding the maximum crop, than on Plot 4, where the minimum produce was obtained.

It might be thought that the excess of nitrogen found in soil regularly manured with ammonium salts would be due to a retention of ammonia in the soil, and not, therefore, determined by the amount of crop residue. That this is not the case is proved by the fact that the excess of nitrogen is always accompanied by a corresponding excess of carbon. On Plot 10 there is but a small increase either in the nitrogen or in the carbon of the soil, although the same quantity of ammonia was applied as on Plot 7. The reason is this: On Plot 10 no ash constituents have been for many years applied; the crop and crop residue are therefore small, in spite of the application of ammonium salts, and the amount of nitrogen and carbon in the soil has consequently not been maintained even by considerable annual remains of roots and stubble.

On Plot 2 fourteen tons of farmyard manure have been annually applied per acre for thirty-eight years, and the produce during the last thirty years has averaged 33½ bushels of dressed wheat and 32 cwt. of straw. Hence, there is as large an annual crop residue contributed to the soil as in the case of Plot 7, and in addition the very considerable quantity of nitrogenous organic matter supplied in the manure. Referring to the foregoing table, the effect on the composition of the soil is seen to be most striking. The percentage of nitrogen in the first nine inches of mould is shown to be double, and the percentage of carbon more than double that found on the unmanured plot.

Dressings of farmyard dung, which is the usual manure of the gardener, may thus considerably increase the quantity of nitrogenous matter in the soil; while dressings of ammonium salts, or of sodium nitrate, will have no permanent effect in this direction, except their use results in the production of a larger crop residue.

Experiments with barley also supply some capital examples of the accumulations of organic matter in the soil, which may result from the use of organic manures, such as farmyard dung, rape, or cotton-cake, &c.

It is thus proved that the nitrogenous organic matter of the soil has its origin in the various vegetable substances left in the land, as residues from preceding crops, to which in some cases must be added the residue from dressings of organic manures. The production of nitrates in soil is of the greatest importance to vegetation, nitrates being the form in which nitrogen is chiefly assimilated by plants; the abundance or poverty of nitrates in a soil thus determines, to a great extent, the quantity of crop which the land will produce. A recognition of this fact is of vital importance to the horticulturist if he is to have any accurate notion as to the influence of different crops, or plants, in maintaining or exhausting the fertility of the soil which he cultivates.

It is evident that the crop which leaves behind it the largest amount of roots, stubble, and foliage will best maintain or increase the nitrogenous capital of a soil; while the crop leaving the smallest residue in the land will be the most exhausting in its effects.

This carbonaceous organic matter of soils, and the black substance found in farmyard manure, under the general term *Humus*, was considered by many intelligent men in the early part of the present century to be the main source of fertility.

Soil Fertility.—The slow and spontaneous decomposition and oxidation of vegetable substances in the earth is continually going on, and is the natural mode by which the soil is enriched. At the time when Liebig's writings directed so much attention to the subject of agriculture, it was assumed that this oxidation of organic matter in the soil took place by mere contact with the oxygen of the air. The active oxidation was referred to the fact that a soil is a porous substance, and that the oxygen of the air became condensed within its pores, and was hence capable of exerting an increased power. We now know, from experiments of Schloesing, Muntz, and Warington, that a porous medium is by no means essential for nitrification, and that the oxidation of organic matter in a soil generally requires something more than the presence of oxygen.

Oxidation in nature is, in fact, nearly always performed by living agents, either by colourless plant-cells or by means of animal organisms.

Though, however, porosity is by no means essential to the nitrifying power of a soil, it is undoubtedly a condition having a very favourable influence on the rapidity of the process.

Our view of the nature of a fertile soil has thus been considerably enlarged, and instead of regarding the soil simply as a porous mass of clay, sand, and humus, we now look on it as a medium full of life. "The soil beneath our feet," says Mr. Warington, "is, in fact, not dead, but thickly populated with a variety of organisms, with the particular function of which we are only gradually becoming acquainted."

The general result of this nitrifying influence in soils is the conversion of the organic matter into three simple substances—water, carbonic acid, and nitric acid. Humus thus becomes the source of a gradual, but uninterrupted, formation in the soil of carbonic acid, which is probably less useful on account of the carbon it furnishes to vegetation than for the solvent power which it exercises with regard to certain minerals, and especially potash and phosphoric acid.

The formation of nitrates will take place most abundantly in surface mould, as the proportion of nitrogenous organic matter (the remains of vegetable and animal life) is most considerable, and the access of air most free.

The production will be greatly favoured by rain and by tillage, and will be far more extensive in summer than in winter time; also much more energetic in hot climates than in cold. The quantity of carbonic acid formed will be found greater according to the richness of the soil in organic nitrogen, and is much increased when farmyard manure has been applied. It is, like the nitrates, produced in largest quantities during the summer months; the amount may be further increased by the application of chalk or lime to the soil.

Absorptive and Retentive Powers of Soils.—One of the properties of humus, and also of all animal manures, is to attract and retain moisture from the atmosphere. These compounds also retain ammonia with great tenacity—a property of immense utility in connection with the supply of nitrogen to plants.

The extent to which farmyard dung increases the water-holding powers of a soil may be shown by one of the Rothamsted experiments.

During a very wet winter samples of soil were taken from the Wheat-field previously referred to; the percentage of water found in the soil manured each year with farmyard manure, and in a soil treated with artificial manures, was as follows:—

Farmyard Manure.		Artificial Manure.	
1st 3 inches	39·67	1st 3 inches	26·53
2nd "	35·62	2nd "	22·93
3rd "	28·85	3rd "	20·62
4th "	23·95	4th "	24·70

It is seen that in the first nine inches of mould the absorbing power of the soil was much increased by the continued use of farmyard manure, but that its effect ceased at this point.

The absorptive and retentive character of a soil is found to be in direct ratio not only to the quantity of organic matters present, but also to the fineness of its state of subdivision.

It therefore becomes essential, in a practical point of view, to secure a proper degree of both if the soil is to withstand drought. In dry climates the power of holding water renders a soil more valuable to the horticulturist, whereas in localities where rains are frequent, a simple determination of this property will serve to indicate to the practical gardener on which of his soils it is most important to him, in reference to surface water, that the operation of draining should be most effectually performed.

The more water a soil contains within its pores, the more it has to part with by subsequent evaporation; and, therefore, the colder it is likely to be. Hence the greater necessity for draining, applying ashes, lime, old mortar or road-scrapings to clayey than to sandy soils. The more sand a soil contains in proportion to clay and humus, the less moisture it is capable of absorbing, and the more readily it parts with what it may take up, which may be clearly shown by some results of Professor Schübler, to whom we owe much important information regarding soils.

Table Showing the Absorptive and Retentive Powers of Different Soils.

Description of Soil.	Water absorbed by 100 of Soil.	Of 100 of Water absorbed there evaporated in four hours at 66° Fahr.
Sand	25	88·4
Light Clay	40	52·0
Stiff Clay	50	45·7
Heavy Clay	61	34·9
Pure Clay	70	31·3
Rich Garden Soil	96	24·5
Humus	190	20·5

"During dry weather plants require a soil which is both absorptive and retentive; and that soil which is capable of seizing atmospheric moisture, and holding it when the atmosphere is heated, is one of the best-constituted soils. But stiff and heavy clays, which take up the greatest quantity of water when it is poured upon them, are not the soils which absorb most moisture from the atmosphere in dry weather; they cake and present only a small surface to the air; and the vegetation on them is generally burnt up almost as readily as on sands. The soils that are most efficient in supplying the plant with water by atmospheric absorption are those in which there is a due mixture of sand, finely-divided clay, and carbonate of lime, with some animal or vegetable matter, and which are so loose and light as to be freely permeable to the atmosphere."*

Loss of Plant-food by Drainage.—Most cultivated soils contain a large amount of mineral food of plants, as well as organic nitrogen—that is to say, nitrogen in combination with carbon, the residue of previous vegetation.

A certain amount of this organic nitrogen is every year converted into nitric acid, which combines with the lime in the soil and forms a most important and

* "Soil of the Farm," by Scott and Morton.

essential plant-food. In this state it is very soluble in water, and therefore readily washed out of the soil by heavy rains unless there is a vigorous crop upon the ground to retain it and take it up as food.

It is known that the most fertile soils possess a great retentive power for phosphoric acid, ammonia, and potash; and these substances are consequently only found in drainage waters collected from the land in minute quantity, except under very special circumstances.

In the case of such ingredients, the small solvent action of rain results rather in their more equable distribution throughout the soil than in their removal from it.

From what has been stated, we learn that the rapid oxidation of organic matter in a soil, which occurs under tillage, means the production of a large amount of available plant-food. The nitrates produced, however, while they are capable of yielding valuable crops, are extremely liable to be lost by drainage; and the skill of the gardener is displayed in so arranging his methods of culture that the nitrates shall be a source of profit instead of loss.

Nitrates in Soils.—We will now proceed a step further, and describe the results which have been obtained at Rothamsted by actual determinations of nitrates in soils of various history.

The analyses of soils under bare fallow amply confirm the statements set forth in previous sections. It is evident that very large amounts of nitrates are produced in soil when exposed to air and rain and kept free from vegetation, and that the richness of autumn drainage water is due to the gradual washing out of the nitrates formed in the preceding summer.

The following table gives three examples as to the quantity of nitrates existing in soils which had been left as bare fallow all the summer; the samples of soil were taken for analysis before loss by autumn drainage had commenced.

Nitrogen as Nitrates in Soil after Bare Fallow, in Pounds per Acre.

Depth.	Clay Croft Field.	Foster's Field.	Agdell Field.
	lbs.	lbs.	lbs.
First 9 inches .	16·4	14·6	40·1
Second 9 inches .	26·5	24·6	14·3
Third 9 inches .	15·9	17·3	5·5
Total 27 inches .	58·8	56·5	59·9

There can be no doubt that it is in this very considerable production of nitrates that the advantages of a bare fallow consist. If a dry winter follows the summer fallow, the crop for which the fallow has been prepared will find at its disposal an amount of nitric acid equivalent to a very large dressing of sodium nitrate, and, if the season be favourable, a proportionately heavy crop will result.

It is seen in two instances that the maximum amount of nitrates occurred in the second 9 inches of soil; this was due to the heavy rains of August in that year, which washed the nitrates formed at the surface into the subsoil. And it is quite evident that the quantity of nitrates found did not represent the whole amount in the soil, as the lowest depth analysed was still rich in plant-food.

In the case of Agdell Field, the samples of soil were taken in September, 1882. During the preceding summer the rainfall had been insufficient to occasion any considerable drainage; the nitrates were therefore chiefly found in the surface soil where they were produced.

The capacity for producing nitrates possessed by a fertile garden soil far exceeds the results obtained under ordinary agricultural conditions. In the following table will be found the quantities of nitrogen as nitric acid existing in the first, second, and third nine inches of soil in selected plots of the Rothamsted experimental Wheat-field when sampled in October, 1881, in lbs. per acre. It will be observed that the nitrates are most abundant in the first nine inches of depth; the mean proportion at the three depths being, in fact, as 100, 59, and 31. The unmanured soil of Plot 4 yielded the lowest amount of nitrates—namely, 15 lbs.; while Plot 19, manured during the three preceding seasons with Rape-cake alone, gave 34·2 lbs. of nitrogen as nitrates. As Rape-cake only slowly decomposes in the soil, a part of the nitrates found will in this case be due to the nitrification of a residue of the manure. A still more striking example of the production of nitrates from organic manures is afforded by Plot 2, which receives annually fourteen tons of farmyard manure;

Depth of Soil.	Plot 4.—Without Manure.	Plot 19.—Rape-cake.	Plot 9a.—Mixed Minerals and 550 lbs. Nitrate of Sodium.	Plot 7a.—Mixed Minerals and 400 lbs. Ammonium Salts.	Plot 8a.—Mixed Minerals and 600 lbs. Ammonium Salts.	Plot 2.—Farmyard Manure.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First 9 inches	9·2	14·1	19·7	22·8	21·1	30·0
Second 9 inches	4·0	13·0	10·0	11·3	13·9	15·4
Third 9 inches	1·8	7·1	8·3	5·7	7·8	6·8
Total 27 inches	15·0	34·2	38·0	39 8	42·8	52·2

here the quantity of nitrate in the soil amounted to 52·2 lbs. of nitrogen per acre, exceeding in richness every other enumerated plot.

From some analyses of a rich kitchen-garden soil, which had grown Clover experimentally for twenty-nine years in succession, it was found that the first nine inches of soil contained nearly four times as much nitrogen as average arable soil, and nearly five times as much as some exhausted Clover-land soil.

The facts indicated by these results are of great practical importance. Soil contains nitrogenous matters which nitrify with different degrees of facility. The bulk of the organic nitrogen of a soil is only capable of very slow oxidation, but a certain proportion is very readily converted into nitric acid. In thoroughly exhausted land the easily nitrifiable matter has to a large extent disappeared, but in soil in a good state of fertility it is being continually renewed by fresh crop residues. This readily nitrifiable matter constitutes a chief part of the floating capital of the soil, on which its immediate productiveness depends. The larger quantity of more inert plant-food forms the sunk capital, which only very slowly becomes available.

The nitrates in a moist soil, rich in organic matter, are found rapidly to disappear at a summer temperature if only a very small and limited amount of air is present. The same result will occur in ordinary arable land if the soil be completely saturated with water, and all oxygen thus excluded.

This destruction of nitrates is attended with the production of ammonia and of nitrogen gas.

Only quite recently it has been shown that the change in question is brought about by the Bacteria of the soil; so that this, as well as so many of the other transformations within the soil previously referred to, is a result of life. The information thus brought to light supplies a good reason why attention should be paid to drainage in the case of all soils liable to become saturated with stagnant water.

ACTION OF MANURES.

By the word manure we imply all those substances which, by elaboration within the soil, are sufficient to supply the nutritive juices to vegetation, whether the plants are grown in the open field, the garden, or the green-house. It, therefore, includes a great variety of materials, which may be arranged under two separate heads: first, *organic*—that is, derived from organised bodies, and once forming part of their structure or their secretions; and, secondly, *inorganic*—that is, having an earthy origin, and not, properly speaking, traceable to organic sources.

Organic manures are those which are capable of yielding to the plant, by decomposition or otherwise, carbon, hydrogen, oxygen, and nitrogen—constituents which uncultivated plants derive originally from the atmosphere and rain.

Inorganic manures are those substances which supply the mineral ingredients, of which the structure of plants is found to consist.

Many of the substances employed as manure contain both organic and inorganic constituents. The greater portion of soils, too, consist of minerals in a greater or less degree of decomposition, combined with a small amount of organic matter.

It has been already observed that the atmosphere may be considered as the natural source of organic, and the soil that of the inorganic, supply of plant-food. As, however, it is the object of the horticulturist to increase the produce of the soil beyond its natural yield, he adopts various methods for accomplishing that end. In the first place, a proper mechanical texture in soils is necessary to fertility; for on the firmness or looseness of a soil depends not only its suitableness for the growth of different crops, but likewise the rapidity of action.

The produce of the soil may also be increased by means of manures—that is to say, by supplying those ingredients which the soil, the atmosphere, and the rain combined are incapable of yielding in sufficient quantity for the nourishment and vigorous growth of those plants placed in the soil by the gardener.

Every soil is capable of yielding a certain amount of vegetable produce under the influence of climate, without the assistance of an artificial supply of plant-food; this may be called its natural fertility, and whether high or low in degree, is, comparatively speaking, a permanent quality. The proportion will vary each year according to the amount of rain, the temperature of the season, and the description of the growing plant. It is known, however, that although the climate of any place may vary one year as compared with another, it nevertheless maintains a certain average which has an important bearing upon the actual productiveness of the soil in a particular locality; and this, to a very great extent, must control both the cropping and the manuring of the soils of that district.

If abundant and nourishing food be given to an animal, it becomes vigorous and fat; on a scanty and poor diet, it continues thin and weakly. It is precisely the same with plants. If they find in the soil all those substances which they require to build up their fabric, in sufficient quantity and in suitable form, they will grow more vigorously, and put forth more shoots, leaves, flowers, and fruits than when they meet with those substances, or even only one of them, in insufficient amount.

Thus, if an ordinary soil be supplied with a manure containing a very small quantity of one important element of plant-food, along with abundance of all the others, the amount of increase which it yields will obviously be measured not by those constituents which are abundant, but by that which is deficient.

By the courtesy of Professor Jamieson we are able to place before our readers some interesting experiments bearing upon this part of our inquiry. Having obtained some pure white sand, from which all impurities had been removed, about 6 lbs. was taken, and mixed with all the chemical substances or ingredients considered essential to plant-growth, in about the proportions in which they would exist in Turnips. The mixture (sand and manure) was then placed in a funnel-shaped vessel leading into a large bottle (Fig. 8), and several Turnip-seeds were sown in it, which were watered occasionally with water purified for the purpose. In due time the Turnips brairded. After some days they were thinned, leaving only the central or healthiest plant. The results of the various experiments are shown in Fig. 9. In vessel A the growth went steadily on; a luxuriant mass of leaves were formed, and eventually a bulb commenced and continued to develop till it was taken up for illustration. The Turnip in vessel B was so small that it appears almost as a mere speck on the paper. Whence is the difference? Precisely the same sand, the same seed, the same watering, and precisely the same ingredients added, *save one*, which was purposely omitted—namely, calcium, or lime. In consequence of this omission, although all the other ingredients were present in abundance, the healthy seed produced vigorous young seedlings, but speedily the *whole of them died.*

Fig. 8.

In vessel C, calcium and all the other ingredients were supplied, but phosphoric acid was omitted. The result was identically the same as in vessel B: the plants brairded well, but soon died.

In vessel D, where the Turnip showed a small growth, the conditions were the same as in A, but potash was omitted. However, owing to some small specks of mica in the sand, which could not easily be separated, the plant seemed to get from it just as much potash as enabled it to live. The presence of mica would seem to imply that this mineral is fitted materially to promote the fertility of a soil in which the other earthy ingredients are properly adjusted. Hence, a developed plant continuing in life, but miserably dwarfed.

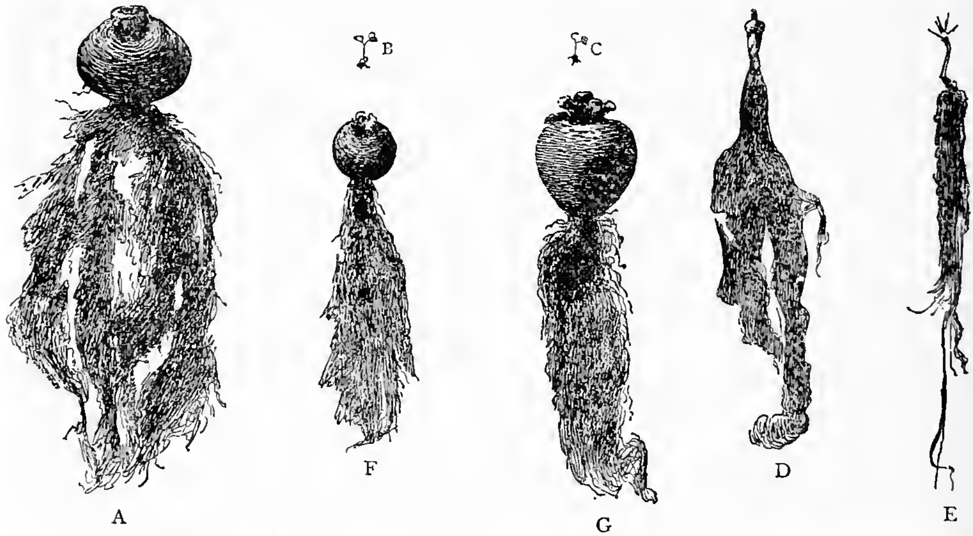


Fig. 9.—TURNIP PLANTS GROWN WITH AND WITHOUT VARIOUS FOOD ELEMENTS.

With Turnip E the peculiarity was the absence in the manure of nitrogen. Unlike D, there was none in the sand, and there was none supplied. True, it was surrounded by abundance of nitrogen in the air; but we have previously seen that plants cannot assimilate the free nitrogen of the atmosphere; but it is thought there was a slight absorption through the sand by the roots. However obtained, it confirms Turnip D, viz., any important ingredient in small quantity (be the other ingredients ever so abundant) means the production of a small plant.

Turnips F and G illustrate the effects of *soluble* and *insoluble* phosphate of lime. The sand and water used were similar to those for the other experiments. Mineral plant-food was given to each, but to F the phosphate of lime was employed in an *insoluble* condition, and to G in a *soluble* state. The results obtained indicate that Turnips may take up phosphoric acid in a variety of forms, but that every kind is not equally beneficial to robust plant-growth.

The value of these illustrations is much enhanced by the fact that they were not made on a single plant, which might by accident give a misleading result, but that there was a duplicate of each, and that these duplicates confirm each other.

The diagram in Fig. 10 is also interesting as showing the comparative growth of Turnips, *with* and *without* certain chemical ingredients, on the barren, sandy soil at Hassock's Gate, Sussex, where Professor Jamieson for several years has been conducting a series of agricultural experiments. The diagram represents typical plants taken from each plot of fifty Turnips. Allowing for the fact that these latter experiments were conducted in a natural or unpurified soil, though a sandy one, it will be seen that the results agree closely with those shown in the preceding diagram.

The practical inferences to be drawn from these facts regarding the value of certain constituents in manures are of the highest importance. It is obvious that a plant can only grow vigorously, thrive, and attain to full maturity when all the essentials of plant-life are present in the soil, and in a sufficiently available form.

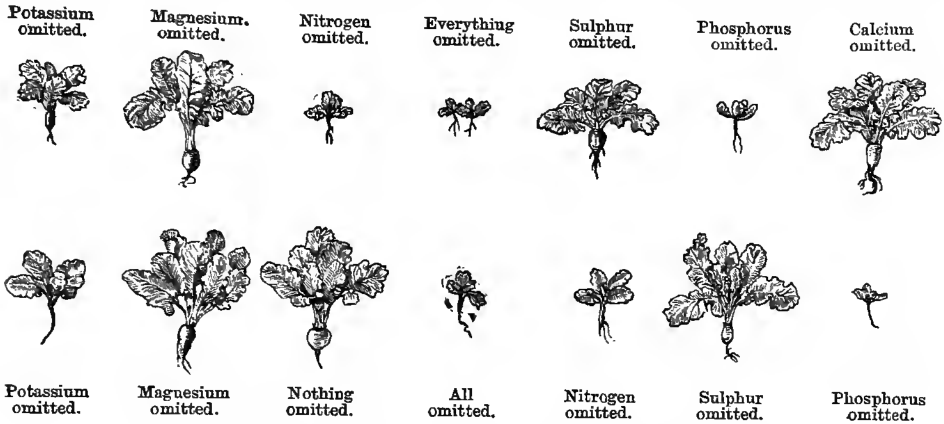


Fig. 10.—TURNIP PLANTS GROWN WITH AND WITHOUT VARIOUS FOOD ELEMENTS.

THE ROSE AND ITS CULTURE.

BY D. T. FISH.

CULTIVATION OF THE ROSE UNDER GLASS.

THIS branch of Rose culture, like the cultivation of this beautiful flower in pots, may be said to be yet in its infancy, and it is to be hoped that in the near future Rose-houses and Roses in pots will be as plentiful as conservatories, plant-stoves, Orchid-houses, and Fuchsias, Pelargoniums, Begonias, Camellias, Heaths, &c.

Any glass-house, with a tolerably good clear roof, will grow Roses, and produce them in abundance, without artificial heat. But to have Roses all the year round will require a sufficiency of artificial warmth to insure a temperature of at least 60° in all weathers, that is, 28° of artificial heat when the external thermometer is at the freezing point, or double that amount when the thermometer is at zero, or 0°. Prominence is given to this fact at starting, to prevent disappointment, as it is often authoritatively stated that no artificial heat is required to grow Roses under glass. Of course not. Plants that live and thrive in our climate without protection, may be assumed to live in greater safety under the shelter of the additional six or eight degrees that a mere glass-house affords them. But cool glass-houses, while mostly affording a full supply of Roses at *certain seasons*, cannot be depended on to furnish Roses at *every* season throughout the changing year, with a free run of temperature from zero to 90°. The additional tenderness of our finest strains of Roses furnishes another argument, were any more needful, in favour of the erection and warming of glass-houses for Roses, planted out or in pots.

A good deal may be done to extend Rose culture under glass by the utilisation of blank spaces or the substitution of Roses for other plants in existing houses. Commercially, housefuls of Roses return far more money if skilfully managed than the same houses furnished with fruit, while no plant can match the Rose in beauty and fragrance, and that peculiar freshness and novelty that distinguish Roses grown under glass and out of season.

Vine-wires, Peach-trellises, the back and side walls of houses, and roof-rafters, are just the places for Roses to clothe or festoon with their matchless beauty, and fill to overflowing with their fragrance. Orchard-houses without trellised roofs may be furnished with large bush Roses, or standards, in the place of fruit-trees that may or may not have yielded much produce or profit.

One of the first Rose-houses in this country, that in the gardens of the London Horticultural Society at Chiswick, was originally an orchard-house. The fruit-trees were simply removed, the borders re-made, and the centre and side borders planted with Roses many years ago, which did remarkably well, and formed a novel feature of interest at the time. The next Rosary under glass best known to the writer is in a large, lofty-domed, span-roofed conservatory. Camellias, Acacias, and other tall flowering shrubs were cleared out; two feet of good turfy loam, well enriched with manure, substituted for the regulation mixture of half peat, half loam; and the Roses planted against the columns that supported the roof in the centre, and the pillars between the tall lights all round the house. Trellises, from eight to ten feet in height, were also arranged over the growing-space between the pillars, and arched over the central paths, imparting to these and the chief paths round the house the charm of Rose-arbours under glass, where the delicate Tea and Noisette Roses could ramble at their sweet will, without danger of being cut down by frost or blighted by the cruel cutting March winds. Strong-growing Roses, such as Maréchal Niel, Gloire de Dijon, Homere, Lamarque, &c., were run up the loftiest columns, and very soon clothed them and the roof with garlands of beauty; while weaker Teas clothed the trellises, and the finer Perpetuals filled the cooler borders, four feet wide, against the vertical sashes. This Rose-house, alike in its structure, arrangement, and results, was a great success, though somewhat too lofty.

Perhaps a span-roofed house about ten or twelve feet high, fifteen wide, and thirty or fifty feet long, with the glass all round coming down to within twenty-four inches or three feet of the ground, with abundant means of admitting air near the ground, and allowing the heated air to escape at the highest part, is the best that could be devised for the forcing or general culture of Roses under glass. Excellent results have also been produced by planting low-sunk houses and semi-pits from eight to ten feet wide with Roses. These can be heated and kept warm at less cost of labour and coal than any other shaped glass structure.

To have Roses in plenty all the year round it will be needful to have more than one Rosary under glass. Two at least will be needed, or a good reserve kept in pots to draw upon. But two houses, large or small, as means or limits suggest, is the more convenient method of keeping up a continuous supply. One might be liberally heated, the other but slightly, or not at all.

Own-root Roses Best for Culture under Glass.—There are many reasons for this. All that need be referred to here is the securing of plants of uniform character, hardiness, and ratio of growth throughout, and the immense cultural importance of being able to draw upon the root for fresh shoots when wanted, to resuscitate or renovate the semi or wholly exhausted tops. Suckers on own-root Roses, instead of being evils to be shunned, are the most valued allies of the cultivator in keeping up the stamina of his Roses, as well as perennial antidotes to premature decay or exhaustion. That Rose-roots love to ramble must be obvious to all that have handled or seen them; most of our efforts to cure them of this tendency fail. The long, fangy roots of Roses cannot be changed to fibrous ones with the same promptitude and certainty as those of fruit-trees. Cramp them into pots; the fangs will run round and round in search of an exit in the bottom, through which they will find freedom, and remain fangs still. Better let Rose-root nature have its way by planting them in the free soil when and where practicable, instead of cramping them into pots, boxes, &c.

The boring character of Rose-roots also suggests another point, viz., that the borders may be deeper for Roses than for fruit-trees. So long as the former find abundance of food and drink, it seems to matter little to the Rose harvest they produce whether the roots are within three inches or three feet of the surface. This chiefly refers to Roses under glass; but even in the open it is possible that our severe attempts to thwart the natural tendency of Rose-roots to descend has been more fruitful of root-suckers than of food and strength to the Roses. Hence possibly a border four feet deep and two wide is better for Roses under glass than one four feet wide and two feet deep.

Unless the subsoil is very wet it will hardly be needful to add much or any drainage for Rose borders under glass. The Rose in a growing state is specially greedy of water, and the roots of Roses under glass will seldom or ever be at rest. It is also easy to withhold water when desirable on cultural or other grounds, such as retarding and ripening growth, &c.

Soil for Roses under Glass.—The best, most permanent, and most fruitful for healthy wood, and a continuous supply of bloom through a series of years, is turfy loam, with a tendency to clay rather than sand. This, chopped into small pieces, and intermixed with a few bushels of charcoal or smashed bones, is the best of all soil for Rose borders under glass. Its porosity and sweetness encourage fibrous and free rooting if anything will. Many add a third or so of farmyard or other manure to it. This encourages gross roots and wood, and breaks down the texture of the loam with great rapidity. Free-growing Roses, such as Maréchal Niel, will make shoots of from six to ten feet a year in the loam pure and simple.

Time and Manner of Planting.—This matters little under glass, more especially as most of the Roses are likely to be turned out of pots. The transference should be thorough as well as careful. Merely to turn a Rose, or other plant, out of a pot, and place it in the border, is but very partially to plant it out. The roots learning the revolutionary motion in the pots, unless carefully disentangled or released, continue to practise it long after their removal.

Modes of Training.—These may be as varied under glass as in the open air, and all the systems practised outside may be practised with more success in-doors, as here the Roses are safe against climatic accidents, which sadly cut into and destroy our much-valued forms and shapes of Roses in the open air. Climbers and strong-growing Roses should mostly have larger liberty under glass. Such Roses as the Maréchal Niel make shoots of ten or twenty feet in length, and these break into flowering trusses at every eye the following summer. It is a wanton waste of vital force, as well as of Roses, to cut such shoots back to any serious extent. Bending down the shoots, or twisting them round, as is often done witn Grape-vines, is the best means of forcing the fine shoots to break out into Rose-trusses from base to summit.

As to bush (standard and pyramidal) Roses, considerable looseness of form and freedom of growth is most pleasing and profitable under glass.

Pruning.—This may be more frequent under glass than in the open. It may also be performed when it seems best for the plants, as under glass it is not necessary to control pruning operations by calculating a game of chance with the weather. Under such favourable conditions the best time to prune is immediately after any and every crop of Roses. Cut promptly, and come again for another crop of Roses, and when these fade, cut again, and so on; the frequent prunings being in fact the key that opens the rich storehouse of harvests of sweet Roses in perpetuity.

Modes of Pruning.—These are, or ought to be, as varied as the Roses grown. Nothing could well be more unphilosophical or suicidal than the laying down of any hard and fast line, as to long or short pruning. Only practice, experience, and following the lead of each plant can determine this point. Hence, the more flexible the mode of pruning the better, so long as it is based on the vital principle of pruning for bloom, and making sure that you get it. As a general rule, cut in the blooming shoots to three or even six eyes of their base the moment the bloom fades. With Maréchal Niel and other Roses of like character, remove the flowering shoots and lay in fresh annually. Where this is impracticable, good results may be achieved by spurring in the flowering shoots closely, as in the Vine.

Pruning for strength or regeneration is widely different to pruning for bloom chiefly or only, and may for a time limit the supply of bloom. Such pruning consists in the bodily removal of all weakly and exhausted shoots, with a view of forcing forth younger and more vigorous ones as close to the root-stock, or base, of the Rose-bush as possible.

If the principle here laid down is accepted, no set time can be laid down for pruning: in fact, the pruning will become almost as continuous as the blooming. Not only will different Roses be pruned at different times, but even different branches of the same Rose, each Rose and shoot being in fact pruned when the local Rose harvest is gathered. General overhauling with the knife may be given, but the very key-stone to success in gathering Roses every day in the year consists in pruning also every day in the year; for incessant growth, and a constant supply of bloom, are the complementary results of perpetual pruning.

Temperature.—The amount, manner, and time of pruning, as well as of blooming, are largely controlled by temperature. The latter should be sufficient to convert all the Roses under glass into perpetual growers and bloomers. Constitution, habit, &c., thwart this consummation, so devoutly to be wished in many cases. The Maréchal

Niel, for example, expends so much force in its first blooming under glass, that cultivators have not yet learnt the art of making it bloom a second, to say nothing about a third time. But other varieties, such as Niphetos, President, Madame Falcot, the old valuable Rose known as Smith's Yellow, China, and others, will yield three or four crops a year under the guidance of considerate culture and the stimulus of warmth. A temperature of from 45° to 75° will be needed to crowd so many Rose harvests within the year.

This continuity of blooming somewhat complicates the culture, inasmuch as semi-dryness and a considerable drop of temperature after blooming are some of the best preparations for the next Rose harvest. And it will be observed that a margin of 30° has been left for the purpose of checking or stimulating the growth and blooming of the Roses. But this can only be imperfectly applied to Roses ever-growing and ever-blooming; still, it may be used to a limited extent, and, combined with the regulation of the water supply, constitutes the chief controlling force in the timing and continuity of the blooming of Roses under glass.

General Culture.—The chief other points in the culture of Rose-houses are watering, the giving of air, shading, and the destruction of insects. Notwithstanding what has been written on partially withholding water, Roses in constant growth should never be allowed to flag. Of course, this applies to such as are to be ever-blooming. Roses in cool houses, or such as are expected only to bloom once or twice a year, may be dried up rather severely to heighten the maturity of the wood with positive benefit. But for Roses in full growth the atmosphere should be kept moist by frequent surface sprinklings, and overhead watering of the Roses at least twice a day, unless when in full bloom. By carefully syringing and keeping the water low, a large proportion of the foliage of dwarf Roses may be wetted without injury to the blooms. Ventilation must be abundant in mild weather, and so managed as not to create draughts. To guard against these, the two sides of span-roofed houses should never be opened together, unless in the very hottest weather. The opening of the ventilators on the highest part of the roof will mostly suffice, without opening the lower ones at all. Shading may also prove necessary for two hours on either side of noon during bright hot weather, when the Roses are in bloom. It preserves the bloom so much longer, and also keeps the colours bright and pure. It must on no account, however, be carried to excess, or one crop of Roses will be preserved at the expense of the next, which will be less numerous and inferior in quality in the ratio of the excess of shade.

Insects.—The chief and most troublesome insect on Roses under glass is the aphis, and fumigation with tobacco cloth or paper is the simplest remedy. Apply this the moment it appears, and before it increases sufficiently to mar or injure the plants. Very often the more heat the more aphides, and, unless with sun-heat, it is not needful to raise the temperature of even perpetual-blooming Rosaries under glass beyond 65°. Such means of prevention are better than cure, though the cure for aphides under glass is simplicity itself. Into an iron fumigator or strong garden pot place a few glowing coals from kitchen or furnace fire, and on these put a pound or so of tobacco rag or paper, previously torn up into fragments. Cover this with a layer of crushed leaves of the common English Laurel, or of damp moss, and exit as quickly as possible, while the cloud of smoke fills the house so densely that you cannot see a Rose-bush or tree through the glass. A quarter of an hour in such a stifling atmosphere suffices for the strongest aphides, but, unless there is too much fire or tobacco, the charge may be safely allowed to burn itself out, and there will be no more live aphides; or should a few appear, smoke again next day; a heavy overhead washing with the syringe displaces or drowns any that were only made sick by the fumigation.

Varieties suitable for Culture under Glass.—In brief, all the best of the Teas, Noisettes, and Hybrid Perpetuals will do well in cool Rose-houses. For perpetual blooming-houses, the choice is far more limited. In addition to those already named, the following may be relied on:—Devoniensis, dwarf and climbing; Marie Van Houtte, Letty Coles, Safrano, Catherine Mermet, Marie Guillot, Anna Olivier, Souvenir de Paul Neron, Marie Henriette, Bougere, Duchess of Edinburgh, Madame Cusin, Souvenir d'un Ami, The Bride, and White Lady.

Probably the best Perpetuals for this mode of growth are:—La France, Boule de Niege, Jules Margottin, Prince Camille de Rohan, John Hopper, Alfred Colomb, Charles Lefebvre, Duke of Edinburgh, Mlle. Marie Rady, Prince Arthur, Victor Verdier, The Puritan, Duchess of Albany.

THE CULTIVATION OF ROSES IN POTS.

One of the chief merits of this mode of culture is that it brings the beauty and fragrance of the Roses within reach of all.

Every one familiar with town and suburban residences, or small gardens in country places, must have been painfully impressed with the paucity or miserable condition of the Roses. Two excuses are mostly forthcoming for this—the smoke-dried air, and "our soil won't grow Roses." The latter excuse has often a real foundation in fact, for not a few town gardens are wholly denuded of soil; a mere heap of builders' rubbish, barren subsoil, or puddled clay, cased over with a smother of fair-looking loam an inch or two thick, being all that is left. Others better furnished have soils that have never been disturbed nor enriched in the memory of man, and certain traditions are handed down from tenant to tenant that Roses have once been tried, and all died.

But the cultivation of Roses in pots in the open air renders the cultivator independent of the soil in his garden. Each pot may be filled with the most perfect soil for feeding the roots of Roses; neither can the roots get away from the good soil, and travel into that which is bad, to their own injury or destruction. The portability of plants in pots is another advantage.

The majority of Roses are more or less ephemeral, although the Teas, Hybrids, Chinas, &c., may be truly defined as perpetual growers and bloomers. No sooner, however, does a Rose in a pot go out of flower, begin to ripen its leaves, or look unsightly, than it may be removed from its coign of vantage or niche of beauty, and another Rose or plant set in its place.

Raised beds or borders might be furnished with Roses in pots merely plunged in the soil, or covered with moss, or planted out in a virtually enlarged pot, box, or basket, from which robber roots could be shut out by concrete bottoms or sides. The first mode would be rather more trouble, but with a little extra care it would answer well. The second differs nothing from ordinary methods of planting out, excepting that the soil is raised above the surrounding surface as a rule, and is reserved for the sole use of the Roses. In damp situations sloping banks may very often thus be formed with admirable effect, and Roses seldom thrive better, never perhaps look so charming, as on a sloping bank from ten to fifteen feet wide.

Standards from two to four feet high prove most useful for wide steps, or stone stairs, landings, balconies, gravel terraces round the house, back or front yards, centres of Rose-beds, backs of borders, forming groups, or single specimens on lawns, &c. Pyramidal, weeping, and climbing Roses can also be grown in pots, vases, or boxes, the chief point being to adapt the size of the pot as much as possible to the size of the plant, or the area it is expected to fill. This done with judgment and skill, combined with a liberal regimen afterwards, there is hardly any limit to the area or space that Roses in pots may furnish with beauty, and fill with fragrance.

Roses in Pots in our Crowded Towns.—The second difficulty about the cultivation of the Rose in crowded towns may be overcome by a judicious selection of varieties. First of all, the sorts chosen should have smooth leaves and few prickles. This may seem a small matter, but it is almost a vital one to success. The rougher the leaves, and the thicker-set the prickles, the more fast and firm all dirt and impurities of every sort stick to leaf and branchlet, and the more surely will the Rose be virtually suffocated into disease or fouled to death in consequence. This is so obvious that it need not be further insisted on. And as there is a goodly collection of smooth-leaved and scantily-prickled Roses, it is easy to make a selection of such for Rose-culture in the open-air in or near large towns. Then town Roses should have a vigorous constitution. All varieties that merit the character of miffiness should be rejected. Fragrance is another quality ever welcome in Roses everywhere, but specially so in those brought close to the cultivator in pots, and grown in towns.

Fortunately there are a goodly number of Roses that possess most of these qualities, the following being among the very best for pot-culture under more or less or very unfavourable conditions:-

HYBRID PERPETUALS.

Boule de Neige, f.	Jules Margottin.
Captain Christy.	Jules Finger.
Charles Margottin, f.	La France, f.
Countess of Oxford.	Madame Chas. Verdier, f.
Duke of Edinburgh, f.	Madame Marie Finger.
Dupuy Jamain.	Mrs. Harry Turner.
Etienne Levet.	Paul Neron.
François Michelon.	Star of Waltham.
Hypolyte Jamain.	Victor Verdier.
John Hopper.	

Among the Hybrid Chinas the best varieties for town gardens are:—

Coupe d'Hébé.	Paul Ricaut.
Charles Lawson.	Madame Plantier
Paul Verdier.	Blairii, No. 2.

Most of the Bourbons are also smooth-leaved, and especially that finest of the family, the Bourbon Souvenir de la Malmaison, and most of the Noisettes and the Teas (with one exception, Comtesse de Nadaillac) have smooth wood and leaves, and are well adapted for pot-culture in towns.

Potting Roses.—As this will be virtually the same whether the Roses are forced or fostered under glass, or grown in the open air, it will be described with sufficient detail once for all.

Some start with maidens; others with plants of considerable size; the simplest and safest plan is to make a beginning with small plants and carry them through their different stages in pots. In this way the plants get used to it, and the roots adapt themselves to this mode of culture before any heavy demands are made upon their tops.

The size of pots must be determined by the size of the plants. In all cases, however, it is well to start with pots as small as the roots can be fairly got into, and to advance tentatively as the roots need more room. Over-potting is also a sure and certain cause of failure. Neither do pot Roses ever look better than in eight or ten-inch pots, though of course much larger ones are often used for exhibition or other purposes. The most interesting exhibition of Tea Roses ever seen by the writer were a collection in eight-inch pots, fresh and perfect in foliage and in bud, and each with from six to a dozen expanded blooms.

The pots must be clean and deep, and if made rather deeper in proportion to the width than the usual run of garden pots, so much the better. The drainage may also be less bulky than is given for most plants. An inch drainage for six, eight, or ten-inch pots should suffice. The draining material should also be nutritious as well as porous. An oyster-shell over the hole, with a layer of smashed charcoal that has been soaked in manure-water, or of half-inch bones, the whole surfaced with a thin layer of horn or hoof-shavings, to form a barrier between the drainage and the soil, is the very *beau idéal* of a porous and feeding drainage for Roses in pots. A dash of soot over all would place a bitter enemy to worms at the point that would most effectually prevent their ingress.

Time of Potting.—If potted up from the open ground, the best time is Octoher or November, the former month being the best for this purpose if the Roses after potting can be placed in a semi-shaded house or pit, and kept close and moist for a few days till the roots get a fresh grip of the soil, and the leaves are thus enabled to renew their functions, and assist the roots in completing the maturity of the wood, and thus establishing them in their new root-runs in pots. Unless this care can be given, Roses had better not be potted up till November. In any case, after potting and establishing the hardier Roses, such as Perpetuals, should be plunged, say, three inches over the rims of the pots in a sheltered place in the open air. The object of this deep plunging is two-fold—to protect the pots and also the roots from the frost, as it breaks the first, and chills and paralyses the latter.

Tea and other sensitive Roses must not be kept in the open air after potting, but should be nurtured in any frost-proof glass structure. Neither must the first potting-up of Roses from the open be confounded with the shifting of Roses in pots into larger ones as the roots need more space. The latter may be done at almost any season, April or July being perhaps the best months for the purpose. No Roses in pots, however, should be shifted into larger pots within two or more months of the time of blooming, and it is especially desirable to bear this in mind in regard to forced Roses, as injudicious or untimely shifting not seldom sends these into growth, to the weakening and injury of the blooms

Potting-up of Roses for Special Purposes.—The foregoing remarks are hardly applicable here. No one who grows many Perpetual or Tea Roses in the open air, but must have tried at times to save their late shows of buds and bloom from the winter frosts by placing them in pots, and moving the latter under glass to flower. With such care as already described for potting-up plants in October, this can be done, and a welcome supply of Roses thus simply secured by the aid of a pit or conservatory throughout the winter months. As the purpose here is temporary—that is, the finishing of the development of the buds into blossoms—it is important that the roots should be disturbed as little as possible. Hence the pots may be larger, or even boxes or baskets may be employed, and three to six Roses, with their roots as nearly intact as possible in balls of earth, be placed in each.

Soil for Roses in Pots.—Most cultivators have said that it cannot well be too rich. It by no means follows, however, that the richest soil is the best. The vital point in the pot-culture of Roses is the multiplication of roots, not the concentration of food into limited areas. The last can be done in many ways; the first only or chiefly by the use of a root-multiplying soil. The half-and-half of strong loam and stronger night-soil, so often prescribed for Roses in pots, certainly does not stimulate the production of roots. The following, however, is a root-stimulating mixture, that can be relied on to grow Roses in pots most successfully:—One part good turfy loam, a second part composed of equal portions thoroughly decomposed farmyard manure and leaf-mould, and a sixth part of the whole of a mixture of equal portions of charred earth or charcoal refuse, sand, bone-dust, or inch bones. If all this can be mixed together six or twelve months before wanted, and be turned over and well incorporated, say three times, before use, it will be all the better. Composts are often used too fresh, for roots never feed on such, a certain stage of mellowness or decomposition being essential to enable the roots to absorb the plant-food that may be in the compost. Such composts are more useful, however. for multiplying than feeding the roots. Having the pots filled with healthy roots, nothing can be easier than the feeding of them once or oftener in the course of the day with liquid guano, soot, or other manure-water, such as house-slops or sewage.

Those who can neither commsnd loam manure, leaf-mould, charcoal, nor bone-dust need not despair of growing Roses in pots. Common kitchen or other garden soil, or a few spadefuls of loam off a common, mixed with road scrapings, will also grow Roses in pots, and assuredly it is not always those that have the pick of the best soils that score the greatest successes, but very much the contrary.

Lift the plants with care, with as many roots intact as possible. Examine the roots carefully, remove suckers, if any, or any prominent buds on the roots likely to run into suckers, with a sharp knife, and cut back any roots on plants worked on briars that may seem to grow too strong for the size of the pot. The pots being previously crocked —that is, drained as already described—place a few pieces of the roughest soil or compost all over the drainage, fill up the pot nearly half full with the compost, and make it firm as the hand, or the base of an empty pot, can make it. Then, holding the Rose plant in the left hand, place it carefully in the pot, and begin to place the longest roots on the top of the soil, giving the roots an upward and circular start round the pots. Fill in with the right hand, and press the earth firmly on to the roots, laying the latter in carefully in different planes as the work of potting or filling in the soil proceeds. Properly potted, each root of the Rose will be separated from any other root, and will have a small area of soil wholly to itself at starting and for some time afterwards. It is almost impossible to press the soil home too firmly around the Rose-roots. Leave a full inch of space from the surface of the soil to the rim of the pot, and let this surface be as level as the eye and fingers can make it from the Rose-stem in the centre to the side of the pot. In larger pots, say from twelve inches in diameter upwards, this space should be from one and a half to two inches in depth. This is the water-space, and it is of great importance that it should be level and ample, so that every portion of the soil within the pot should receive its equal share of moisture.

After potting, water the roots home, that is, fill the entire space left from the rim of the pot to the surface of the soil with water. This finishes the levelling of the surface, and consolidates the roots into their new quarters. One such watering is mostly sufficient, but if there is any doubt about the soil being moistened through, a second filling up may be given. The plants should be left to drip or dry thoroughly, and then placed in their quarters in the open air or under glass, as already indicated, or tho watering may be deferred till after placing.

Surface Mulching.—An inch, two, or more of cocoa-fibre refuse or half-decomposed manure is the best material for excluding frost and conserving the moisture and manurial strength of the soil. It also renders watering unnecessary until the roots are in full activity—a point of almost vital importance to success, for nothing is so injurious to the texture and strength of composts, however good, as frequent watering, before the roots have permeated through them. So soon as the soil becomes fairly full of roots, Roses in pots may be watered freely as often as required. It is a decided gain, however, at all seasons, to prevent, as far as may be, the loss of moisture and of strength by surface-mulchings. As the Roses get into full growth during the summer, or by forcing or fostering under glass at any season, the mulch should be converted into a perpetual supply of rich food by the use of strong manure on the surface.

Keeping the Roots in the Pots.—Rose-roots have a strong tendency to dig deep to find the gold, that is, their food. This deep boring proves rather troublesome to the cultivator of Roses in pots, for instead of staying within the pot, the best roots not seldom make tracks for and rush through the bottom, thus exchanging the very best for the worst of soils. Much may be done to keep the roots at home by giving them a horizontal rather than a vertical inclination at starting. Another most useful check to root-wandering is the production of a vacuum under the pot Rose by inverting an empty pot under it. This is also the most effectual baulk that has yet been devised against the entrance of worms into Rose-pots, and the ingress of the latter is almost more fatal to successful cultivation than the egress of the roots. A handful of soot under the inverted pot will render this device worm-proof.

Staking Pot Roses.—If the plants are large and the situation at all exposed, stakes will be needful until the roots are re-established and possibly afterwards; one good stake at first will suffice, and this is given as much to insure rapid rooting as for the safety of the top. As the dwarf Rose runs into a dense bush, six, or even a dozen stakes may be needed to mould it into form, but the fewer the better.

Culture and Pruning.—The whole of the top should be left intact for at least a month, six weeks, or two months after potting. Each branch and twig of the Rose-bush will exert a stimulating influence in resuscitating the semi-suspended action of the recently-detached roots. So soon as the roots are actively at work the pot Rose shoots may be thinned out, and only a few of the stronger ones left. These may be cut back more or less, according to the habit of the Rose and the time it is wanted to bloom. (See general remarks on Pruning, Vol. II., p. 9.)

As a rule, however, Roses in pots may be more severely cut back than those in the open air, as they have a tendency to produce more moderate-sized shoots, and these are strengthened by close pruning. Better results are also mostly reaped from a few strong shoots than a greater number of weakly ones. But so much has already been written on the pruning of Roses, that a few illustrations appealing to the eye will prove more interesting and instructive than pages of letter-press. In Fig. 48, the pruning and training of pot Roses may be seen in operation—from the lifting of the small plant from the open ground in July or October, until it has grown into the best and most useful form for a pot Rose—that of a dwarf bush in its third season from the ground.

Free exposure to light and air is essential, alike whether the Roses are grown in the open throughout the year, or are to be forced or fostered under glass. Plunged in the open air or placed in houses, no contact nor over-crowding must be permitted, for perfect maturity of growth is the secret of robust health and profusion of bloom.

Young plants may need shifting twice a year, say April and July, but established ones once every autumn, say in October. It will not always be needful to give them a larger pot, but the drainage may be replaced or re-adjusted, as much old soil as possible removed, and replaced with fresh compost, such as that already recommended, and the plants removed to their old quarters, or placed in new ones under glass, as thought best.

The general culture throughout the growing season may be summed up in a sentence, thus: Keep them clear of insects, stable against winds, and never let them flag for lack of water, or want of food. Manure-water, made from soot, pigeons' dung, or guano, the latter not stronger than half an ounce to the gallon, are among the best foods for pot Roses, and a good overhead sprinkling at least twice a day—say at six a.m. and six p.m.—will impart size, vigour, and hardness to the foliage, and additional beauty to the buds and blossoms.

Roses in Pots under Glass.—Roses in pots mostly bloom at least a second time in the open air. Nothing can be more natural than the moving of late-blooming Perpetuals and Teas into the window or conservatory to expand the buds and blossoms that might otherwise be cut down by early frosts. In this way Roses may often be enjoyed throughout most of the winter months. Besides, as already remarked, the time of blooming is largely determined by the season of pruning. Instead, therefore, of allowing all the Roses in pots to bloom a first or a second time nearly abreast, some portions of them could be cut back—say at the end of July—to force a second bloom, and these late cut-backs would yield a succession of flowers in a sunny window or light conservatory till the end of the year.

The same end might be reached by potting-up Perpetuals and Teas in bud at the end of September, and by such and other means of fostering late blooms on out-of-door Roses, as well as the general culture of Tea and other varieties in the conservatory, and by forcing, the greatest and newest charm of modern horticulture, that of Roses all the year round, may be brought within reach of most horticulturists. Much can be accomplished by these two methods of growing Roses: that in the open air, and in ordinary green-houses and conservatories. But if we add a Rose-house and the forcing of Roses in pots to these two, the supply is enlarged, and a continuous succession of flowers more thoroughly insured.

The pot-culture of the Rose in cool houses does not differ from that in the open air, unless in the matter of climate. The latter, however, is a most vital difference, affecting treatment, however, far less than produce. Roses in conservatories may need more frequent and larger shifts; shorter and less thorough rests. Fortunately Teas and some of the Hybrid Perpetual Roses, notably La France, go on blooming, breaking afterwards, and flowering again on the new wood throughout the season. Still, as the normal temperature of the conservatory, from 45° to 50°, is too low to perfect Roses in winter or very early spring and summer, there is need of forcing Roses in pots, and of having a hot-house full of Tea Roses planted out, to sustain the supply. The ordinary culture and treatment of green-house plants admirably suits Roses in pots in conservatories, and as growth cannot be effectually arrested there by cold, it is good practice to partially arrest it by comparative drought, when practicable, between each succeeding crop of bloom.

Two, three, or even four crops a year may be gathered in conservatories, according to treatment given, variety grown, and temperature maintained. In forcing-houses, Roses may be encouraged to break early, and develop their first blossoms at the end of March or early in April, their second in June, and their last in September or October. But where a considerable variety are grown, they will be very far from coming in all at one time, and so much the better for a continuous supply. So soon as any plant has finished blooming it should be cut back, the roots kept rather dry for a week or a fortnight, and then freely watered and syringed overhead, to encourage the plant to break into fresh shoots. Disbud these breaks early, retaining one or more of the most promising shoots on each branchlet as room can be found for them. These, under the fostering conditions of light and a growing temperature, will speedily grow into fresh-flowering shoots, to undergo the same process as those that preceded them, and so on throughout the season.

While Roses thus stimulated and fostered to flower in succession every year must never be allowed to lack food, or suffer for want of water, it is a serious mistake to over-feed or over-water them. The season when these stimulants, such as liquid manure, are most useful to them, is just before the successive breaks of the young shoots and for a month or so afterwards. As soon as any of the buds show colour, all stimulating food should be withdrawn, and also the daily overhead syringing.

The Autumn Treatment of Conservatory Pot Roses.—A portion of these will probably go on blooming far into the winter, and these, where there is no second house, and indeed all the others, will necessarily remain under glass. But it is often practicable to place a good portion of the stock in the open air for a month or six weeks towards the middle or end of September. This practice is most useful in cleansing if needful, and more thoroughly maturing, as well as strengthening the plants. This brief open-air regimen also affords a good opportunity for re-potting the Roses if needful, examining the drainage, top-dressing the plants with rich compost, washing the pots clean, &c., before replacing the Roses under glass, which must be done by the end of October. If some of these are placed in exceptionally light and warm parts of the conservatory, they will often yield useful pickings of bloom, although not a full crop, throughout the winter months.

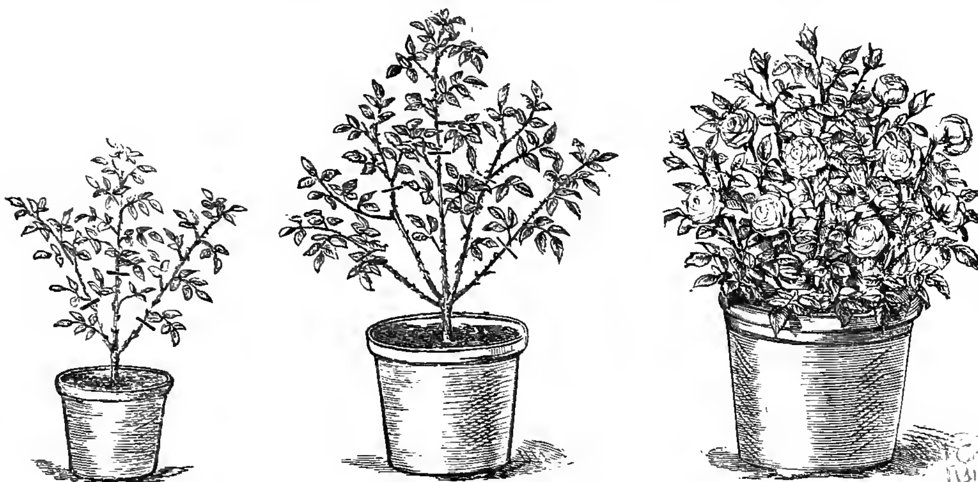


Fig. 48.—Pruning of Pot Roses.

FORCING ROSES IN POTS.

This differs from that already described in temperature and season of growth. It used to be said with truth that Roses grew and bloomed naturally in spring and summer, matured in autumn, and rested in winter. The so-called Monthly Roses introduced the new fashion of growth and bloom in succession throughout the year. These have originated our Teas, which are the old Monthlies grown large, and become sweet. The Hybrid Perpetuals, as their name implies, inherit similar qualities, though in a lesser degree. Still, with all these more excitable classes the normal temperature of our climate is too low for the development of perfect Roses from November to May. Hence, if we would have Roses in plenty throughout these chilly months, they must be forced. Change our winter temperature to a summer one, and subject well-prepared thoroughly-ripened Roses in pots to summer heat from December onwards, and Roses in February, skilfully grown under favourable conditions, are almost as certain as Roses in June. Were artificial light, electric or otherwise, as well under our control as heat, the qualifying "almost" might be dropped out of the preceding sentence.

Plants on their own roots are mostly preferred. These respond more readily to artificial warmth, and escape all the difficulties and dangers that may originate in incongruities between stocks and scions. It must, however, be admitted that great success has been obtained in the forcing of Roses worked on the briar and other stocks.

That the pots be well filled with roots is a vital point with the experienced Rose-forcer. This condition of success may be said to apply to all plants as well as the Rose. Not only must there be an abundance of roots, but the whole ball of soil should be filled to overflowing with them, and the roots should press against the internal surface of the pots all round, to insure the fullest Rose harvest which the tops are capable of yielding.

A third point is maturity and strength of wood. Growth should be well ripened, and full of vital strength. By this latter phrase, mere size is not exactly meant. Medium-sized growth, with the buds as prominent as if they were ready to sever their connection with it, is the visible sign of the strength here desired.

Early pruning and disbudding are essential to success, especially in early forcing. Pot Roses placed in heat in December should have been pruned in September or October. This would concentrate, and, as it were, accentuate vital force into the buds left, and such well-filled buds respond at once to the stimulants heat and moisture. It is also good practice to disbud severely, only leaving two buds or so on a shoot, so as to keep the head of the Rose thin, and thus insure more strength as well as light for those left.

Bottom heat, though not absolutely essential, is very helpful. It should be from five to ten degrees in excess of the atmospheric temperature. A house or pit about twelve feet wide, with a narrow path down the centre, and a pit four feet deep on either side, filled with leaves or tan, is perhaps the best possible for the early forcing of Roses. Such a structure would hold from seventy to a hundred pot Roses, according to their size. With the pots plunged in a bottom heat of from 55° to 60°, the surface temperature should not exceed 45° to 50° for the first fortnight or three weeks.

Temperature.—A cool start is best for Roses. From 45° to 50° is sufficient until the buds are fairly broken and the roots in full activity. As growth extends, a rise of ten degrees is ample until the buds begin to show colour. During the last or flowering stage, a night temperature of 60°, and a day one of 70°, may be provided; but these figures should never be exceeded by artificial heat. An addition of ten or more degrees of sun-heat will do no harm. For though the Rose dislikes anything like excessive heat, yet any attempt to keep down the temperature by admitting a rush of cold air, say in March, would do far more harm than a temperature of 80° for a few hours.

Those who have noted how Roses in the open air thrive and prosper in the dewy mornings towards the end of May, will not neglect to secure a growing atmosphere for their forced Roses by overhead sprinklings and damping down paths and stages, &c. When bottom heat is given by the use of fermenting materials, few of those additional sources of moisture must be resorted to. During dull weather, and so soon as the plants get into bloom, overhead sprinkling should be discontinued. It is very important that the water used for this purpose should be soft and pure, or it leaves disfiguring marks on the leaves and bloom.

Watering the Roots.—But little will be needed for the first few weeks; probably none if the pots are plunged in a mild, moist, bottom heat; but as the shoots extend, and the leaves get fully developed, the Roses in pots may require watering every day, or even twice a day. The temperature of the water should exceed by five degrees that of the forcing-houses.

Routine Attention to Forced Roses.—This consists in keeping the roots and stems free of suckers, thinning out any weakly shoots or any excess of buds, tying up the shoots if the buds are so heavy as to need support, surface-stirring the soil, or adding fresh should the roots, as they often do, come up and run along the surface; keeping them free of insect pests, and so exposing them to light and air as to keep up their strength to the last.

Time of Blooming. — Within about three months or a little more of the time of starting should be allowed. As the season advances, less may be sufficient. Should unfavourable weather prevail, it is safer to allow more time; the forcing of Roses into bloom in May being a much easier and shorter matter than to make them flower in February or March. Blooming may be prolonged by shading during bright sunshine, and lowering the temperature to 60° or so as a maximum; or, better, by removing the Roses to cooler houses when in flower.

Simpler Means of Forcing Roses in Pots.—Among these, that of taking dwarfs or short standards up out of the ground in the early autumn, placing them in pots, and introducing them into forcing or cooler houses or pits in January, and thus gently fostering them into bloom in April and May,

may be noted. This rough-and-ready mode of forcing Roses in pots results in anticipating the natural Rose season in the open air by a month, six weeks, or two months, and may be practised by any one possessing a cool pit or a green-house. Though the results are neither so certain nor so perfect, they are well worth the slight efforts made to procure them.

After-treatment of Forced Roses.—While the plants are in full beauty, they are sure to receive the attention needful, but so soon as the flowers fade comes the danger of neglect or injurious treatment. The batches of late-flowering Roses—that is, those that bloom after the middle of May—may be placed in a sheltered situation out of doors, and if carefully attended to as regards pruning and watering and keeping clean, will be none the worse for their gentle forcing, but all the better, the forcing one year being an excellent preparation for their forcing to even better purpose the following one. But forced Roses that bloom in February or March must be kept under glass till the 20th of May, when all the summer or once a season blooming Roses should be placed out of doors. For the first two or three months they can hardly be put in too warm or sunny quarters to thoroughly ripen the wood; but afterwards, and throughout the autumn, the colder the place that can be found for them the better. These should be pruned in September, and will be ready to start once more for forcing anew in November or December.

Treatment of Tea and Hybrid Perpetual Roses after Forcing.—The safest method of treatment for these consists in cutting them back rather hard so soon as they have finished flowering (say in February or March), keeping them a little dry at the roots for a week or a fortnight, top-dressing the surface of the pot with fresh soil, turning over and adding some fresh material to the hotbed if needful to augment the bottom heat, and then fostering growth by overhead sprinkling, a humid atmosphere, &c., as before. The result will be a second crop of bloom often better than the first, and produced in much less time, say in April or May. From this point there are two modes of procedure before the forcer. The process of cutting back and resuscitation may be repeated, and a third crop of Roses gathered from the same plant in July and August. This repetition may answer well where the bloom is more prized than the permanent stability and usefulness of the plant. As a good supply of Roses from the open air may now mostly be depended on from June to the end of the growing season, most forcers of Roses content themselves with two crops of bloom off the plants, gathering both between February and the end of May, and then place their Roses out of doors from June to October. Here, however, they must be carefully and skilfully treated, the wood that produced the second crop thoroughly ripened by solar heat, and rested by cold and drought, the two latter obtained by withholding water behind a north hedge or wall. Neither must these Roses, full of vitality, and of only semi-suspended growth at their most restful period, be pruned too early, or a third growth of bloom would be produced so late (that is, in September) as to render the plants unfit for hard forcing in November or December.

If, however, not required for early forcing next year, these Roses might be pruned again, and would produce good crops of late autumn and early winter Roses either in the forcing-house, warm conservatory, or sunny window.

Well-grown, properly-managed Roses in pots in the open air will furnish any amount of the best material for forcing, and thus all the three sets of portable Roses will contribute to work out the most pleasing and profitable of modern Rose problems, that of a constant supply throughout the year.

Varieties Specially Adapted for Pot-culture and Forcing.—In addition to those already named as among the more suitable for open-air culture near or in towns (see page 265), the following are the most suitable for general culture in pots in the open air, conservatory, or for forcing. For the latter purpose especially fragrance is of the highest importance.

Among the Teas, Devoniensis, Maréchal Niel, Narcisse, Madame Willermoz, Gloire de Dijon, and Triomphe de Guillot fils are some of the most fragrant. Almost the only sweet-scented Roses among Bourbons or Noisettes are Madame Isaac Pereire and Madame Desprez. The most fragrant of the Perpetuals, in addition to those already mentioned, and recommended for growing in towns, are—

Anna Diesbach.
Abel Grand.
Alfred Colomb.
Mlle. Annie Wood.
Baronne Prevost.
Beauty of Waltham.
Camille Bernardin.
Comtesse de Mortmart.
Centifolia rosea.
Comtesse de Chabrillant.
Charles Lefebvre,
Duchesse de Caylus.
Duchess of Sutherland.
Mons. E. Y. Teas.
Elizabeth Vigneron.
Harrison Weir.
Glory of Waltham.
Madame Boll.
Madame Gabriel Luizet.
Madame Fillion.
Madame Furtado.
Mlle. Marguerite Dombrain
Marie Baumann.
Monte Christo.
Pierre Notting.
Souvenir de Leveson-Gower.

The three so-called Cabbage Roses—that is, the common Crested and White Unique, and the common Rose-coloured or Old Moss—are still among the very sweetest of all, and for this reason, as well as for their many associations, deserve to be grown in pots, either for forcing or otherwise.

OTHER ROSES FOR POT-CULTURE OR FOR FORCING.

Noisettes.

Celine Forestier.	Wm. Allen Bichardson.
Lamarque.	Caroline Kuster.
Solfaterre.	Rêve d'Or.

Teas.

Catherine Mermet.	Madame Bravy.
Comtesse Riza du Parc.	Madame Cusin.
Homere.	Madame Margottin.
Isabella Sprunt.	Madame Welch.
Innocente Pirola.	Marie Van Houtte.
Jean Ducher.	Sonvenir d'Elize.

Hybrid Perpetuals.—In addition to those already named for their fragrance, &c., the following are a few good varieties for pot-culture:—

Abel Carrière.	Madame Lacharme.
Baroness Rothschild.	Madame Clemence Joigneaux.
Catherine Soupert.	Mlle. Marie Rady.
Comtesse de Serenye.	Prince Camille de Rohan
Duke of Connaught.	Séuateur Vaisse.
Edward Morren.	
Fisher Holmes.	

GLASS STRUCTURES AND APPLIANCES.

HEATING.

BY WILLIAM COLEMAN.

ALTHOUGH heating by the circulation of hot water through metal pipes dates back to a period prior to the Christian era, when the Romans heated their baths by means of coils of pipes which passed through the fire, the method does not seem to have made much progress until the latter part of the last century. More than a hundred years have elapsed since a Frenchman employed hot-water pipes for warming incubators, but the system did not reach this country until 1817, when M. Chambannes introduced an apparatus for heating a conservatory and the rooms in his house. From that time until the removal of the duty on glass, and the introduction of cheap foreign timber, its progress was extremely slow, and the principle being imperfectly understood, many mistakes and failures were the stepping-stones which led up to the gradual perfecting of a science which now forms the great moving power in our forcing operations.

Until within the last few years, the old brick flue was the only heating-apparatus, and clumsy as it now appears to have been, we gather from reliable authors, independently of our own experience, that excellent crops were forced into early maturity by means of well-constructed brick flues. There is, as all horticulturists know, another method of obtaining heat, viz., from fermenting materials, but this method has been sufficiently treated incidentally in other articles.

Circulation.—All horticultural buildings are heated upon the low-pressure principle, pure soft water, free from lime, being the best medium that can be used. The apparatus is filled with cold water, which attains its greatest density and smallest volume at 39·2 Fahr. Upon the temperature being raised above this point, the volume increases and the

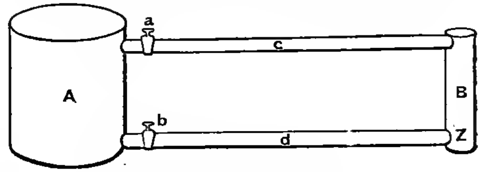


Fig. 46.—Circulation of Water.

density decreases. Let us assume that the boiler A (Fig. 46) is filled with cold water, and the stop-valves *a* and *b* are closed. On applying heat to A, the water will expand, and the water at the bottom of the boiler after it has been heated and expanded will evidently be lighter than it was before. From this cause, even in the boiler, a circulation of the water takes place, the heated particles rising upwards through the colder ones, which sink to the bottom, owing to their greater specific gravity, until they in their turn become heated and expanded like the others. This intestine motion continues until all the particles become equally heated and have received as much heat as the fuel can impart to them. But supposing the two valves *a* and *b* are now opened simultaneously, the warm water in the boiler will immediately flow along the top pipe, *c*, towards B, and the cold water in the return-pipe will flow along *d*, from B to the boiler. In this way the cold water is kept descending to the bottom of the boiler to be re-heated, through the pipes, instead of in the boiler itself. As the water in the pipes is constantly parting with its heat by radiation and conduction, while that in the boiler is as continually receiving additional heat from the fire, an equality of temperature can never occur; if it did, circulation would cease.

Expansion cisterns in small apparatus like Fig. 47 are absolutely necessary, otherwise the expansion of the heated water would defeat the object in view, and in the event of the water boiling, the safety of the boiler might be endangered. Although under good stoking the water should not boil, yet there is always a certain amount of danger. For this reason the expansion cistern, B, should be connected with the lowest part of the return-pipe, when it will also serve as a supply cistern for filling and feeding the boiler. Supply cisterns should never be connected with the flow-pipes, and where practicable they should be made self-acting by having a high pressure ball-tap affixed to a small supply pipe, at a level that will keep the cistern about three-fourths full, to admit of expansion from the boiler before it overflows. The expansion cistern and all pipes connected with it should be placed where they will be quite safe from frost.

Air Pipes.—There are very few apparatus in which the water would circulate unless some plan were adopted for allowing the escape of air, which invariably accumulates in the pipes. In large complicated apparatus where pipes are fixed on different levels, neglect of this precaution has been the cause of many failures.

Suppose we want the boiler (Fig. 47) to be filled by the supply pipe at B, the pipe D will of course be filled simultaneously with it. The water will also gradually rise in the boiler until it partially fills the upper pipe C, and the air which is in the pipe X Y will be forced towards Y by the weight of water behind it. If the quantity of air is large enough, it will prevent the junction at Y, and cut off the communication. If a small hole be drilled at Y, the air will immediately escape, when circulation will follow. In houses where a very small lead pipe, E, can be carried above the level of the supply cistern, an open vent will be secured. In pits, small stop-taps must be used, as pipes safe from frost cannot be carried high enough. The taps should be turned occasionally, as air is constantly accumulating, and every tap in the largest apparatus should be open during the time the boiler and pipes are filling with water.

As more failures arise from neglect of this simple arrangement than many people imagine, the amateur engineer will do well to note that a vent should be let into the highest part of every set of flow-pipes. In some series, especially where there are dips under doorways, or wherever there happens to be a rise, more than one air vent may be needed; for if any air be allowed to concentrate, it will form as much obstruction to the flow of water as a closed valve. Air being 827 times lighter than water, it cannot be made to *descend* under any amount of pressure, consequently a small tap or pipe is the only remedy. The diameter of these need not exceed three-eighths of an inch. The pipes should be secure from frost, and the points turned down as in Fig. 47, to prevent any solid substance from getting in, or the ejection of hot water over the foliage of plants when the boiler is working under strong pressure.

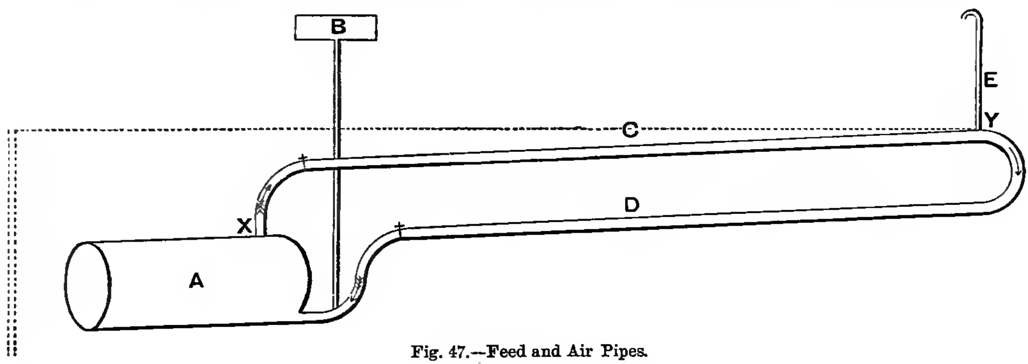


Fig. 47.—Feed and Air Pipes.

Pipes.—The pipes in general use for heating hot-houses are three and four inches in diameter. Pipes two inches in diameter are sometimes used, but for all practical purposes those of the largest size are to be preferred. The quantity of water contained in a given length of each varies in proportion to the square of its diameter. Equal lengths of two, three, and four inches being taken, the squares will be four, nine, and sixteen. Their heating power is not, however, governed by the water they contain, but by their radiating surface. The three-inch contains half as much again as the two-inch, and the four-inch twice as much as the two-inch, and it is by these surfaces that all calculations are made. It was formerly, more than now, the practice to use smaller pipes for connecting the radiating pipes in the houses with the boiler, a pipe one inch in diameter being sometimes employed to supply a set of four-inch pipes. But pipes of larger and uniform size answer best, particularly where several hundred feet have to be heated from a boiler which contains a great quantity of water.

Quantity of Piping required.—The quantity of piping required for heating a given area is one of the most important points connected with the whole system. At one time the inventors of boilers invariably wronged themselves and disappointed their clients by overrating the power of their apparatus—boilers they can scarcely be called, as the water very rarely *boils*, neither is it economical engineering to allow or require it to do so. When the water in a hot-house boiler reaches 212°, the boiling point, either it is too small for its work, or the pipes are badly set; indeed, to heat the water to 200° Fahr. the pipes must have a very unsightly rise, and the amount of driving would result in a terrible waste of fuel. In order to obtain the greatest amount of heat from the smallest consumption of fuel, we should employ a large range of piping at a comparatively low temperature, rather than a small quantity of piping worked at a high temperature. To determine the length of piping required for a glass structure, we must first of all ascertain the number of cubic feet of air to be warmed per minute. This done, it will be necessary to take into account the position of the house—whether there is a large or small amount of glass in proportion to the area; whether it is a span-roof or a snug lean-to against a south wall; and last, but not least, the position the pipes are to occupy. As heat naturally ascends, it is necessary to place the pipes on a low level, but not so low as to be removed from the full action of the atmosphere. Generally they are placed opposite the ventilators, sometimes in grating-covered areas, where, unless the areas are thoroughly ventilated from the exterior, two-thirds of the heat is lost.

On reference to the excellent work by Mr. Hood, we find the following table showing the length of four-inch piping required to heat 1,000 cubic feet of air per minute to from 45° to 90°, the temperature of the pipe being 200°.

Temperature of External Air	Temperature at which the House is to be kept.									
	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.
10°	126	150	174	200	229	259	292	328	367	409
20	91	112	135	160	187	216	247	281	318	358
30	54	75	97	120	145	173	202	234	269	307
32	47	67	89	112	137	164	193	225	259	296
40	18	37	58	80	104	129	157	187	220	255
50			19	40	62	86	112	140	171	204

To use the above table, look for the lowest external temperature in the left-hand column, and at the top for the highest temperature at which the house is to be kept, and where the two columns intersect will be found the number of feet of four-inch pipe which will heat 1,000 cubic feet of air per minute to that degree. It is, however, best to allow rather more.

Example.—Take a house containing say 10,000 cubic feet of air which it is necessary to keep at 70°, the external air being 32°. The figures at the angles below 70° and opposite 32° are 164. Multiply this sum by ten, and the result will be 1,640 feet of four-inch piping.

Position and Arrangement of Pipes.—*Main Pipes.*—Unless the house is very small it rarely happens that the heating or radiating pipes proceed direct from the boiler as in Fig. 46, but more frequently from the mains or carriers, from which a number of houses or compartments can be heated. Main pipes should in all cases rise steadily from the boilers; they should never be allowed to dip, and if possible sharp bends should be avoided. As many people have an idea that several series of four-inch pipes require a main whose area is equal to that of all the branches, it may be well to state that this is a fallacy which often leads to unnecessary expense, followed by unsatisfactory results. Small mains, on the other hand, which offer great resistance, should in like manner be avoided, and the happy medium, in all cases the best, decided upon. This, unless the place is very large and complicated, will be secured by the introduction of four-inch pipes, which may rise quickly to the first part of their work, afterwards the rise need not exceed half an inch in every nine-foot length.

Mains should always be protected from the influence of the atmosphere when placed above ground, otherwise they will lose a great deal of heat. When carried below the ground-line, as is generally the case in gardens, brick areas, in which the pipes can be supported or suspended, will be most suitable for their protection. The areas should be closely covered and not ventilated, as a body of quiescent air is a good non-conductor of heat. When so covered, facilities for getting to the pipes should always be provided, otherwise leaks will cause much unnecessary labour and trouble in breaking up the ground to discover them.

In large gardens distinct sets of mains may be required to carry the water from two or more boilers, working separately or together. Under this arrangement every flow and return from the different boilers should have patent stop-valves that can be closed in case of accident to one of the boilers, when the sound part of the apparatus can be kept at work during repairs.

Joints.—Many modes of making joints are now in use, and being well understood by good workmen, short reference here will suffice. Many who look upon the screw-and-flange joints with vulcanised india-rubber rings or washers as plebeian, cling to the old cement joints.

The india-rubber rings make excellent joints (Fig. 48, in which *a* shows the ring before, and *b* after, the joint is made). They require very little skill, are made quickly, and can be taken to pieces, and removed or altered in a very short time. Cement joints take up less space, they look neater than screws, and their cost when fixed is about the same; but if alterations or removal are necessary they become more expensive. Iron cements require skilful preparation, as owing to the chemical change which eventually sets in, tightly-caulked joints often burst the sockets. When spigot and faucet pipes are used, red and white lead, thoroughly mixed, and strands of tarred hawser-rope, make joints equal, and in many respects superior, to the best mineral cements. By the application of fire these joints can be fused and taken to pieces without breakage. An excellent joint can be made by caulking with rope, and facing with Portland cement; but, like the joints made with iron filings and sal-ammoniac, it is almost impossible to disconnect them when once they are thoroughly set without breaking the pipes.

Fig. 48.—Ring Joint.

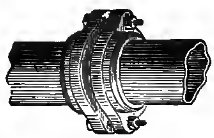


Fig. 49.—Flange Joint.

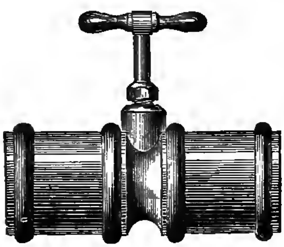


Fig. 50.—Ordinary Throttle-valve.

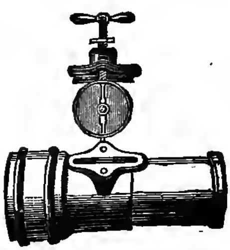


Fig. 51.—Patent Slot Throttle-valve.

Another joint (Fig. 49), which is now rapidly gaining favour, is made with socketless pipes, which butt together, and are kept perfectly water-tight by means of vulcanised india-rubber rings, drawn together by two flanges, which can be tightened with screws and nuts. The pipes being cast without sockets, alterations or additions can be quickly made by unskilled workmen, and any length can be removed and replaced with little trouble.

Valves.—Without valves a complicated heating apparatus would be like a ship without a rudder. The circulation in a single flow and return pipe, like that shown in Fig. 47, can be regulated by stopping or increasing the fire; but when more than one series of pipes is used, stop-valves become absolutely necessary. The ordinary throttle-valve (Fig. 50) is made with a metal disc, which offers very little resistance to the water when open. When closed it checks the circulation fairly well, but the discs being made of brass, and the body of the valve of cast iron, they soon get out of order. Valves should always be placed in returns, as well as in flows, otherwise, especially when boilers are shallow, and the orifices of the flows and returns are near to each other, the water will circulate backwards, *i.e.*, it will leave the boiler by the return-pipe, and return by the flow.

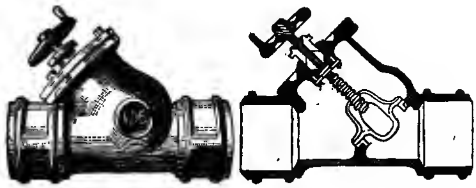


Fig. 52.—Improved Diaphragm Valve. Section.

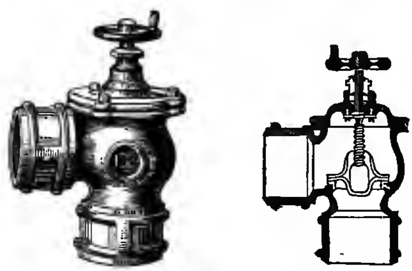


Fig. 53.—Improved Angle Valve. Section.

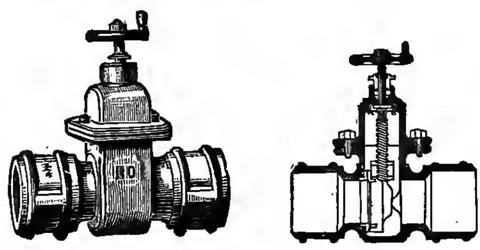


Fig. 54.—Improved Slide Valve. Section.

The slot throttle-valve (Fig. 51) is a great improvement on the old throttle-valve.

High-pressure valves should always be used where boilers are coupled together, in all mains, and wherever it may be thought desirable to effectually shut back the water in case of break-down or accident. The three valves (Figs. 52, 53, 54) manufactured by Foster and Pearson, of Beeston, to which the Horticultural Society's medal has been awarded, are admirably suited to this purpose, as they answer the two-fold purpose of valve and stop-tap.

Valves are sometimes placed in front of **H**-pieces (Fig. 55) when a flow and return pipe run through

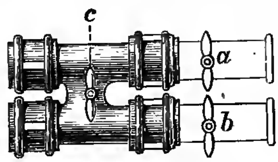


Fig. 55.—**H**-piece with Valves.

several compartments, say A, B, C (Fig. 56); by placing the castings, say at O, A can be heated by

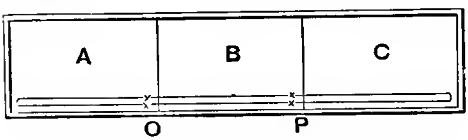


Fig. 56.—Heating Compartments separately.

shutting the valves, *a b*, while B and C remain cold. By opening them at O, and closing them at P, A and B can be heated, while C remains cold; and by opening all the valves, the three sections will be heated. **H**-pieces are often made with valves at *e*, but with an air pipe at the extreme limit of C, these are of no practical value.

Boilers.—The number of these before the public is now very great, and, at first sight, almost formidable; but when classified and divided into three or four sections, to which nearly all of them belong, the difficulty in choosing a boiler for any special purpose is not so great as many imagine.

The power of a boiler depends upon the area of heating surface, and the amount of heat given out depends upon the position of that surface, and the way in which a boiler is stoked. If every square foot of effective heating surface in a boiler is equal to the heating of forty to fifty feet of four-inch piping, and fifty to sixty feet of three-inch, it is easy to decide upon the boiler capable of doing the work, provided always that we take off thirty per cent. of the manufacturer's calculation, and take two boilers to heat, say, one thousand feet, when *one* is represented as being capable of doing the work. Then, were two forms, one more simple than the other, presented for our approval, we should not go far wrong in choosing the simplest form, affording the largest surface for the fuel to act upon in a direct manner.

Makers of boilers often prejudice themselves, and disappoint the public, by specifying the quantity of piping their boilers will heat when everything is fresh, clean, and new, the interior free from incrustation, and the flues clear of dust. Driving, however, does not mean economy of fuel, and, as all practical men are anxious to obtain an apparatus that will do the greatest amount of work at the smallest outlay for fuel, or for repairs in case of accident, a boiler capable of heating fifty per cent. more piping than is

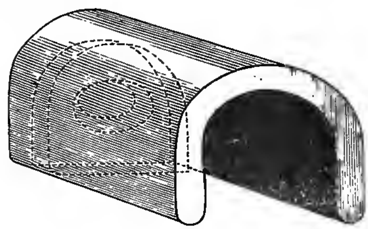


Fig. 57.—Plain Saddle Boiler.

likely to be attached should always be selected, as it will be found the cheapest in the end.

The following table gives the maximum quantity of pipe which a boiler will heat, supposing the best fuel only be used; every square foot of boiler exposed to the direct action of the fire being equal to three square feet of flue surface:—

Surface of Boiler exposed to the direct action of the fire.	4-in. pipe.	3-in. pipe.	2-in. pipe.
4 square feet will heat	200 feet, or	266 feet, or	400 feet.
6 ,, ,,	300 feet, or	400 feet, or	600 ,,
8 ,, ,,	400 feet, or	533 feet, or	800 ,,
10 ,, ,,	500 feet, or	666 feet, or	1,000 ,,
14 ,, ,,	700 feet, or	933 feet, or	1,400 ,,
20 ,, ,,	1,000 feet, or	1,333 feet, or	2,000 ,,

A small apparatus ought always to have more surface of boiler in proportion to the length of pipe than a larger one, as the fire is less intense, and burns to less advantage, in a small than in a larger furnace.

The Saddle Boiler is too well known to require description. The plain saddle (Fig. 57) is the type of a great number of boilers, which cannot easily be beaten. It is made in cast and wrought iron, welded or riveted. Wrought-iron boilers, although more subject to incrustation, are generally chosen in preference to cast, and when well set over a fire-place composed of fire-bricks, and properly stoked, they are sure to give satisfaction. An improved form of this boiler is made with what is called a terminal end. Besides the surface exposed to the direct influence of the fire and the exterior (as in the ordinary saddle), there is an additional flue. After leaving

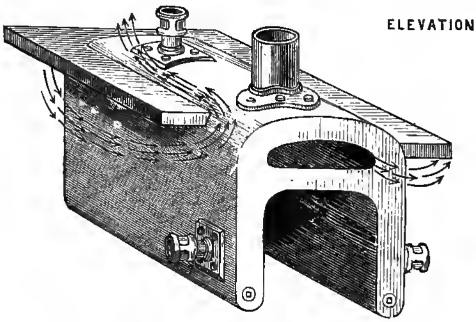


Fig. 58.—Terminal End Saddle Boiler.

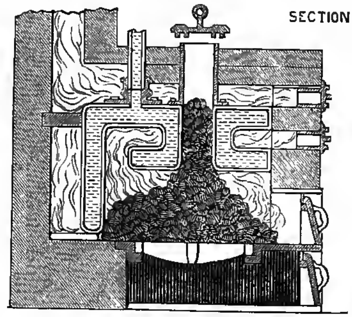


Fig. 59.—Section of Terminal End Boiler.

the furnace, and passing to the back of the boiler, the products of combustion pass to the front in one stream, thence under the check plate, quite round the exterior, as shown by the arrows in Fig. 58, over the top, and into the chimney. Figs. 58 and 59 show this boiler with patent top feeder, which is recommended as being more economical, inasmuch as the boiler can be stoked from the top instead of the front, or *vice versâ*, as the doors and setting are similar. Not having had any experience of this form, the recommendation is given as received; but, judging from the section, we think that the position of the feeder must interfere with the removal of accumulations of soot and dust when cleansing becomes necessary. Fig. 60 shows the same boiler with part of the brickwork left unfinished, to show the mode of setting. If not well set, boilers are a source of constant waste and trouble.

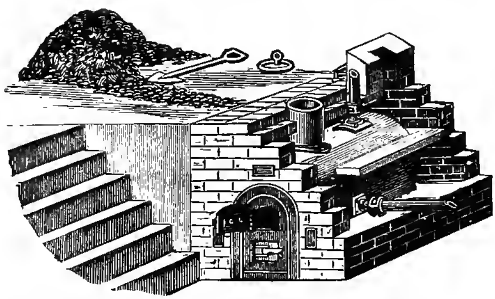


Fig. 60.—Elevation showing Method of Setting.

Hartley and Sugden's Gold Medal Boiler.—Figs. 61 and 62 show the saddle in another improved form. In addition to the surface against which the flame impinges and the exterior, there are in this boiler three additional flues. After quitting the furnace and passing to the back of the boiler, the heat runs through the central flue to the front in one stream; it then divides, and returns to the back by the two side flues.

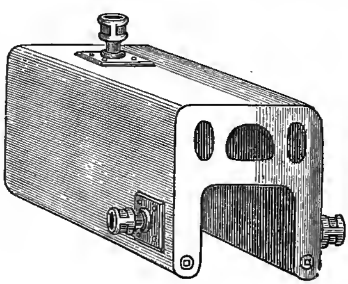


Fig. 61.—Improved Saddle Boiler.

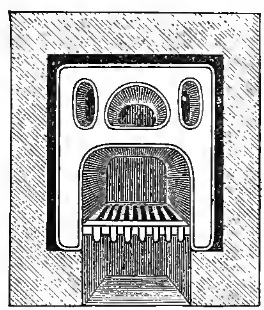


Fig. 62.—Setting of Fig. 61.

All the preceding boilers are very easily set, there being no complicated flues, and although coke is best, they will consume any kind of fuel. In addition to the above, there are several other forms of saddle, including Gray's Corrugated, and the Witley Court. The drawback to the latter, when made in or under medium size, is the smallness of the space for the fire. If banked to draw at all, the fire burns out before morning. If tightly banked, it does not maintain the heat.

Stevens' Improved Cornish Boiler.—Figs. 63 and 64.—Although this modified form of the old and good Cornish boiler can hardly be called a saddle, it ought, perhaps, to be placed in that section. It consists of two wrought-iron cylinders riveted together, one within the other, having about two inches of waterway between them. The grate-bars are inside the cylinder, towards the lower part, the space beneath forming the ash-pit, and that above, the furnace. The heat, therefore, passes through the centre of the boiler first, then returns over its upper half, and is finally conducted under the lower half on its way to the chimney shaft. The principle of the boiler not only exposes a large area of water to the direct action of the fire, but the heat operates with its greatest force upon the upper part, where there is no possibility of solid matter accumulating to cause the iron to burn, as it invariably does when incrustations intervene. The great amount of work done by this excellent boiler, with a small expenditure of fuel, has thoroughly established it as one of the best boilers now in use. It is easily set, and does not require a deep stoke-hole.

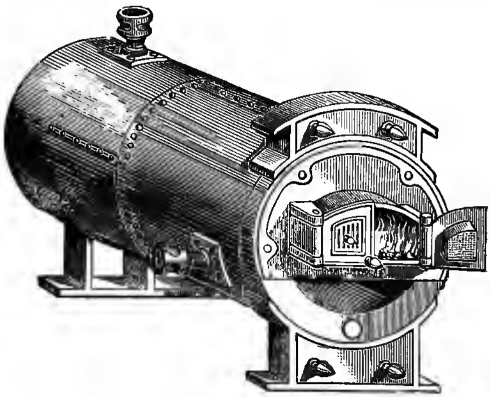


Fig. 63.—Stevens' Improved Cornish Boiler.

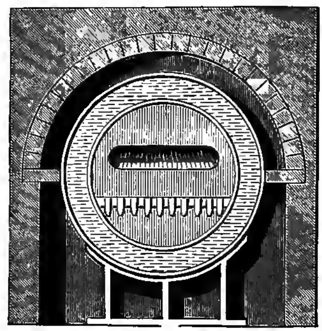


Fig. 64.—Section of Cornish Boiler.

Tubular Boilers.—These boilers, quick and powerful in their action, have been much used for heating large establishments, but owing to their liability to crack from unequal contraction when cooling, have gone out of favour. In order to overcome or reduce the danger of such sudden collapse, Messrs. Weeks and Co. have invented the Duplex Upright Tubular Boiler (Fig. 65). It is made in two parts, which can be worked jointly or separately, so that in the event of accident one part can be detached and replaced, while the other is doing the work, if not perfectly, in a way that will keep the occupants of the houses from injury. This is, no doubt, a great improvement, but such boilers require a somewhat deeper setting, which is often inconvenient.

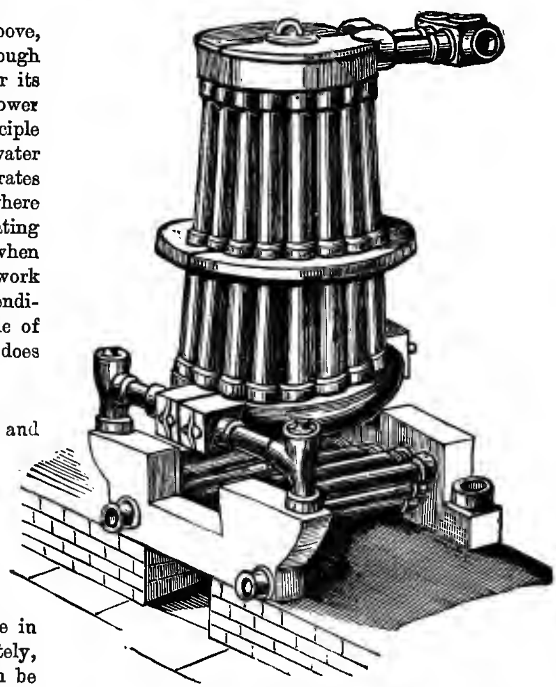


Fig. 65.—Weeks's Duplex Upright Tubular Boiler.

In the Chilwell Horizontal Tubular Boiler the apparatus is also sectionally divided, but in a quite different manner. The tubes are here arranged over an ordinary furnace, with doors upon Sylvester's construction. The cold water from the return-pipe enters the box A (Fig. 67); thence it passes through pipes B B to the box C; thence through D D to the box E; thence through F F to boxes H H; thence through I I to boxes K K; and thence into the flow-box L. This repeated circulation abstracts a large

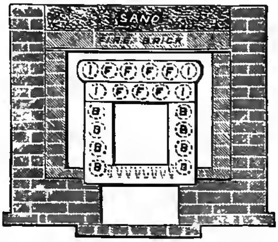


Fig. 66.—Section of Chilwell Boiler.

amount of heat—if anything, the danger may, perhaps, be of working at too high a temperature, as already referred to—and the furnace being ample and draught moderate, a steady combustion can be maintained through a long night. This is said to be the most powerful boiler yet made, and to be capable of heating 2,000 feet, and even more. It requires only a shallow stoke-hole, only four feet three inches being required from the bottom of it to the level of the flow-pipe, a matter of importance in damp districts.

One drawback to tubular boilers should be mentioned: when coal is burnt, the tubes are very apt to become coated with tar.

Before closing these remarks on boilers, there is one useful little boiler which must not be overlooked, as there is not a garden in the United Kingdom, be it nobleman's or amateur's, in which it cannot be turned to excellent account, either for heating green-houses, Grape-rooms, coach-houses, or for giving temporary assistance where the pipes attached to larger apparatus are found in-adequate to their work. It is the Portable Boiler and Furnace represented in Fig. 68. It requires no setting, and will stand on the space occupied by an ordinary watering-can. It is very quick in its action, and performs an amount of work truly astonishing; and it may be placed inside the house, although a place outside is preferable. Almost every maker now turns out these slow combustion

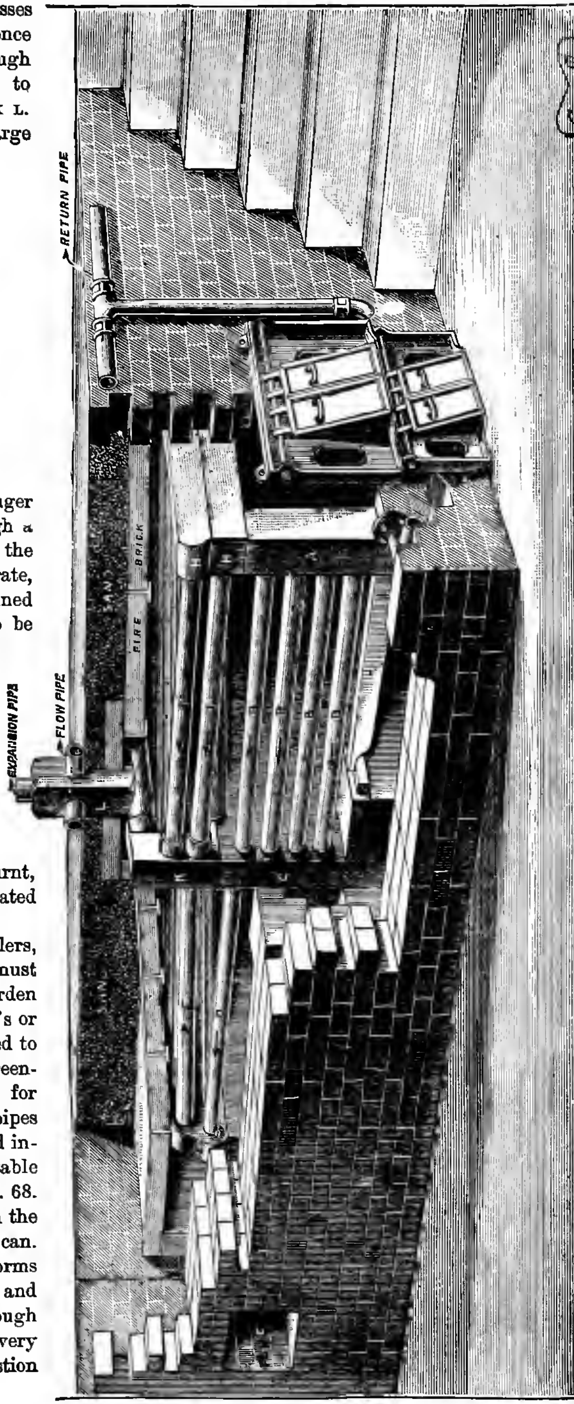


Fig. 67.—The Chilwell Horizontal Tubular Boiler.

boilers, which can be kept slowly consuming the fuel —coal, coke, or cinders—for twelve hours at a stretch without attention. They can be had in various patterns, and many of them are as neat and ornamental as a front ball stove.

Setting Boilers.—This is not less important than a judicious selection of the boiler best suited to its work. Many excellent boilers have been set and taken down again as inadequate through being improperly set, or placed behind badly arranged piping. Where amateurs or owners of one or two houses employ native bricklayers to set that universal boiler, the "Saddle," slight mistakes often lead to disappointment on the one hand, and injustice on the other. Now, as these boilers cannot be surpassed, for the benefit of a great number of the readers of these pages the diagrams in Fig. 69 have been prepared, to show how these small furnaces should be built. After raising the foundation to the proper height, the bars are placed with their ends in a line with the front of the boiler, and their upper sides level with the bottom; the remainder of the length of the furnace is made up of fire-bricks. In front of the bars comes the dead-plate, then the furnace door, whose bottom is on the same level. The distance between the front of the boiler and the door, nine inches, is made up with brickwork, which forms the general front. In this are placed three soot-hole doors, as shown in the figure. At the back are placed two fire-lumps, *d*, the same size as the boiler. They leave an opening opposite the centre of the arch for the outlet of smoke and flame into the flues, where they divide, and run right and left along the sides of the boiler, as indicated by arrows in the front view. Two cast-iron plates, *a*, built into the brickwork, divide the lower from the upper flue, but do not extend to the front wall by about five inches, thus leaving a passage from the lower into the upper flue, thence into the chimney. These flues should be as deep as the size of the boiler will allow, and the brickwork forming their sides some four inches away from the boiler. The upper fire-lump, *d*, checks the flame and keeps it back as long as possible in contact with the inner arch of the boiler before it passes out and divides, on its way to the two lower flues. The damper should be conveniently placed for regulating the draught, and the chimney, although capable of being quite closed near the throat, should be tall and roomy. Fourteen inches by nine makes a good chimney; for larger boilers it may be more.

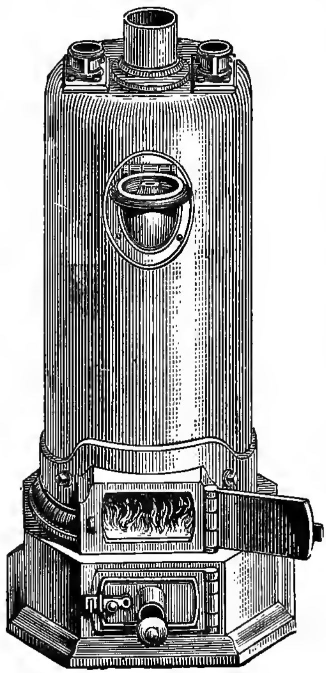


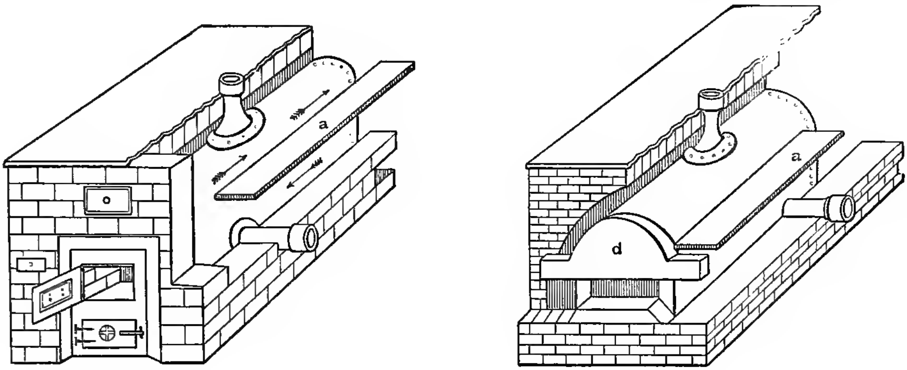
Fig. 68.—Slow Combustion Boiler.

When large boilers are purchased it is always advisable to obtain plans and instructions for setting from the makers. The interior of all furnaces should be composed of fire-brick, in preference to iron, which is a rapid conductor, and the most perfect combustion takes place when the fire is enclosed with fire-bricks or Welsh lumps. They should be constructed for a strong fire when pressure is needed, and for burning a small quantity of fuel when little heat is required. All furnace and ash-pit doors answer best when made to fit close, without getting out of order or warped by the great heat of the fire. The best for large apparatus are known as Sylvester's construction, which have no hinges to warp. The doors, which are faced inside with fire-brick, move on rollers on an iron rod, or slide in a ledge or groove. The frame of the opening projects outwards towards the base, so that the door partly rests upon it, and the more it is moved the tighter it fits, an arrangement which enables a stoker to regulate the draught to the greatest nicety. (See Fig. 67.)

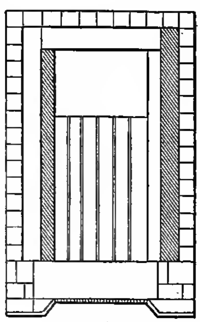
Site for the Boiler.—As all heated fluids naturally force their way upwards, the boiler should always be placed on a low level, and at the same time as near its work as possible. It may be possible, by means of circulating columns and cisterns, to compel water to circulate below the boiler, but only in extreme cases should a steady rise in the pipes be departed from. In large and complicated places a central position is very important, as long mains are in this way avoided. There are, however, many irregularly built places which formerly kept, perhaps, twenty fires going, now heated from one stoke-hole, where long mains cannot be avoided; and although some heat is lost, the loss is not so great as might be imagined, provided the areas are well built and carefully protected from wet and a circulation of air. All stoke-holes, it is needless to say, should be provided with a deep drain, and protection from the elements.

Fuel.—The cost of fuel varies so much in different parts of the country as to render it impossible to say what will be found most economical in any particular district. This fact does not, however, prevent us from saying what experience has proved to be the best. Some furnaces, notably the saddle, will burn any kind of fuel. Bituminous coal, anthracite, coke, and wood when plentiful, may be used for almost any kind of boiler; but where good coke can be obtained it is undoubtedly the best. Bituminous coal under slow combustion is apt to distil rather than consume, when the bars and tubes become choked, and the heat is lost. Anthracite, like coke, gives off no smoke, and on this account is suitable for use near mansions, where smoke would be a nuisance. Moreover, in the complete control of draught it forms an excellent slow combustion fuel for large boilers; but it is not so well adapted to small ones. The worst fuel is coal which contains sulphur, for if present to any great extent, its effect on the plates and rivets is very rapid and destructive.

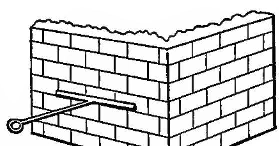
Stoking.—Although stoking has been left till last, it is by no means the least important item in economical hot-house management. A boiler may be well set, pipes in plenty properly fixed, the whole apparatus in first-rate working order, and yet success or failure will depend upon the attention and ability of the stoker. If a skilful hand, he will see that his supply cistern is full of soft water, air taps and valves in working order, stoke-holes and ash-pits clean and free from refuse, waste, and clinkers. If coal is used it should be placed on the dead-plate to coke before it is passed on to the fire. Too much should not be introduced at one time, when the draught regulated by the damper will increase or check the escape of heated gases into the chimney. A careful stoker will keep his fire-doors closed, otherwise a large quantity of cold air will pass between the fuel and the bottom of the boiler, which it will cool to a considerable extent. Fresh air is, however, necessary to combustion, but it should pass through the bars of the grate, when the heated gaseous matter will rise upwards to the bottom of the boiler, where, if the outlet is neither too large nor too high, a greater effect will be produced than if too easy an outlet is allowed into the chimney. When the fire is burning clear and heats are up, a furnace can often be shut up quite close for hours together, when a draught would mean a loss of fuel and possible injury from overheating. As a rule constant feeding tends to waste of fuel, and the introduction of too thick a layer necessitates the admission of too much air above as well as below the fire-bars, while too little



Front Back



Ground Plan



Chimney

Fig. 69.—Mode of Setting Plain Saddle Boiler.

draught leads to the formation of carbonic oxide and loss of heat.

The Tank System.—Mr. Rendle, the inventor of one of the methods of glazing without putty, some years ago introduced a novel mode of heating, which he termed the "tank system." The object is to afford a moist bottom heat to plants without the aid of fermenting materials, which are troublesome and expensive. The plan recommended is to construct a tank either of brick, slate, or other imperishable material, of any width, to suit the purpose for which it is intended, the length of the house or pit, and about five inches deep. The apparatus is very simple, as will be gathered from a glance at Fig. 70, which represents a long shallow trough, divided longitudinally as far as *a*, some four inches from the extreme end. From the top of the boiler A, a pipe communicates with one of the divisions, say at *b*, and from the bottom of the boiler another pipe opens into the division *c*.

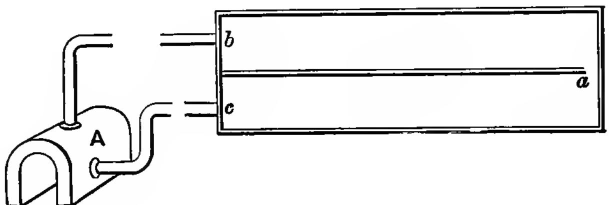


Fig. 70.—Tank System of Heating.

The first is the flow, the second is the return, and the apparatus is complete. The hottest water flows by the pipe inserted in the top of the boiler into the tank at *b*; and simultaneously its place is supplied by colder water descending through the pipe *c*, which enters at or near the bottom of the boiler, to be re-heated, and so maintain the circulation. The flow and return portions may be in one trough or tank, with a division along the centre, as shown in the figure, or a series of tanks may be carried in different directions, provided all are constructed on the same level. Various kinds of materials have been employed in the construction of tanks, but owing to the action of the hot water it is a difficult matter to keep them sound and free from leakage. Wood has answered fairly well when well put together, but being perishable, it does not last long. Iron is a rapid conductor, moreover it is expensive. Brick, on the other hand, radiates heat slowly, and on this account is perhaps the best material that can be used, as the sides of the tank can be raised to any convenient height, and it forms the best of all foundations for a coating of good Portland cement.

Heating by Flues.—*Position of the Flue.*—We are indebted to the Dutch for the introduction of the detached brick flue, and although we do not often hear of gardeners giving preference to this mode of heating, there still exist many good old gardens in which well-built flues are in active operation. An experienced horticulturist and writer who had great opportunities for testing the merits of the flue, the tank, and the hot-water pipe system, says: "If well built and managed, they have their advantages. They are less expensive and more quickly heated than steam or hot-water pipes, and therefore useful in repelling sudden attacks of frost in plant-pits and green-houses. The space they occupy, and their heavy appearance, militate against their being used in green-houses of the first order, unless they are placed under the stages or plant tables as in A, or under the floor as in B (Fig. 71), in which case they should be carried through a chamber, the sides, bottom, and top of which should be clear of the flue at least three inches. The small quantity of air thus surrounding them soon becomes heated, and should be admitted into the house through neat hit-and-miss brass ventilators. A similar ventilator should be built in the wall of the chamber near the fire-place, by which a fresh supply of air is admitted, and propels the heated air in the chamber through the ventilators in the pavement into the house. All underground flues, however, lose much of their heat by its being absorbed by the walls which surround them, and they can only be recommended when it becomes absolutely necessary that they be placed out of sight."

In A (Fig. 71) we find the flue running along the front, where it is partially shut out from view by the plant table above it, and the warm air, given off by the brickwork of which the flue is constructed, being light and buoyant, taking the direction of the arrows, completely cutting off the entrance of cold from without. This, however, is perhaps not the best mode of diffusing heat throughout a glass structure, as it is a well-proved fact that the atmosphere of all glass-houses is coldest near the roof on frosty nights, on account of the loss of heat by radiation. Moreover it is doubtful if a flue running along the front only would be found sufficient for a green-house of ordinary dimensions; therefore, assuming that there is only one doorway, it would be advisable to carry the flue all round the interior of the house into the chimney formed in the back wall at the north-east angle, which is also the best position for the stoke-hole.

Dimensions, Materials, and Mode of Constructing Flues.—Ordinary flues (Fig. 72) are generally made ten to twelve inches in width and sixteen to eighteen inches in height internally, more or less, according to the size of the house and the area to be heated. The heating capabilities of flues have been variously estimated; but as much depends upon the construction and mode of glazing, no very correct data can be laid down. It has, however, been calculated that one fire will heat 3,000 feet to Vinery temperature if the structure be span-roofed, having all its sides and ends of glass, while in the case of lean-to houses, one fire will heat 5,000 feet to stove temperature. The materials may include good ordinary bricks, fire bricks or tiles, or fire-clay pipes set on earthenware chairs. Stone flags have been used, but owing to the liability of stone to crack under the force of great heat, they are not suitable, neither are they economical. Fire-bricks set on edge make an excellent flue, which will last for many years; but, owing to the great number of joints which they contain, many prefer fire-brick tiles, three feet long, one foot broad, and two and a half inches thick. These tiles should be set on edge, having bottoms and covers of similar dimensions, and the better to secure gas-proof joints, the ends should be rebated or checked as a carpenter would halve together the ends of two planks, and the joints well packed with properly prepared fire-clay or ground mortar. Flues and tanks should be built upon a solid foundation to prevent settlements and fractures, as the safety of the plants depends entirely upon the prevention of the escape of smoke or noxious gas when sulphurous fuel is in course of combustion. Those in hot-houses where the ground has been or is likely to be disturbed should be set on arched piers; but in ordinary green-houses they may be placed on a foundation formed of two courses of common brick laid in grout or concrete. The bottom or floor of the flue should be formed of pavement or tiles resting upon bricks set edgeways, as shown in Fig. 72, so as to raise it well above the floor of the house. The object sought in this arrangement is the prevention of damp, which would have a tendency to cool the air in the flue and obstruct the draught of smoke and heat, while the pigeon-hole basement will in a great measure do away with the loss of heat by absorption. The best covering is made of fire-clay, quite flat on the upper surface, not hollowed out for the reception of water, which filters through into the interior of the flue, if it does not produce scalding steam of a most dangerous character. Atmospheric moisture is, however, necessary, but this is best produced by the use of loose glazed earthenware vessels placed on the covers for the reception of the water.

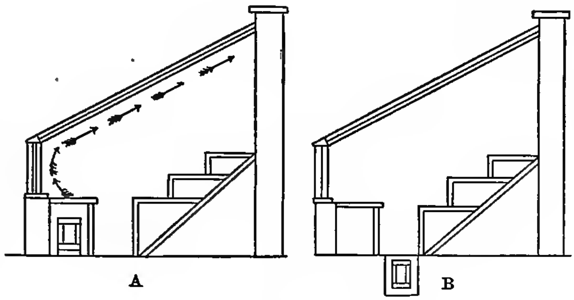


Fig. 71.—Position of Flues.

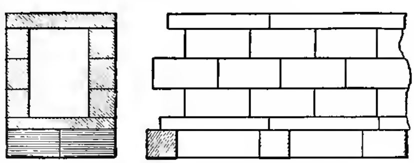


Fig. 72.—Construction of Flues.

The Amateur's Flue.—When fires for purposes not strictly horticultural, as in dwelling-houses, are kept constantly going, and 75 per cent. of the heat passes up the chimney, flues equally efficient, and much cheaper, can be made of the ordinary fire-clay pipes now so extensively manufactured in Staffordshire and elsewhere. The modern glazed pipe now so much used for drainage and sewerage purposes, which we meet with in every builder's yard, is perhaps as good an article as anything yet introduced, and, being so extensively used throughout the United Kingdom, can be obtained in stock sizes at a very reasonable price. Well-prepared fire-clay should be used for the joints, and the flue, when finished (with a slight rise, as in hot-water pipes), should rest on brick piers or chairs, at least six inches clear of the ground or other cold substance, which would otherwise abstract a great deal of the heat.

In small green-houses attached to the dwelling, where economy is imperative, these pipes will fill up a void which has long been felt by thousands of intelligent men, who derive as much pleasure from the culture of a few cheap plants, shaded by a Vine or two, as the nobleman does from a priceless collection of Orchids. All that is wanted, the professional gardener might pooh-pooh as a make-shift, but the enthusiastic amateur would regard as his sheet-anchor—a cheap apparatus that will enable him to drive out damp, which is often as fatal as frost itself, and keep the temperature above the freezing point when the silent enemy is approaching his treasures. This may be found in the circular ware flue, which any handy man can construct for himself.

Heating by Hot-air Stoves.—Although the name of these is legion, they are not now much used for heating green-houses, as it is generally admitted that cold air drawn from the outside, and allowed to pass over a surface heated above 212°, has an injurious effect on vegetation. Heating or forcing, however, is one thing, and keeping out frost is another; and in many small structures, corridors, &c., in which a slow combustion stove would best answer all that is required, one or other of these may safely be used. All act, more or less, upon the same principle, slow combustion, induced by the exclusion of air. Some, however, are more simple and less costly than others, and as we are now trying to find an economical substitute for hot water, the old and well-tried Arnott's stove must not be overlooked. Like the tubular flue, it is specially the thrifty man's apparatus, as he can construct it himself, and sleep in security when it is at work. The late Mr. Rivers, who used it extensively in his orchard-houses, said: "For a house twenty to thirty feet long, by twelve wide, a stove two feet four inches square, and three feet ten inches high, and the fire-box eight inches over, and eight inches in depth, will be amply sufficient. It should be placed in the centre of the house, within a foot or eighteen inches of the back wall, and the smoke-pipe go at once into the chimney outside. If it be thought necessary to have the feeding and draught-door outside, the draught-pipe must be reversed. The stoves should be built with four-inch brickwork, and good ground mortar; all the fire-boxes with fire-brick and fire-clay. A large fire-lump will make a suitable cover or top, and on this a shallow pan, two inches deep, and two feet square, filled with water, will always prevent the air from burning, and keep a genial moisture in the house. Gas-coke is the most suitable fuel."

Closed Radiating Stoves.—When a portable iron stove, which can be removed in summer, takes precedence of the less sightly Arnott's apparatus, a good representative will be found in the well-known "Tortoise" stove. In these stoves the admission and exit of air are always under control, and the fire is, consequently, not visible. They are generally independent, the only connection between the stove and the chimney being an iron pipe for conveying away the products of combustion, and promoting a draught. This system, like the preceding, is best adapted to structures from which all that is required is the exclusion of frost, and the prevention of stagnant moisture in damp, foggy weather. When properly managed these stoves give out a large amount of heat in proportion to the quantity of fuel consumed, and, being ornamental, they are suitable for situations where plant-life is not the only consideration.

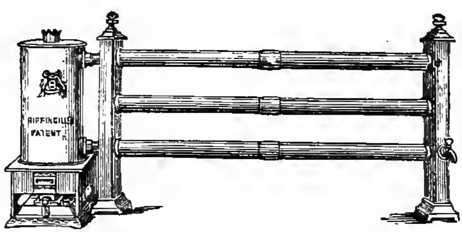


Fig. 73.—Rippingille's Oil Stove System.

Gas Stoves. — The preceding modes of warming are specially adapted to amateurs' green-houses in the country, or where gas is not within reach. But where this product can be obtained, heating by gas is a convenient and cleanly mode of preventing injury from frost in green-houses attached to suburban residences; and if the products of combustion be prevented from escaping into the house, the plants growing in it are in no more danger than where any other mode of heating is employed. Numerous methods of heating by gas have been devised, in the best of them water being generally the medium of conveying the heat; but with the necessary precautions the heat of the stove may be used direct, as in the preceding forms of apparatus.

Mineral-oil Stoves.—These also may be used where it is desired to avoid the use of coal, and gas cannot be had; but a flue or pipe should always be provided to carry off the products of combustion. Mr. Rippingille has patented a very neat and, for its size, effective arrangement, in which an upright cylindrical boiler supplies a small and portable series of flow and return pipes, about six feet long. The whole can easily be removed or changed in position, and is capable of doing very efficient and valuable work in a small house. The whole arrangement is shown in Fig. 73.

Mr. Deard and others place a small boiler behind one of the grates in the dwelling-house, and lead an inch or two-inch pipe from it for the heating of small green-houses, &c.

HOUSE, AREA, AND WINDOW GARDENING.

By William Thomson.

PLANTS IN ROOMS.

Plants for Invalids.—Those of our readers who are in the enjoyment of good health will doubtless willingly consent to our attention being first devoted to the requirements of those who are unable to partake of out-door amusements, and who desire to know to what extent they can indulge in gardening in a room. Invalids have bought certain plants, or had them given to them; they wish to know which plants will live longest and give the most satisfaction under the circumstances; and they desire to be informed how they are to keep those plants in health, and how to recover them when they get out of health. In short, they want the greatest possible amount of pleasure with the smallest expenditure of time and the least possible fatigue.

An invalid cannot always give *regular* attention to matters horticultural; hence those plants which will bear some neglect, and yet look not much the worse for it, are evidently the sorts which should be recommended for such positions. In this category few will dispute our claim to give the first place to the India-rubber (*Ficus elastica.*) It would be difficult to find a plant whose wants are more easily satisfied. Only take care that there is always some water in the pan in which the pot stands, and that the dust which may have settled on the leaves is occasionally sponged off, and nothing more is required. It must be taken for granted that it is a healthy specimen when received, that it has been properly potted, and that it has not come straight from a hot-house where it has only just made its first roots, but that it is well rooted and has been properly hardened off. If the roots are kept well supplied with water, and the leaves are kept clean, this plant will retain its leaves for a long time in perfect health. On the other hand, if the soil is allowed to get dry a few times, or the dust allowed to accumulate on its foliage, the plant will in due time show its disapproval of such treatment by shedding its lower leaves and forming brown spots upon those which remain. But under fair treatment it will continue to improve in size and appearance until its roots have not room for further growth, and then it must be sent away to be moved into a larger pot —shifted, as gardeners call it—which is too laborious a work for an invalid to attempt.

The next place upon the list of invalids' plants must be awarded to *Aspidistra lurida;* the variety which has broad white bands down its long leathery leaves is very ornamental. This species came from China some sixty years ago, and is particularly interesting from its most unusual mode of flowering; this takes place in July or August, when upon looking at the base of the leaves you will find little purplish-brown saucer-shaped flowers, so nearly the colour of the soil, and so little projecting above the surface of the soil, as to escape the observation of most people. Though so unlike a Lily in appearance, it really belongs to that beautiful order of plants. It should not stand in water like the India-rubber tree, but should be occasionally watered, so that its soil is not allowed to become either very wet or very dry; and its leaves must be kept clean by washing or sponging.

Another plant which can be recommended as requiring little attention beyond judicious watering and sponging, is the Scarborough Lily (*Valotta purpurea*), which can be grown in the same pot for three or four years, if properly planted at first. It probably will not flower the first year after being potted, as it requires time to nearly fill the pot with its roots before it throws up a flower-spike; but when it does bloom, its crimson Amaryllis-like blossoms amply reward the grower for a little patience.

As a contrast to this in many ways we next mention the large white Arum (*Richardia æthiopica*), often called Calla or White Lily. It likes plenty of water and its leaves kept clean; and then it repays one with fine white trumpet-shaped flowers, of the form of the Lords and Ladies in our hedgerows, only much larger. It does best in a rich light soil.

Other plants, suitable for growing in a room, and dependent for their well-doing much upon the use of a sponge over their leaves periodically, are to be found amongst Palms, Dracænas, Aralias, and many other genera with smooth leaves. There are, however, very many plants which cannot be kept clean in this way. These must be occasionally sent out of the room in which they are kept, to have the dust blown off their leaves with a pair of bellows, or washed off by being held sideways over a sink, and watered from a watering-pot with a rose, taking care that the water has the chill taken off before it is used. Of these, one of the most ornamental is *Acacia lophantha,* or more correctly, *Albizzia lophantha,* a Mimosa-like plant, with very elegant foliage, and almost hardy. Another pretty plant, with feathery leaves, is *Grevillea robusta,* but this is liable after a time to shed its lower leaves, in which case it loses much of its beauty.

Attention has recently been called by Mr. Caparn to the usefulness of *Tacsonia Van Volxemi* as a room plant. He grows it in a pot in an unheated greenhouse from May to September, and keeps it in a sitting-room window for the rest of the year; it begins to flower in August, and notwithstanding that the aspect of his window is east, it continues to bloom until December. It will grow in ordinary potting soil, and requires shifting into a larger pot from time to time, as the growth of its roots renders this necessary. A little manure sprinkled over the soil and washed in helps it during the growing season. It clings to wires arranged for it to climb upon, and can be removed from these wires without much difficulty when it is wished to move the plant. The wires in the window had better be fixed there, indeed a single stout wire is sufficient for the purpose, and it would be desirable to have this wire looped at intervals of eight or ten inches, in order to be able to tie the branches up firmly. It requires to be regularly watered, inattention to this causing the leaves to flag and the plant to become sickly. It is much benefited by being laid out on the grass once or twice during the year on mild days and well syringed with water, taking care that the water is not colder than the atmosphere.

Palms, or at least such of them as do not need a high temperature, are particularly suitable for culture in rooms, since their roots are contented with pots of a smaller size proportionately than most plants, and their foliage is easily kept clean. They may for general purposes be divided into two groups, those which have fan-shaped leaves, and those which have plume-like or feathery leaves. The former group contains many kinds which will grow in rooms, but as a rule they take up too much space. The latter group are free from this drawback, and occupy very little space in proportion to the effect which they produce.

Where there is room for Fan Palms, a selection from the following list should be made:—

Chamærops excelsa.	Latania borbonica.
Chamærops Fortunei.	Sabal Adansonii.
Chamærops humilis.	Sabal Palmetto.
Corypha australis.	

The best amongst the pinnate-leaved Palms for growing in rooms are—

Areca Baueri.	Jubæa spectabilis.
Areca sapida.	Phœnix dactylifera.
Chamædorea elatior.	Phœnix reclinata.
Chamædorea lunata.	Phœnix sylvestris.
Chamædorea Schiedìana.	Seaforthia elegans.
Iriartea andicola.	

Ferns generally are not suitable for room culture, unless covered with a glass shade, which is a mode of cultivation that will be treated of separately. There are nevertheless numerous exceptions to this rule, and among them may be mentioned some very curious and beautiful forms.

Among foreign species the following may be recommended:—

Adiantum cuneatum.	Asplenium bulbiferum.
Adiantum pedatum.	Cyrtomium falcatum.
Cyrtomium caryotideum.	Nephrodium molle.
Davallia canariensis.	Platycerium alcicorne.
Davallia pyxidata.	Polystichum capense.
Doodia aspera.	Pteris arguta.
Doodia caudata.	Pteris cretica.
Doodia lunulata.	Pteris serrulata.
Lastrea opaca.	Pteris tremula.

If space can be found for such large-growing forms as the following, they are well worth attention:—

Phlebodium aureum.	Woodwardia radicans.
Phlebodium sporodocarpum.	Woodwardia orientalis.

Amongst British Ferns there are not many that will grow well in a room, the atmosphere being too dry for them. Yet there are some that can be grown if the pots in which they are planted are more than half full of drainage, and are kept standing in shallow pans of water. By this arrangement the roots do not get down into the water, but are always in a moist atmosphere. In this way it would be well to try:—

Asplenium lanceolatum.	Lastrea Oreopteris.
Asplenium marinum.	Lastrea spinulosa.
Athyrium filix-fœmina.	Lastrea Thelypteris.
Cystopteris fragilis.	Lastrea uliginosa.
Lastrea cristata.	Osmunda regalis.
Lastrea dilitata.	Polypodium Phegopteris.
Lastrea Fœnisecii.	

The following British Ferns should be planted similarly, but should not stand in pans of water:—

Asplenium Adiantum nigrum.	Polypodium Robertianum.
Asplenium fontanum.	Polypodium cambricum.
Asplenium Trichomanes.	Polystichum aculeatum.
Ceterach officinarum.	Polystichum angulare.
Lastrea filix-mas.	Polystichum lobatum.
Polypodium Dryopteris.	Scolopendrium vulgare.

The soil in which Ferns generally delight is peat with a little loam, leaf-mould, and silver sand; if the peat is sandy, it may not be necessary to add any silver sand; but if the peat is fibrous, sand must be added to keep the mixture open and allow a certain amount of air to get to the roots.

Although most Ferns like a damp atmosphere to grow in, yet there are many (like the Wall Rue Fern, which is common upon old walls, and the hay-scented *Cheilanthes fragrans*, which grows in the cracks of hot rocks) which will do well if their little roots can get down between pieces of porous stone, where there is always a slight and uniform moisture. If they can get this, they will put up with very varied conditions of the atmosphere in which their fronds happen to be.

Those who have a green-house which they can use principally for Ferns, would find it a good plan to grow one or more small groups of Ferns mixed in a box, which may be ornamented round the outsides in various ways, and which is then available for moving into sitting-rooms, halls, or staircases for temporary decoration. The annexed engraving shows how this may be done with a large group. Smaller groups are, however, more manageable, and more easily moved. Many kinds of Ferns will stand being located in a sitting-room for five or six hours daily, if they are permitted to pass the rest of the twenty-four hours in a proper Fernery.

Bulbs.—The flowers of bulbs generally are so beautiful, and the perfumes of many of them are so delicious, that it is worth while to practise the best modes of cultivating them within our means and opportunities.

The soil which will be found most useful consists of six parts of old fibrous turfy loam, one part of well-decomposed manure, and one part of rotted leaf-mould; to this must be added a little sharp silver sand, more or less, according to the requirements of different plants.

The pots for bulbs should be five inches across and six inches deep. This size will hold one large bulb, or from three to six smaller bulbs. Good drainage having been put into the pot, and a little moss laid over it, the pot is to be filled three-fourths full of the compost mentioned, which should be pressed gently down but not made hard. Over this should be placed a layer of silver sand half an inch thick, on which the bulb or bulbs should be arranged; after this the pot is to be filled up with the soil, some bulbs being completely covered, while others require the point or neck of the bulb to be left exposed. The most successful growers then place the pots upon some hard dry pathway or yard, and bury them in ashes, where they are kept for six to eight weeks, the ashes being ten or twelve inches over the pots. This treatment appears to check stem-growth, and to encourage root-growth. It also keeps the soil uniformly moist, and at a uniform temperature.

Many room-gardeners may not be able to adopt this plan; it therefore becomes needful to do the next best thing, and that is to stand the pots in a dark cellar for a similar length of time; when the

LARGE GROUP OF FERNS.

stem begins to grow they may be moved into lighter quarters, but not too suddenly. Where it is not convenient to put the pots into a cellar they may be placed in a dark cupboard; but this is not so good for the bulbs, as the soil is liable to get too dry. Where only a few bulbs are grown the pots can be put into deep boxes, and covered with ashes, which however must be damped (but not soaked) with water before they are used. Cocoa-fibre is a very good covering, and much cleaner than ashes.

A very useful substitute for soil, and much less likely to make a mess in a room or on a window-ledge, is a preparation of cocoa-fibre and charcoal, sold by Barr and Son, 12, King Street, Covent Garden. This, however, is only suitable for Hyacinths, Crocuses, Tulips, and other bulbs of a similar form; it will not do for tuberous-rooted plants, such as *Agapanthus* or *Alstrœmeria.*

Another substitute for soil is common moss; in this many bulbs can be grown in pans, and when they are in bloom they form pretty ornaments for tables, both in the dining-room and the drawing-room. We mention both these rooms because they require to be treated differently with regard to certain plants. In a drawing-room you can move about and change your seat if you find yourself unpleasantly near to a flower with a strong scent; but in a dining-room a guest must, at least at meals, sit in the place appropriated to him; consequently, highly-perfumed plants should be relegated to the sideboard, and not be placed on the table where they may be disagreeable to some people.

Bulbs will also grow well in pans of sand or gravel, provided that the pan is kept filled with water; this mode of cultivating them differs, however, but slightly from that of growing in vessels containing water only.

The first place amongst bulbous plants must be given to the *Daffodil* (Narcissus), of which, according to the latest lists, there are now more than 500 named varieties. More than forty years ago, Dean Herbert, who was an ardent admirer of "Daffydowndillies," wrote: "It is desirable to call the attention of the humblest cultivator, of every labourer, indeed, or operative who has a spot of garden, or a ledge of window, to the infinite variety of Narcissi that may be raised and most easily in pots at his window, offering him a source of harmless and interesting amusement, and perhaps a little profit and celebrity."

Next to these we may name *Hyacinths,* which combine various colours with beautiful perfume, and are equally hardy and as easily grown in pots. They may also be grown in tall glasses specially made for the purpose. These should be nearly filled with water, and the bulb placed on the top, so that its lower side only just touches the surface of the water. A few small lumps of charcoal should be put into the water to keep it sweet. Very fine specimens of Hyacinths may be grown in this way. When they get six or more inches high, they will require to be supported by a strong wire to prevent the plant toppling over.

Crocuses are the cheapest of all bulbs, and now that they can be bought of mixed colours at the rate of seven for a penny they may be truly called the poor man's flower. Blue, purple, golden-yellow, and white are the prevailing colours of the Dutch Crocus, which flower in February and March, and some varieties of these are beautifully striped or tipped with another colour. There are other kinds which flower in the autumn, and also some winter-flowering sorts; these are mostly rare species, and consequently high-priced, costing from a shilling to eighteenpence each bulb. At the same time they are really not dear plants even at this price, considering the length of time which they remain in bloom. Inasmuch as their cultivation is of the simplest character, and they are to be had in flower in-doors from September all through the winter up to April, there is no genus of plants which commends itself more strongly to in-door gardeners, and especially to young amateurs. One very unusual characteristic in Crocuses must be noticed: though they shut up their blooms early in the evening, and remain in that state until the next morning's sun causes them to open again, yet if the room in which they are grown or placed is lighted in the evening, their flowers will expand and remain open for some hours.

Tulips, both single and double, are well worthy of being cultivated in pots, and may be had in flower from December to May. Their colours are crimson, scarlet, pink, yellow, and white. They give fine showy flowers, but are not so neat and compact in their habit as Hyacinths.

Snowdrops are amongst the earliest of spring-flowering bulbs, and their graceful white blossoms are always favourites. One of the most satisfactory ways of growing them is in pots large enough to hold three bulbs of either Hyacinths or Tulips surrounded by a ring of Snowdrops. After these last have bloomed, they leave a profusion of green foliage, which forms a bed through which the larger bulbs stand up and flower subsequently.

The *Snowflakes* may be described as tall-growing Snowdrops with a more elegant habit of growth. The Spring Snowflake is nine inches high, and flowers just after the Snowdrop is over. The Summer Snowflake grows eighteen inches high, and is in bloom during May and June. The Autumn Snowflake grows about the height of the Snowdrop, and flowers in August and September.

Scillas, or Squills, are very satisfactory bulbs for treatment in pots. *S. bifolia* is the first to blossom in early spring, and has a little spike of small purple flowers. The next to follow is *S. siberica* the flowers of which are more like Snowdrops in form, though not quite so large, while their colour is bright cœrulean-blue. After this comes *S. amœna*, which has the form and habit of *S. bifolia*, but is rather taller, and the flowers are dark blue. Then *S. campanulata* comes in; this is the common blue Squill of gardens, which is sometimes found white, and occasionally pale pink. About the same time (that is, in May) the Blue-bell of our hedges and woods, *S. nutans*, is also in bloom. All these are very pretty pot-plants for rooms.

Bulbs of *Gladiolus* reward the grower with tall spikes of showy flowers of several colours. They should be put into pots in April, and they will bloom in August and September. Growing as they do from three to four feet high, they are not suitable for small windows. The colours are white, yellow, pink, and scarlet, and some flowers are beautifully striped, spotted, or mottled. Gladioli require a richer soil than most bulbs, and should therefore have a larger proportion of well-rotted manure in the compost in which they are planted. When growing, they will be all the better for an occasional watering with liquid manure.

Lilies.—To grow these well in pots, they must be planted two inches below the surface of the soil, and the pots must have plenty of crock for drainage; hence the pots must be large and deep. The soil must be a mixture of loam and sand, and to this mixture must be added an equal quantity of good peat or good leaf-mould. When planted, the pots should be covered with and plunged in ashes, and kept there until one or more leaves show through, when they may be removed to the room or window in which they are to flower. A little clear liquid manure given once or twice a week, in addition to any watering that may be necessary, will be a great help to the bulbs in the production of fine flowers. Some of the larger Liliums, such as *L. auratum* and *L. candidum*, are so strongly scented that they are scarcely suited for a room, but most of the others may be grown satisfactorily.

We must limit our remaining remarks upon bulbs suitable for in-door culture to the mere mention of a few other very desirable plants. *Anomatheca cruenta* is a pretty little grass-leaved plant with small bright scarlet flowers. *Camassia esculenta* has star-shaped blue flowers on long graceful spikes. *Chionodoxa Luciliæ* is another blue-flowering bulb of great beauty. Colchicums have rose-coloured flowers in the autumn, in form resembling a large Crocus, but without leaves. *Crocosma aurea* has bright orange blossoms, and is very graceful. *Hyacinthus amethystinus* is quite a dwarf amongst its kind, only six inches high, with beautiful amethyst-blue flowers. *Hyacinthus candicans* grows from three to five feet high, and has a long spike of elegantly hanging white bell-like flowers. *Imantophyllum miniatum* is a noble Amaryllis-like plant with clusters of orange-crimson blossoms. *Milla* (or *Triteleia*)—all the species are beautiful and easily grown, the flowers being either white, purple, or lavender, shaded or striped with a darker colour. The species of *Nerine* have either crimson or scarlet blossoms, and are all well worth growing. *Ornithogalum caudatum* is the Onion-plant so commonly seen in cottage windows; there are other species much more ornamental. *Schizostylis coccinea* has spikes of scarlet flowers, much resembling a very small Gladiolus. *Zephyranthes* are dwarf Lily-like plants, with either rose-coloured or white blossoms. (For further details see chapters on BULBOUS PLANTS.)

Succulents, as plants with thick fleshy leaves are called, may be styled the donkeys of the vegetable kingdom, since they will stand neglect and ill-treatment better than any other kinds of plants; they will exist on the poorest root-food, and will even live for long periods without any, while, as to drink, they may almost be said to be total abstainers. They are found principally upon sandy plains in tropical and semi-tropical countries, chiefly in Mexico, South America, and Southern Africa, in places where they are exposed to great heat, and get little or no rain or refreshing dews. These being their natural conditions, they can be strongly recommended for window-culture, since they do not require that amount of regular and systematic attention which is a matter of life and death to most plants. Especially are they the plants for amateurs who are often away from home, and for invalids who are occasionally too unwell to attend to them. It must not, however, be supposed that they will look as well and flower as freely if neglected as if properly attended to; on the contrary, they well repay one for care and attention. Sandy loam, mixed with brick rubbish or broken and smashed bricks, is the soil generally suited to these plants; some of them are the better for a little leaf-mould. If the air be not too dry they will extract from it nearly all the moisture they require for their growth; any deficiency in this respect must be made good by occasional slight waterings of the soil; but this must be done very sparingly. On the other hand, while it is an easy matter to cause them to rot off by giving too much water, it is difficult to provide them with too much sunlight, since in their natural habitats they know as little about shade as a Gold Coast native knows about snow. A pair of bellows is an invaluable tool to the grower of Succulents in rooms, for it should be in frequent use to keep the plants clean and free from dust.

Amongst Succulents the most easily procurable belong to the Crassulaceous order. *Bryophyllums* are curious, with greenish-purple flowers appearing in June, and grow two feet high. *Cotyledons* are summer-blooming, growing about one foot high, and having flowers either red, orange, yellow, or white. *Crassulas* are mostly white-flowered, and generally bloom from June to August, though one species (*C. lactea*) flowers in December and January, and is, therefore, especially to be recommended. Very few exceed nine inches in height. *Echeverias* are larger plants, growing from one to two feet high, and flowering principally in the autumn; their colours are scarlet, red, orange, or yellow, and they are always admired. *Crassula* (*Kalosanthes*) *coccinea* has grand trusses of crimson or scarlet flowers, and lasts a long time in bloom, beginning in June. It grows about one foot high. *Pachyphytum* is grown principally for the thick, fleshy glaucous leaves, which are very singular. *Crassula falcata*, also known as *Rochea falcata*, has curious hatchet-shaped leaves of a mealy-green, and very elegant trusses of showy scarlet flowers in July. It will grow to the height of four feet, but blooms freely when only a foot high. *Sedums* are almost endless in the number of species, and they are mostly white-flowered, though some are yellow, pink, and purple. They are very dwarf, principally from three to six inches high, and very interesting. *Sempervivums* are chiefly yellow, although species occur with purplish and reddish flowers. They bloom in June and July, growing from six inches to two feet high.

Another very numerous group of Succulent plants occurs amongst the *Cactaceæ*, most of which are covered with spines or prickles. Whilst the *Crassulaceæ* are remarkable for the curious forms of their leaves, the *Cactaceæ* are noteworthy for the singular growth of their stems and branches, and for the absence of any leaves. *Cereus* is a large genus, containing many stately plants, with magnificent flowers, and also some dwarf species, not exceeding two feet, suitable for rooms. Amongst the latter the colours of the flowers are various enough to please most people, scarlet, red, rose, pink, purple, orange, yellow, white, and most of them flower during the summer months. *Echinopsis* and *Echinocactus* may be taken together, being very much alike. Most of them are less than six inches high, and the flowers are chiefly yellow or red, and very beautiful. *Epiphyllum* has a very peculiar arrangement of jointed leaf-like stems, looking just like a flattened green worm, and reminding a zoologist of an enormous Tænia. From the very dwarf growth of these plants it is usual to graft them on an allied plant called *Pereskia*, known also as the Barbadoes Gooseberry, from its having globose fruit. Placed upon these stems, nine or ten inches high, the *Epiphyllum* grows into an umbrella-shaped head, and its pink or crimson blossoms hang from the ends of the branches and produce a very lovely effect. Though it is doubtful if they would form flower-buds in a room, yet plants in bloom can be kept so for a long time. They bloom from June until late in the year. *Mammillarias* form a strong contrast to the plants last mentioned, since they are rarely more than a few inches high, and are a globular mass of nipple-formed projections or tubercles, with a few bristles at the point of each nipple. The flowers of the majority of the species are white, yellow, or red, and they are summer-blooming, the flowers coming up between the tubercles in a most singular way. *Melocactus* much resembles *Echinocactus* in general form, and the flowers are usually red. *Opuntia*, of which the Cochineal plant and the Prickly Pear are examples, has branches composed of ovate flattened joints, and flowers principally yellow. *Pereskia* is distinguished from most other plants of the Cactus family by having a woody stem instead of a fleshy one, and by having leaves; the plants are curious, and the flowers are either white or red, coming out late in the autumn. *Rhipsalis* has curious long, slender, jointed, leafless green stems and branches; flowers minute, and yellow; these are very singular plants.

Cacalia and *Kleinia* are members of the large natural order *Compositæ*, though no one would ever guess such to be the case unless they examined the flowers. The jointed stems of *Kleinia articulata* are so perfectly round that it has been called the Candle Plant. Flowers yellow.

Agave is the genus to which the American Aloes belong, and is placed in the natural order *Amaryllidaceæ*, while *Yucca* and *Aloe* are members of the Lily order. Plants of these three genera have such a strong general resemblance that they are often confounded. The Aloes (which are Cape of Good Hope plants) and the Agaves are only suitable for very large rooms, halls, or porches; but the Yuccas are smaller, and of a more useful character for ordinary rooms.

Gasteria and *Haworthia* are the last Succulents which we shall mention; they are Liliaceous plants, both from South Africa. The former has its warty leaves growing alternately in the same plane, and looks as if it had been pressed into this form between two boards. There are many different species, all of which have pretty scarlet or red flowers on long slender stems, all blooming in July. On the other hand, the flowers of the Haworthias are all grey and

THE WOOLLY CLEMATIS (CLEMATIS LANUGINOSA).

A very fine large-flowered hardy climber from China, belonging to the order of Crowfoots.

THE WOOLLY CLEMATIS.
(CLEMATIS LANUGINOSA.)

inconspicuous; but then the little tufts of rough-pointed leaves are very pretty, and look like diminutive Aloes. They all flower in the summer. (See further Green-house and Hot-house Plants.)

Annuals, in very great variety, may be grown from seed, and prove a source of much pleasure. The pots should have plenty of drainage, and a little piece of moss over the drainage to prevent the earth being washed down amongst the crocks, which might stop the surplus water from running away, and thus destroy the object for which the drainage was put there. The soil should be good loam, with a little leaf-mould and silver sand in it, and this should be pressed into the pots firmly, but not too hard. Having thus filled the pots three-parts full, lay on the top a few seeds, about twice as many as you intend to grow in the pot, taking care that two seeds do not lie side by side, or close together. Dust gently over the seeds enough sandy mould to just hide them, and then, should the soil be very dry (otherwise the seeds are better without it), water with spray from a brush. When the seedlings begin to grow half of them must be pulled up, leaving, of course, the strongest to grow on.

The following list contains a good in-door selection of dwarf Annuals, of many of which there are numerous beautiful varieties that will richly reward the patient and careful cultivator:—

Selected Annuals, Dwarf and Erect.

Acroclinium roseum.	Godetia grandiflora.
Bartonia aurea.	Kaulfussia amelloides, or more correctly, Charieis heterophylla.
Calendula pluvialis (Cape Marigold.	Leptosiphon androsaceus.
Calliopsis bicolor.	Lupinus Cruikshankii.
Centaurea Cyanus (Corn-flower).	Nemophila insignis.
Clarkia pulchella.	Papaver rhæas.
Chrysanthemum carinatum.	Phlox Drummondi.
Collinsia bicolor.	Reseda odorata (Mignonette).
Convolvulus minor.	Rhodanthe Manglesii.
Delphinium Ajacis (Larkspur).	Salpiglossis sinuata.
Dianthus chinensis (Indian Pink).	Saponaria Calabrica.
Eschscholtzia californica.	Schizanthus pinnatus.
Gaillardia picta.	Sphenogyne speciosa.
Gilia tricolor.	Tropæolum minor (Nasturtium).
	Viscaria oculata.

If it be wished to grow tall climbing Annuals, there are none better, or more easily grown, than the following:—

Climbing Annuals.

Convolvulus major.	Tropæolum aduncum (canariensis).
Lathyrus odoratus (Sweet Pea).	T. majus (Nasturtium).

These must be provided with strings, wires, sticks, or boughs to climb up, if we would see them in their greatest beauty.

Chrysanthemums are excellent plants for cultivation in pots, and are most useful on account of their coming into blossom late in the autumn, when few other hardy flowers are to be had. Frost spoils their blooms, and wind and rain bruise them; but if brought in-doors, before bad weather has injured them, they will keep in flower for a long time, and last well into the new year. Cuttings struck in October are said to make the best plants for the following year; but it is much less trouble to break up an old plant in March, and then to pot rooted pieces, which will make fine plants by the middle of summer. In order to get plenty of flowers, the points of the shoots should be pinched off as they grow, but this pinching must not be continued after the end of July. Cuttings should be struck in sandy loam and leaf-mould. Rooted cuttings and divisions of the roots should be planted in stiff loam mixed with well-rotted manure. Potted plants should be well watered all through the summer, and liquid manure may be given occasionally until the flower-buds begin to show their colour, after which no more manure-water must be given. Syringing over the leaves night and morning during hot weather is of great assistance to the plants. If the roots are once allowed to become quite dry it will materially affect their blooming.

There are two kinds of large-flowered Chrysanthemums, the Chinese and the Japanese, the former flowers being very regular and symmetrical in form, while the latter are ragged and irregular, though of brilliant and attractive colours. The small-flowered Chrysanthemums are called Pompones, and grow two or three feet high. They are, therefore, more suitable for window-sills and other exposed situations than the large-flowered sorts, which, from their habit of growing much taller, are more liable to be injured and blown down by high winds.

There are now to be had a great many named varieties of each of these three sections. It will be better, however, if house and window gardeners confine their attentions to a few good sorts which are known to be free bloomers; of each of these they can propagate as many plants as they choose.

Amongst Pompones there are none to beat the following:—Adéle Frizette, fringed lilac; St. Michael, yellow; Marabout, fringed white; Mdlle. Marthé, white; Bob, dark brown; Cedo nulli, white, with brown tips; Miss Julia, dark chestnut; Louise, crimson; Adonis, rosy-purple; Mr. Astie, yellow.

A small selection of large Chinese sorts may be taken from the following list:—George Glenny, golden-amber; Mrs. Rundle, white; John Salter, red-cinnamon; Julia Lagravère, deep crimson; Virgin Queen, white; Lady Talfourd, rosy-lilac; Jardin des Plantes, golden-orange; Venus, rosy-lilac peach.

The following are among the best of the Japanese sorts:— Elaine, white; James Salter, clear lilac;

Red Dragon, chestnut-red; La Frisure, rose; Peter the Great, yellow; Fulgore, rosy-purple; Fulton, bright yellow; Oracle, dark rosy-purple. (For a wider choice see under FLORISTS' FLOWERS.)

Hardy and Half-Hardy Plants.—Amongst many others which might be named as suitable for growing in pots, in rooms, the following are some of the best, since they are all evergreen. For the benefit of those who may not be acquainted with these plants, their height, colour of flowers, time of flowering, and soil are given:—

Acacia armata, 3 ft., yellow; May; sand, loam, and peat.

Agapanthus umbellatus, 2 ft., blue; July; rich loam, old manure and sand.

Cassia corymbosa, 3 ft., yellow; July; loam and sand.

Coronilla glauca, 2 ft., yellow; July; peat and loam.

Cystisus racemosus, 3 ft., yellow; summer; any good soil.

Myrtus communis, 4 ft., white; July; sandy loam and peat.

Nerium Oleander, 6 ft., pink; summer; any rich light soil.

Othonna crassifolia, 2 ft., yellow; September; rich light soil.

Solanum Capsicastrum, 1 ft., white; scarlet berries in winter; rich soil.

Plants for Hanging Baskets.—There is no prettier finish to a window, in which plants are grown, than a well-furnished basket hanging from a hook fixed on the top of the window-frame, or in the ceiling just above it. Some people put several plants into one basket, but we give the preference to one well-grown plant.

Fig. 19 represents a plant of *Sedum Sieboldi*, which is an excellent basket-plant, always looking neat and prim. The Ivy-leaved Pelargonium, shown in Fig. 20, has a more irregular habit, and on this account will by some be preferred; some good varieties of it can now be obtained, with double as well as single flowers, crimson, lilac, pink, and white.

The following plants may also be used for hanging baskets:—Ivies, especially the small varieties, *Linaria Cymbalaria* (the Ivy-leaved Toad-flax), *Saxifraga sarmentosa* (sometimes called the Wandering Jew), *Campanula garganica*, *C. fragilis*, *C. Barrelieri*, *Isolepis gracilis*, *Sedum Anacampseros*, *S. carnosum*, *Senecio mikanioides*, *Tropæolum* (Nasturtium), *T. canariense*, *Lobelia insignis*, *Lysimachia Nummularia* (Moneywort, or Creeping Jenny), and many others.

Herbs and Aromatic Plants.—Most of the plants which are grown in rooms are selected for the sake of the beauty of their flowers, some for the fragrance of their flowers, and a smaller number for the beauty of their foliage. We do not remember to have ever met with a collection of plants which have been cultivated for the pleasant perfume given off by their leaves; and yet an interesting group might be chosen for this purpose. The following would be worth growing:—Common Lavender (*Lavandula Spica*), Winter Lavender (*Santolina Chamæcyparissus*), Rosemary (*Rosmarinus officinalis*), Basil (*Ocimum Basilicum*), Sage (*Salvia officinalis*), Balm (*Melissa*) *officinalis*), Spear Mint (*Mentha viridis*), Pepper Mint (*Mentha piperita*), Common Thyme (*Thymus vulgaris*), Lemon Thyme (*Thymus citriodorus*), Woodruff (*Asperula odorata*), Sweet Marjoram (*Origanum Marjorana*), Lemon-scented Verbena (*Aloysia citriodora*).

Under the head of Herbs we must not omit to mention Parsley and Watercress, which can be grown in rooms, in saucers or shallow basins of water. Mustard and Cress are often grown in plates, on pieces of flannel kept well saturated with water.

There are certain plants which have blooms so highly scented as to be very objectionable to some people, and even to make them ill if obliged to remain in the room with them. Amongst these must be included Hyacinths, Polyanthus Narcissus, Oleander, Mignonette, and some kinds of Lilies, especially *Lilium auratum*.

The foregoing are all sweet-scented, and so strongly odoriferous that many people do not care for much at a time of such perfumes.

But there are plants whose blooms give out odours that are quite disgusting, such as the Carrion Plants (*Stapelias*), and some kinds of Arum (*A. crinitum* and *A. Dracunculus*). These smell like putrid meat, and ought never to be grown in rooms, the beauty and curiosity of their flowers notwithstanding.

Cinerarias are not desirable for growing in a room, inasmuch as they soon get infested with aphis. Heaths also (*Erica* and *Epacris*) seldom do well for long, and the same may be said of many plants from New Holland; all these seem to want purer air and more light, and they show their dissatisfaction by shedding their leaves.

Effects of Gas on Plants.—It is usually considered very undesirable to burn gas in rooms in which plants are kept, and it is supposed that they cannot live long under such conditions. This, though partly true, is not wholly so. It is true of some plants, but by no means of all. The facts of the case are clearly explained by a writer (J.S.W.) in *The Garden* newspaper, who says: "Many people, both in town and country, keep plants in their rooms, and not a few grow them there from one year's end to the other. Of course plants do not thrive so well in dwelling-rooms as in the green-house, and a very common impression exists that gas-light is particularly obnoxious to them, for the gas itself does not reach the plants; if it did, the rooms would be unfit for human beings, as well as for plants. When plants fail it is put down to the gas, and not a few are dissuaded from attempting the window culture of plants, and room decoration, for that reason. My conviction is that the gas is often wrongly blamed for the damage. In fact, it is difficult to understand how gas itself can affect anything in a room, because

Fig. 19.—Sedum Sieboldi.

it is consumed as fast as it is discharged from the burner, and never enters the room as gas at all where combustion is complete. That the heating and drying effect of the gas-flame does affect plants is probable, but, except in degree, it does no more harm than the light from a lamp, a candle, or a coal fire.

"From what I have observed I am prepared confidently to assert that both cut flowers and growing plants may be kept in gas-lighted rooms for a long period, if other conditions are right, although, of course, some species succeed much better than others. My sitting-room is well lighted by gas, and there is also a fire constantly burning every day during the winter, and when the weather is cold. Yet in this room, even on the mantelpiece above the fireplace, I have kept nearly all kinds of flowers in water for a remarkably long time, and also had plants in pots on brackets quite near the gas for as long a period: among these plants may be mentioned Maidenhair Ferns, which stood the room atmosphere almost better than anything else, except Chinese Primroses. These and many other evidences have convinced me that far more blame is put upon gas than it deserves, and that no one need be afraid of attempting the culture of plants in rooms lighted by it, provided they will attend to the wants of plants in other ways. In a small cottage, I know of two Acacias that have been growing on the window-sill for about five years, and are only about two yards from a gas-burner. They are put out in front of the window in summer for about two months, but during all the rest of the year they are in the room, and do well.

"What really destroys plants in rooms is mismanagement, and want of light and air. No plant,

Fig. 20.—Ivy-leaved Pelargonium.

not even the Killarney Fern, will thrive long unless it has light and air; in rooms far from the window, no plant can be expected to exist, much less to grow, for any length of time. Let any one try the experiment of growing their room-plants near the window, watering and potting them with some care, and they will find that they will both grow and flower."

"One thing, however, is undoubtedly against them in well-lighted apartments, and that is the light itself, which keeps up a certain amount of excitability in the leaves and flowers, which is exhausting. Wherever possible it would be advisable to shut window-plants out of the room when the shutters or blinds are closed, keeping them outside of them whenever danger from frost is not apprehended. A good deal, of course, depends on the size of the room, and how it is warmed and lighted; but the larger and loftier it is the better, as the worst effects of the fire or lamp are only felt a few feet or yards distant. Rooms heated by means of hot-water coils and pipes are the worst, as, no matter where the plants may be placed (the pipes being, as a rule, equally distributed throughout), the dry air from them soon injures them, and their foliage shrivels and dies. In fact, the dry air of dwelling-rooms is their worst fault so far as plant-life is concerned, and cultivators know well that but for the light and heat and moisture they are able to command in such structures, glass-houses would be no better than dwelling-rooms. Another point is that the higher the stand is for plants in a room the worse for the plants, as the nearer to the ceiling the hotter and drier and more vitiated the air is; for in dwelling-rooms it is rarely any adequate outlet is provided for the foul air to escape. Room plants should therefore be set as near the floor-line as possible, and when they are tall they look much better set low than high, and are better seen. They also receive the rays of the sun better through the window.

"During the night the room fires should be allowed to burn quite out, so that the room may be cooled before morning, and if it can be ventilated at the same time, all the better. As a rule the first thing done in the morning is to open the doors or windows wide, no matter how cold or windy it may be, and the plants are injured by cold or draughts; the ill-effects of this they soon show, and it is at once put down to the gas, which had really nothing to do with it."

COMMON GARDEN FLOWERS.

Speedwell (*Veronica*).—This is a somewhat comprehensive genus, and includes green-house herbaceous plants, and evergreen shrubs, hardy annuals, hardy aquatics, and a large group of hardy perennials. Some of the former are natives of New Zealand, and are sufficiently hardy for the south and west coasts, and are very ornamental in early spring. *V. speciosa*, *V. salicifolia*, and *V. macrocarpa* are the parents of the beautiful hybrids, with white, blue, purple, red, and crimson flowers, including *V. Andersoni*, *versicolor*, *Lindleyana*, *Kermesina*, &c. A species named *V. Traversi*, with handsome evergreen foliage, is an excellent plant for conservatory decoration during the winter and spring months.

The name Speedwell is given to a common British plant of the hedgerows, named *Veronica Chamædrys*, also known as the Germander Speedwell, or Wild Germander, which is regarded as a corruption of its Greek-derived name, *chamai*, "on the ground," and *drys*, "a tree," and alludes to the form and trailing habit of many of the species. It is said that Speedwell is derived from its corolla falling off and flying away as soon as it is gathered, "Speedwell" being equivalent to "Farewell," "Good-bye," and a common form of valediction in old times. "Forget-me-not," a name that has since passed to a Myosotis, appears to have first been given to this plant, and addressed to its fleeting flowers. The common Speedwell is a perennial, frequenting pastures, hedges, and meadows, and bears during May and June bright blue flowers. Its flowers only expand in dry weather, and so beautiful are they as well to deserve Phillips's epithets of "the celestial bird's-eye blossom." The derivation of the generic name, *Veronica*, is open to some speculation; it is considered by some to be an appellation derived from *vera* (Latin) and *icon* (Greek), and signifying "true image." Some consider that it was named after Veronica, the saint of the Roman Calendar; or from the Greek *phero*, "to bring," and *nike*, "victory"; because some species were efficacious medicines. *V. Chamædrys* is a well-known road-side plant, flowering freely in May, and scarcely any passer-by could leave unnoticed the charming blue flowers. Its leaves, in Sweden and some parts of Germany, have been used as a substitute for Tea, and for that purpose are said to be more grateful and less astringent than the leaves of *Veronica officinalis*, which have been used for the same purpose. This is also a common plant, inhabiting dry banks. It seems to have been so good an imitation of the China Tea that Simon Pauli, an old Danish botanist, contended that they were identically the same. In his book on "Plant Lore, Legends and Lyrics," Mr. R. Folkard gives this curious legend concerning the Speedwell:—"When our Saviour was on His way to Mount Calvary, bearing His cross, he passed by the door of Veronica, a compassionate woman, who beholding with pity the Lord's distressed condition, and the drops of agony on His brow, wiped His face with a kerchief or napkin, and the features of the Redeemer remained miraculously impressed upon the linen. The kerchief itself was styled the Sudarium, and from some resemblance of the blossom of the Germander Speedwell to this saintly relic, bearing the features of Christ, the plant received the name of Veronica."

Of the hardy perennial Veronicas there is a large group, and we will now pass in review a few of the best and most showy of them. *V. alpina* is the Alpine Speedwell, an evergreen herb with a creeping habit, flowering in early summer, colour blue varying to pale pink. It is a native of the great mountain chains of Europe, Asia, and America, and is to be found on some of the higher Scotch mountains. It is well adapted for the rockwork, also for gardens. *V. amethystina* is a native of the South of Europe, a very handsome border plant, twelve inches or so in height, blooming in summer; the flowers of a charming amethystine-blue, arranged in pyramidal clusters. *V. austriaca dentata*, and another variety named *pinnata*, are from the South of Europe, and very useful for planting on bare banks and slopes. *V. candida* is the Silvery Speedwell, from Russia; it is dwarf in habit and has silvery leaves, and makes an excellent plant for edging flower beds, but should not then be allowed to send up its blue flowers. *V. corymbosa* is the Many-spiked Speedwell, and one of the most ornamental, growing two feet high, and throwing up racemes of pale blue flowers arranged in corymbs. *V. gentianoides* is a showy and pleasing kind, the plant forming a carpet of shining leathery leaves, the flowers pale blue with darker streaks; a native of Greece. There is a variety of this with variegated foliage. *V. incana* is also an elegant plant, producing flesh-coloured flowers in summer, growing eighteen inches or so in height. *V. longifolia subsessilis* is a new deciduous species from Japan, surpassing in beauty all the hardy species at present in cultivation. It is not only the best of the family, but one of the finest hardy perennials yet introduced. It is distinct in habit from any of the genus; the lateral leaves are very large and abundant, and of a deep olive-green colour. The flowers are in dense erect spikes, a foot in length and from four to five inches in circumference, of a deep rich blue; it grows about two feet in height, and is perfectly hardy. *V. orientalis* has pleasing light blue flowers. *V. prostata* is a native of Central and Southern Europe; it is one of the most showy of the dwarf Veronicas, forming dwarf spreading tufts, bearing numerous terminal spikes of deep blue, and is useful either as a rock or a border plant. *V. rupestris* is one of the handsomest of rock plants, producing sheets of dark green foliage, smothered in early spring with bright blue flowers, and it is very useful for carpet bedding. *V. saxatilis* is the Rock Speedwell, from the Alpine rocks of Europe, and it is also found in the Highlands of Scotland; it produces large brilliant blue flowers, and it is quite dwarf in growth. There is a variety of this, named *Grievei*, bearing rose-coloured flowers. *V. telephifolia* is a very distinct trailing species with small, glaucous, fleshy leaves, producing light blue flowers in great profusion. All the foregoing, which by no means exhaust the list of hardy perennial Veronicas, do well in good ordinary border soil.

Of the annual forms, *V. glauca* and *V. syriaca* are the only two to be found in gardens. Both are blue-flowered; but they do not find a place among our leading hardy annuals.

The Periwinkle (*Vinca*)—As the slender stems of the Periwinkle adapt it excellently for garlands, it was with the Romans a favourite subject for that purpose. Its Roman name, *Vinca pervinca*, which may be freely translated the "bond over bond," refers to the entwining and toughness of the stems, and is thus mentioned by Pliny among the summer flowers of Italy: "The *Vinca pervinca* is an evergreen, the branches of which run out like so many strings. It is a plant used in topiary garden work; yet it is sometimes employed in chaplets. From the Greeks it received the name of Chamædaphne."

The common name, Periwinkle, is said to be a mere corruption of the Latin name, *Pervinca*, for by our earliest writers it is called the Pervinke, and it was only by degrees that it subsided into the unmeaning name it now bears. Chaucer speaks of it thus:—

> "There sprange the violet al newe,
> And fresh Pervinke, rich of hewe."

The leaves of the Smaller Vinca are so glossy and green that it is sometimes called the Little Laurel.

In France the Periwinkle is considered the emblem of the pleasures of memory and sincere friendship, probably in allusion to Rousseau's recollection of his friend, Madame de Warens, occasioned, after a lapse of thirty years, by the sight of the Periwinkle in flower, which they had once admired together. In Italy garlands of Periwinkle are placed upon the biers of deceased children, for which reason the plant has acquired the name of the Flower of Death; but in Germany it becomes the symbol of immortality. Culpeper, in his "Herbal," says that the Periwinkle is owned by Venus, and that the leaves eaten together by man and wife cause love between them.

The Vincas are hardy evergreen perennials, with creeping and rooting herbaceous stems. This is especially true of *V. herbacea*, a dwarf extensively trailing plant; not nearly so rampant in growth as the Greater and Lesser Vincas, it is more suitable for the rock-garden than these. It does best in a sunny position, in light but good soil, rather dry than moist. The flowers are purplish-blue, and appear in spring and early summer. It is a native of Hungary.

V. major is the Greater Periwinkle, a well-known evergreen trailing plant, with large and handsome blue flowers. This is especially adapted for covering and adorning low fences, and it will grow in almost any position, and especially under the shade of trees. A variety of this, named *elegantissima*, has the foliage distinctly margined with gold; a very effective plant during the winter months; useful for growing in pots, trailing round pillars, &c.

V. minor is the Lesser Periwinkle, smaller in every part than the major form, and usually with a more trailing habit. This, like the preceding, varies in the colour of the flowers. And there are also a double and variegated-leaved varieties. The double form is very pleasing and useful. A variety of *V. minor*, named *argentea variegata*, has the foliage margined with silver. Then there is the minor form with white flowers; and also a variety of this in which the leaves are margined with silver.

The Vincas are very useful subjects. The smaller forms can be used with great advantage as edging plants, and they are particularly useful for covering rock-work. They do well in a good loam. It is simply necessary to trim the plants, sometimes cutting out the decayed wood. The plants are readily increased by division.

ORCHIDS.

By William Hugh Gower.

Maxillaria.—The name is derived from *maxillæ*, the jaws of an insect, from the fancied resemblance of the column and lip; at one time it contained a very mixed lot of plants; many of these, however, have been removed to other genera, and only those remain which have the lateral sepals joined to the base of the column, a cucullate labellum, which is jointed to the base of the column, and four pollen-masses, with a short caudicle fixed to a lunate gland. The majority of the species are small-flowered, and the colours in most instances are very sombre, so that now, there being such an immense number of really beautiful Orchids to select from, it is no wonder these inferior kinds find little favour in the eyes of the Orchidologist. The species we here introduce, however, are worthy of space even in the most limited collection. Maxillarias are all very easily managed. Pot in rough peat and a little sphagnum, supply them liberally with water when growing, and never *entirely* withhold it even when at rest. Peruvian House.

M. grandiflora.—The pseudo-bulbs of this beautiful species are ovate, slightly flattened at the edges, and deep green, bearing a pair of oblong-ovate leaves, which taper at both ends; they are nine to twelve inches long, and dark full green; scape much shorter than the leaves, one-flowered; flowers erect, upwards of three inches in diameter; sepals equal, ovate, and pure white, slightly streaked with pink; petals also pure white, but much smaller than the sepals; lip three-lobed, pouched, reddish-purple on the outside; disc white, side lobes rich purple, front lobe triangular, reflexed, white, with a golden-yellow marginal border. Winter and spring months, lasting long in beauty. New Grenada and Peru, at from 4,000 to 7,000 feet elevation.

M. venusta.—In general habit and appearance this species resembles the preceding; the flowers are solitary and nodding, pure snowy-white, the lip bearing a few blotches of crimson, and faintly stained with pale yellow. Winter and spring months, lasting for months in full beauty. New Grenada, at 5,000 to 6,000 feet elevation.

Mesospinidium.—A small genus of plants, having much the appearance of *Odontoglossums*, and requiring just the same kind of treatment, which see. These plants will succeed either in pots or upon a block of wood. Peruvian House.

M. sanguineum.—A small-growing, elegant plant, with compressed pseudo-bulbs, which are ovate and dark green, the upper part freckled with brown; leaves in pairs, strap-shaped. The spike is branched and pendulous, bearing a quantity of rather small rosy-red flowers. Winter and spring months. Peruvian Andes, now named *Cochlioda sanguinea.*

M. vulcanicum (*Cochlioda vulcanica*).—This species derives its name from the fact of its discoverer, Dr. Spruce, having found it growing upon the volcanic mountains in Eastern Peru. In general appearance it resembles *Odontoglossum roseum*; it is a more robust plant than the preceding, but the pseudo-bulbs and leaves have the same heavy green colour. The spike is not branched, but bears numerous beautiful rosy-crimson flowers, which are much larger than those of *sanguineum*, and last a long time in perfection. Winter months. Peruvian Andes.

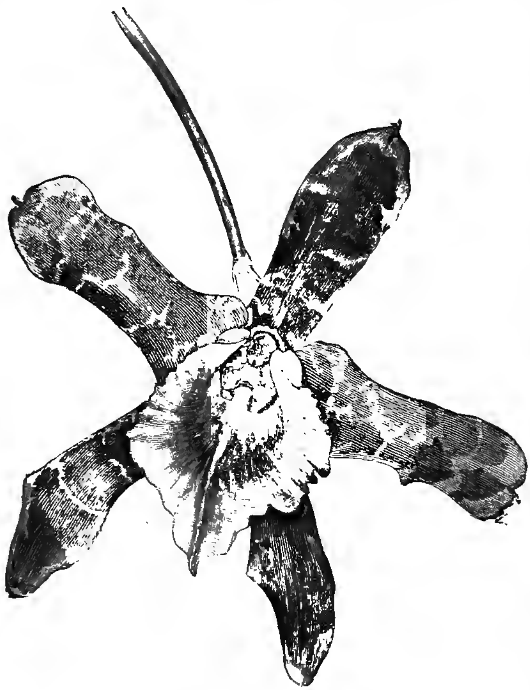
Miltonia.—A family of Brazilian Orchids, nearly allied to *Oncidium* and *Odontoglossum*, but its very short column at once marks the distinction from both. Dr. Lindley established the genus in honour of Viscount Milton, who was a zealous cultivator of this order of plants. The genus is thus briefly characterised: "Sepals and petals equal, an undivided sessile lip continuous with the column; a short column with two auricles, and a membranous naked anther, containing two waxy pollen-masses, furrowed behind, and having an obovate caudicle and oblong gland." Miltonias may be grown in hanging baskets, but we prefer pot or pan culture, and the soil should be equal parts of peat and sphagnum, with a little sand added; drain well, as they enjoy a liberal supply of heat and moisture when growing, with partial shade; during the resting season full exposure to the light, and just sufficient water to keep them from shrivelling, is all they require. Many cultivators grow their Miltonias fully exposed to the sun's rays, under which treatment they certainly bloom very profusely, but the foliage is always of a sickly yellow, and the effect when the flowers appear is not pleasant; but partially shading as recommended above will not rob the plants of their proliferousness, and the green leaves will afford a beautiful contrast to the delicate blossoms. Brazilian House.

M. candida.—A very handsome species, with large, ovate pseudo-bulbs, which have a pair of narrow-lanceolate leaves. Scape erect, produced from the base of the pseudo-bulbs, and bearing five to six large flowers; sepals and petals about equal, oblong, yellowish-white, spotted and barred with brown; lip white, somewhat round, rolled over the column, and crisp on the margin. In the variety *grandiflora* the flowers are much larger; the sepals and petals are yellow, blotched and spotted with rich bright brown; lip yellowish, tinged with pink. September and October. Brazil.

M. cuneata. — This plant in growth very much resembles the preceding species. It is a very handsome plant when in flower. Scape erect, four to five or more flowered, each flower nearly four inches in diameter; sepals and petals lanceolate, with undulate margins, ground-colour chocolate, transversely barred with tawny-yellow; lip distinctly wedge-shaped, pure white, suffused with a tinge of pink. Spring and early summer. Brazil, in the neighbourhood of Rio Janeiro.

M. Clowesii.—A fine, bold-growing species; pseudo-bulbs ovate, bearing a pair of long, ensiform, dark green leaves. Raceme erect, many-flowered, flowers some three inches across; sepals and petals lanceolate, rich yellow, blotched and barred with brown; lip flat, cordate, contracted at the point, where it is white, passing into deep violet-purple at the base. Autumn months. Organ Mountains, Brazil.

M. Regnellii.—This very handsome species has erect oblong pseudo-bulbs, each bearing a pair of erect sword-shaped leaves some twelve inches long. Scape longer than the leaves, erect, many-flowered; sepals and petals spreading, waxy in texture, and soft white; lip large and flat, rosy-lilac. In the variety *purpurea*, sometimes known as "Rucker's variety," the whole plant and flowers are much larger; the sepals and petals are soft rose, margined with pure white, and the large flat lip is of a uniform purplish-crimson. Autumn months. Minas-Geraes, Brazil.


Miltonia Candida.

M. spectabilis.—A dwarf plant producing short oval pseudo-bulbs on creeping stems, which bear a pair of short and thin ligulate leaves. Peduncles axillary, one-flowered, each flower measuring three to four inches across; sepals and petals rather short, waxy-white; lip large and flat, centre rosy-violet, shading off to white. There are several varieties of this species. Late summer and early autumn months. Brazil.

M. spectabilis, var. *Moreliana.* — This plant is frequently treated as a distinct species; it, however, is really undistinguishable when out of flower, and when in bloom colour is nearly the only difference, but in this it is very distinct. The flower is the same shape as *spectabilis*, but larger, and of a uniform rich deep purple; the lip in addition being veined with dark rose. Late summer and early autumn. Brazil.

Mormodes.—This genus is not distinguishable from *Catasetum* when out of flower, as they have the same stout fusiform pseudo-bulbs, and plaited, membranous, deciduous leaves, and the flowers have the same habit of breaking out into strange varieties. The chief distinctions are to be found in the shape of the labellum, and in the column, which is destitute of the peculiar tendrils (*cirrhi*) which are to be found in *Catasetum*. The name is derived from *mormo*, "a goblin," and refers to the extraordinary appearance of the flowers. Mormodes not only produce strange-shaped flowers, but their flowers are in many instances very highly coloured and showy, and therefore it is hard to explain why they have fallen into disrepute with cultivators of Orchids. These plants are easily managed. Naturally they are epiphytes, growing, we are told, principally upon the branches of a species of *Erythrina* on the mountain-ridges of Santa Martha; but, on account of the weight of the pseudo-bulbs, pot culture is preferable in this country; the pots should be drained well, and the peat must be rough and fibrous; during the growing season they enjoy a copious supply of water, but during winter it should be entirely withheld. Cool end of Brazilian House.

M. aromaticum.—Raceme short and erect, flowers soft pink, profusely dotted with bright red. They are very fragrant. Summer months. Mexico.

M. atropurpureum.—Raceme erect, and many-flowered; flowers large, and of a uniform deep blackish-purple. Summer months. Central America.

M. barbatum.—This species is figured in the *Botanical Magazine* under the name of *M. atropurpureum*, but it is quite a distinct plant. The scape is erect; flowers pendulous and distant, of a uniform rich reddish-brown; lip velvety, and furnished with numerous short hairs. Spring months. Panama.

M. Cartonii.—A variable plant. The first time it flowered in cultivation it produced a dense, many-flowered raceme of beautifully-striped flowers; since then we have a form of it with dark lake-coloured flowers, speckled with red; and another with dull red flowers, ornamented with dotted lines of red; and again a form in which the sepals and petals are flesh-coloured. In the type the sepals and petals are yellow, with longitudinal streaks of bright red; lip pale yellow, sparingly streaked with short lines of red. Summer months. Santa Martha, at 3,000 to 4,000 feet elevation.

M. Greenii.—A magnificent species of somewhat recent introduction; raceme dense, many-flowered, and pendulous; flowers large, yellow, densely spotted with dark red; lip same colour, with a dark purple base. Summer months. Central America.

M. igneum.—This very showy species produces large fleshy flowers on a dense raceme, about a dozen together; the sepals and petals are rich chocolate, and the lip a fiery orange-red. Winter months. Central America.

M. luxatum.—Raceme many-flowered, each flower upwards of three inches across, and powerfully aromatic; sepals and petals pale lemon-colour, sometimes creamy-white; lip same colour as the sepals, with a few streaks of reddish-brown. Summer months. Mexico.

M. macranthum.—This is a magnificent species; the raceme bears six to twelve flowers, which are nearly six inches across, of a uniform rich deep brown. In the variety *colossus* the sepals and petals are pale rose-colour at the base, the upper part light yellow; lip golden-yellow, dotted with rose. Spring and early summer. Central America.

M. pardinum.—Raceme many-flowered; flowers large, rich yellow, dotted and spotted with bright brown. Summer months. Mexico.

M. Skinnerii.—A handsome species; the flowers are large, soft creamy-yellow, streaked with lines of deep red; lip deep yellow, spotted with red, and furnished with numerous white hairs. Summer months. Central America.

M. speciosum.—Sepals and petals rich, deep golden-yellow; lip same colour, tipped with rich purple, and dotted with dark crimson. Summer months. New Grenada, at 4,000 to 5,000 feet elevation.

M. uncia.—The flowers are larger than those of *M. aromaticum*, creamy-white, variously spotted and blotched with purplish-violet. Summer months. Mexico.

M. Williamsii.—This is a very beautiful species; the pseudo-bulbs are short, and very stout. Spike erect, raceme dense, bearing twelve to fifteen large, creamy-white flowers, which are very aromatic. Spring and early summer. Mexico.

Nanodes.—This genus was established for a very small plant known as *Nanodes discolor;* the name signifies "pigmy," and was very applicable to that species, inasmuch as the whole plant was not more than two inches high, and flowers and leaves were very similar in colour; the species here described, although corresponding in colour, is a short robust plant, and with some slight differences in the arrangements of the parts of the flower. The genus is distinguished by "its lip being adnate to the column, and cohering with the lateral sepals above which it is placed, and by its four compressed pollen-masses being sessile side by side on an ovate gland." Block culture suits these plants best. Peruvian House.

N. Medusæ.—The specific name comes from the peculiar long-fringed margin of the labellum. The plant has no pseudo-bulbs, but a long fleshy stem which grows downwards; the stems are tufted, a foot or more long, and bear linear-oblong leaves, which are three to four inches long and an inch broad, arranged in a distichous manner, clasping the stem at the base, and pale green in colour, with more or less of a glaucous hue. Flowers usually in pairs at the ends of the branches, flat, thick, and fleshy in texture, and two to three inches in diameter; sepals and petals sub-equal, linear-oblong, green, more or less tinged with brown; lip very large, nearly round, lobed in front, the margin very deeply fringed, the whole of a rich deep maroon, except a small patch of green on the disc. Summer months. Andes of Peru.

Nasonia.—Small-growing plants, which require to be grown upon a block of wood, with a little sphagnum moss; they require a good supply of water, and no season of rest, as they have no pseudo-bulbs, but only slender stems. Peruvian House.

N. punctata.—This little plant is frequently to be found in collections under the names of *N. coccinea* and *N. cinnabarina;* these very likely originated upon the Wellerian theory, that they *mean more* than the word *punctata.* It is quite destitute of pseudo-bulbs, but produces numerous tufted stems, which attain a height of three to six inches, supporting small, dark green, oblong-lanceolate leaves, which are arranged in a distichous manner. Flowers solitary, borne on short pedicles from the axils of the upper leaves, and about an inch in diameter; sepals and petals about equal, rich cinnabar-red; lip obovate, rich yellow; its flowers are produced in great profusion during March and April. Mountains of El Lisme, Peru.

Odontoglossum.—The name comes from *odous,* "a tooth," and *glossa,* "a tongue," and refers to the tooth-like processes with which the lip is ornamented; they are very nearly allied to *Oncidium,* and like that genus include a vast quantity of species and varieties, the greater portion of which are remarkable for the extreme delicacy and beauty of their markings.

Odontoglossums are all mountain plants, and will not thrive in a high temperature, neither must they be subjected to the drying-off system, as they grow nearly all the year round; some few species enjoy the temperature of the Brazilian House, but these will be specially mentioned. In potting Odontoglossums the first thing to study is drainage, for although these plants enjoy an abundance of water, it must be carried away quickly; for compost use rough peat and sphagnum moss in about equal parts, surfacing with live moss, which produces a neat and cheerful appearance, and the roots like to work through it and cling to it; the majority of the species grow well under pot-culture, but a few of the smaller kinds thrive best upon blocks of wood, and when thus grown they will require frequent dippings in a tub of water, which should be kept ready at hand for this purpose. Peruvian House.

O. Alexandræ.—This species when introduced to cultivation, in 1863, was described by Mr. Bateman, and he then said it was "allied to *O. Pescatorei* and *O. crispum,* but is quite distinct from both, and probably more lovely than either." Since then, however, botanists have decided that Mr. Bateman's plant is identical with the previously little-known *O. crispum;* but so anxious have all cultivators been that this gem should be known by the name of our lovely Princess, that *Odontoglossum Alexandræ* has become quite a household word, and the older name of *crispum* is principally confined to botanical parlance.

The pseudo-bulbs are oblong-ovate, compressed, and deep green, occasionally freckled with brown towards the apex; leaves narrow-lanceolate, and light green; raceme many-flowered, usually six to twelve are developed, each measuring two to three inches in diameter; sepals and petals pure white, the latter broader and waved at the margin; lip oblong-acuminate, white, crested with yellow, and ornamented with reddish-purple spots and lines. This species is subject to considerable variation in its markings. In the var. *Bluntii* the sepals and petals as well as the lip are decorated with reddish-purple spots; it commemorates the discoveries of Mr. Blunt. The var. *Warnerii* first flowered with Mr. R. Warner, of Bloomfield, and is dedicated to him on account of his great exertions to increase the taste for this beautiful order of plants; its flowers measure upwards of three inches across, and are very numerous; sepals and petals broad, and beautifully crisp at the edges, profusely spotted with reddish-brown, and suffused with rose; lip large, white with a large blotch in front of the yellow crest, crisp on the margin. The var. *Trianæ* is so named in honour of the celebrated botanist and traveller, Dr. Triana, who discovered it; the flowers are large, sepals white, deeply tinged with rose, the dorsal sepal having one large reddish-brown spot, the lower ones several of the same colour on each; petals broad, pure white; lip spotted with rose, and streaked with rosy-purple. The var. *gustatum* produces large flowers; these are snow-white, with a profusion of purplish spots on the sepals and petals, the lip stained with rich yellow. The plants bloom nearly all the year round. New Grenada, at 7,000 to 8,000 feet elevation.

O. Bictoniense.—A strong free-growing species, with oblong compressed pseudo-bulbs, about six inches high, and bearing several broadly-lanceolate spreading leaves; scape erect, one to two feet high, usually simple, but sometimes much branched and many-flowered; sepals and petals rich chocolate, sometimes tinged with green; lip variable, in some forms white, in others rosy-purple, or deep purple. Winter and spring months. Guatemala, at 6,000 to 7,000 feet elevation.

O. blandum.—An elegant, somewhat small-growing species, with ovate pseudo-bulbs, which are green, tinged with reddish-brown, and bear narrowly-lanceolate leaves six to nine inches long, and light green; scape slightly shorter than the leaves, many-flowered; sepals and petals white, in some varieties tawny-yellow, profusely spotted and dotted with deep crimson; lip broad, acuminate, much toothed, and waved at the edges, same colour as the petals, stained on the crest with yellow, and bearing a large maroon blotch in the centre. It is somewhat similar in appearance to *O. nævium.* Winter months. New Grenada.

O. cirrhosum.—This very beautiful species caused quite a commotion in the Orchid world when first leathery, oblong-lanceolate, acute, twice as long as the pseudo-bulbs, pale green; scape twelve to eighteen inches long, bearing ten to twenty flowers, each upwards of three inches across; sepals and

ODONTOGLOSSUM CRISPUM OR ALEXANDRÆ.

introduced, but speedily lost caste; in fact it was too accommodating, for it had been found in large quantities, it travelled well, and soon sold for a very low price, and thus in spite of its extreme beauty it came to be despised; nevertheless, it is deserving of a place in the choicest collection. It is a free-growing plant, with oblong compressed pseudo-bulbs, smooth, about three inches high and light green; leaves petals somewhat lanceolate, the latter broader, all being lengthened out into slender tail-like points, creamy-white, profusely spotted with reddish-brown; in some forms these spots are a deep crimson-maroon; lip broad at the base, where it is yellow, ornamented with radiating lines of reddish-orange; the apex lengthened out like the petals, and the same colour. It flowers at various times in the year. Andes of Ecuador, at 6,000 feet elevation.

O. citrosmum.—Pseudo-bulbs some four inches high, ovate, compressed, smooth and shining, bearing a pair of oblong-ligulate coriaceous leaves; racemes pendulous, coming up with the young growth, twice as long as the leaves, many-flowered; sepals and petals pure white; lip crescent-shaped, white, stained with yellow at the base, and sparingly dotted with reddish-crimson. In the var. *roseum*, the lip is rich soft rose. Mexican division. May and June. Guatemala.

O. cordatum.—A free-growing species with oblong-ovate pseudo-bulbs, and oblong-lanceolate leaves; scape erect, branched, many-flowered; sepals and petals spreading very much, lengthened out into narrow tail-like points, tawny-yellow, transversely barred with irregular blotches of chocolate; lip heart-shaped, acuminate in front, white, spotted near the margin with chestnut-brown, and stained at the base with rosy-purple. In the var. *superbum* the flowers are broader, and the markings are all deep purplish-brown. Mexican division. Spring and summer. Guatemala.

O. coronarium.—This is a climbing plant with a stout ascending stem, producing at intervals thick, somewhat ovate, compressed pseudo-bulbs, which are upwards of four inches high; leaves oblong-obtuse, about a foot long, and three to four inches broad, thick and leathery in texture, and deep green; scape erect, one to two feet high; the raceme bears from twelve to twenty large flowers, all open at the same time; sepals and petals nearly equal, much waved at the edges, golden-yellow, irregularly spotted and blotched with deep chestnut; lip narrow at the base, yellow, with a pair of light red blotches on the disc. Summer months. Various parts of New Grenada and Peru, at 5,000 to 7,000 feet elevation.

O. grande.—A truly superb species, with very stout and fleshy ovate pseudo-bulbs, which are deep blue-green in colour, and bear a pair of broadly-oblong, thick, and coriaceous leaves, intense deep green, with a glaucous hue; scape erect, rising with the young growth, bearing several flowers, each measuring four to six inches or more in diameter; sepals and petals lanceolate, the latter the wider, rich orange-yellow, transversely banded with bright chestnut; lip nearly round, creamy-white, dotted and freckled with brown, disc marked with deep orange spots; the whole flower has the appearance of having been varnished. August and September. Guatemala.

O. Hallii.—This is a grand yet variable species, so far as the colours and markings are concerned. Pseudo-bulbs ovate, somewhat compressed, four to five inches high (and with age often becoming wrinkled), bearing two or more narrow, acuminate, deep green leaves a foot long; scape twice the length of the leaves, many-flowered, each flower three to four inches across; sepals and petals nearly equal, all spreading and tapering to an acuminate point, where they are recurved; in some varieties they are primrose-colour, in others rich yellow, spotted and blotched with brown, or purple; lip white, beautifully fringed on the edge, and more or less spotted with the same colours as the petals, and like them drawn out into a tail-like recurved point, stained yellow towards the base, and ornamented with long crests on the disc. Spring and summer. Peru and New Grenada, at 8,000 feet elevation.

O. hastilabium.—A large bold-growing species, and one that continues a long time in bloom. Pseudo-bulbs ovate, compressed, some six inches high, pale shining green in colour, bearing usually two oblong coriaceous leaves, which are dark green. Scape erect, three to six feet high, often much branched; flowers numerous, seldom less than twenty, frequently eighty or ninety are developed when the plant is vigorous; these are delicately fragrant, and from one to two inches across; sepals and petals linear-lanceolate, acute, soft creamy-white, sometimes tinged with pale green, and transversely barred with lines of dark red or purplish-brown; lip subrotund, white in front, dark rose or purplish-rose at the base. Spring and summer months. Brazilian House. New Grenada, as low down as 2,000 to 5,000 feet elevation; it does, however, occur at nearly twice the altitude.

O. Insleayii.—This handsome species is a near ally of *O. grande.* Sepals and petals somewhat oblong, about equal, pale yellow, tinged with green, and transversely banded with chestnut-brown; lip spathulate, slightly rolled back, pale yellow to orange-yellow, and prettily dotted round the margin with rich cinnamon or chestnut spots. There are several varieties, *Leopardinum* and *splendens* being the best. Autumn months. Mexico, at 5,000 to 6,000 feet elevation.

O. Kramerii.—This unique and elegant species requires more warmth than many of its relatives, and should be grown in the Brazilian House. Pseudo-bulbs nearly round, with the edges much compressed, and pale green, bearing a single leaf less than a foot long, oblong-lanceolate, smooth throughout, with a sharp keel beneath, where it is pale green, dark green above; the scape arising from the fully-developed growth, sometimes erect, but more often pendulous, bearing several flowers: sepals and petals about equal, oblong, the dorsal sepal curved inwards, pure white, tinged in the centre with violet; lip broad, deeply bilobed in front, reddish-violet, yellow at the base, with two half-moon-shaped bands of dark brown in front of the crest. June and July. Costa Rica.

O. luteopurpureum.—A robust-growing and very variable plant, possessing great beauty. Pseudo-bulbs three to six inches high, ovate and compressed, bearing a pair of broad dark green leaves about a foot long; scape as long or longer than the leaves, many-flowered. Flowers differing much in the intensity of their markings in different plants, and measuring nearly three inches in diameter. Sepals and petals nearly equal, usually rich brown, or brownish-purple, variously blotched and banded with light yellow, the border generally well defined, and of a deeper yellow; lip somewhat fiddle-shaped, chocolate at the base, white in front, where it is prettily fringed, and ornamented with numerous yellow bristles. In the variety *sceptrum*, the flowers are rich golden-yellow, profusely spotted and blotched with rich cinnamon. Autumn months. New Grenada, at 6,000 feet elevation.

O. maculatum.—This is a small-growing but very beautiful species. Pseudo-bulbs oblong, compressed, bearing a single oblong-lanceolate leathery leaf; scape many-flowered; sepals rich brown, the upper one barred or blotched near the base with yellow; petals much broader, deep yellow, the basal half more or less spotted with brownish-crimson; lip heart-shaped, tapering to a point, white, profusely spotted with the same colour as the petals. It varies considerably in its markings. Summer months. Mexico.

O. membranaceum.—A very small plant which thrives best on a block of wood. Pseudo-bulbs small, ovate, whole plant seldom exceeding six inches in height; sepals and petals white, transversely banded with narrow lines of reddish-brown; the lip white, streaked the same as the petals. Spring months. Guatemala.

O. nævium.—This species takes rank as one of the most beautiful of the genus, and still remains one of the scarcest. Pseudo-bulbs rather oblong, slightly compressed, and which, with the narrow leaves, are deep green; scape many-flowered; sepals, petals, and lip narrow, beautifully crisp, and drawn out into long tail-like points, snow-white, freckled and spotted with purplish-rose and crimson. Its most elegant flowers appear during the summer months. New Grenada, at 6,000 feet elevation.

O. nebulosum.—A strong-growing plant, and a profuse bloomer if kept in a low temperature. Pseudo-bulbs ovate, somewhat compressed, smooth and pale green, bearing two or three oblong-acute leaves; scape arising with the young growth, three to six-flowered; sepals and petals pure white, spotted and barred with reddish-brown at the base; lip white, spotted and clouded over the whole surface with brown, with a patch of yellow at the base. Its large flowers are produced at various times of the year. Mexico, at 10,000 feet elevation.

O. Pescatorei.—In habit of growth and general appearance when not in flower, this species resembles *O. Alexandræ*, to which species, indeed, it is a dangerous rival. The flowers are borne upon large panicles of thirty to forty, or more; the individual blooms, however, are smaller, and it may also be known by its fiddle-shaped lip; in some varieties the flowers are of the purest white, stained on the lip with crimson and yellow, and more or less spotted with rose; in other forms the whole flower is beautifully tinged with flesh-colour. Spring and early summer, lasting several months. New Grenada, at 6,000 feet elevation.

O. Phalænopsis.—This elegant little plant belongs to a different section of the genus from any hitherto noticed, which includes *Phalænopsis*, *vexillarium*, *Roezlii*, &c., in which the flowers are very flat, the sepals and petals small, whilst the lip is very large. Pseudo-bulbs small, conical or oblong, bearing a single grass-like leaf, the whole plant seldom exceeding eight inches in height, and more creamy-white than green. The peduncles arise from the base of the pseudo-bulbs, and are not longer than the leaves, bearing about two flowers, each upwards of two inches across; sepals and petals white; lip broad, rosy-crimson, bordered with white, and stained with yellow at the base. The cool end of the Brazilian House suits it best. Spring and early summer. New Grenada, at 5,000 to 6,000 feet elevation. Now named *Miltonia Phalænopsis*.

O. pulchellum, var. *majus.*—A free-growing plant, with oblong bright green pseudo-bulbs, bearing a pair of linear leaves upwards of a foot long; scape erect, about as long as the leaves; scape many-flowered; flowers thick and fleshy, pure waxy-white, with a stain of yellow on the lip, and deliciously fragrant. Winter and spring months. Mexico.

O. Roezlii, now *Miltonia Roezlii*, as before remarked, belongs to the section with large flat labellums. It is named in honour of its discoverer, M. Roezl, one of the most successful and indefatigable plant collectors that ever entered on this fascinating but hazardous employment. Pseudo-bulbs slender, ovate, compressed, two inches or more high, pale green, bearing on the summit a pair of linear-lanceolate leaves nearly a foot long; scape slender, erect, three to six-flowered, each flower measuring upwards of three inches across; sepals and petals about equal, pure white, the latter having a large and conspicuous blotch of rich purple at the base; lip large and broad, obcordate, notched in front, pure white, stained with yellow at the base, and streaked with purple on the disc. It thrives best in the Brazilian House, but is very liable to the attacks of thrips if kept in too high a temperature. Autumn and winter months, lasting long in perfection. New Grenada.

O. Roeslii, var. *album*.—A charming plant, introduced since the normal form; it differs in nothing except colour, or perhaps in want of colour, for it is destitute of the large purple blotches on the petals, and the whole flower is of the purest white, saving a stain of very pale yellow at the base of the lip. Winter months. New Grenada.

O. Rossi, var. *majus*.—As its name implies, this is an enlarged form of the type; it is a small-growing plant, seldom exceeding six inches in height, and thrives better on a block of wood or in a basket than when subjected to pot-culture; the small pseudo-bulbs are ovate, bearing a solitary membranous leaf; scape usually one-flowered, but sometimes two and three are produced; sepals white, broadly banded with purplish-crimson; petals also white, but the crimson bands are mostly confined to the basal part; lip large, cordate, and pure white. Winter months. Mexico.

O. triumphans.—This, as its name implies, is a splendid species, and it is one that has never been introduced in large quantities, or has not become so plentiful in collections as many other kinds. It is a robust-growing plant, with large ovate pseudo-bulbs; these are slightly compressed and smooth, but with age become corrugated; they bear a pair of oblong-lanceolate, acuminate leaves nearly a foot high, which, like the pseudo-bulbs, are bright shining green; scape erect, much longer than the leaves, usually simple, but sometimes branched, arising from the mature growth, and ten to twelve-flowered, each flower measuring upwards of three inches in diameter; sepals and petals about equal, spreading, ground-colour rich golden-yellow, variously blotched and spotted with brownish-crimson, or deep chocolate; lip somewhat heart-shaped, deep rose or crimson in front, pure white at the base, where it is stained in the centre with yellow. Spring and early summer months. New Grenada, at 6,000 feet elevation.

O. Uro-Skinnerii.—This is one of the strongest-growing species, named in honour of an enthusiastic lover of plants and a keen observer, who, from his long residence in Guatemala amongst the numerous Orchids with which that country abounds, discovered the secret of that want of success which attended the cultivators in this country in their attempts to establish these mountain gems. The writer of these notes has frequently been indebted to him for valuable information as to the natural surroundings of many of the species here described. *O. Uro-Skinnerii*, as before remarked, is a strong-growing species, producing large and broad subrotund pseudo-bulbs, which are compressed, and pale green, freckled with red spots and dots; leaves broadly-lanceolate; scape erect, usually simple, sometimes branched, ten to twenty-flowered; sepals and petals about equal, ground-colour lively green, profusely spotted with reddish-brown; lip large and spreading, white, very thickly covered with round spots of pale blue or lilac. Autumn and winter months. Guatemala, at 5,000 to 6,000 feet elevation.

O. vexillarium, now called *Miltonia vexillaria*, is the last species we shall enumerate, but the most superb. The whole plant seldom exceeds twelve to fifteen inches in height, and both pseudo-bulbs and leaves are of a peculiar glaucous greenish-white; scape erect, three to seven-flowered, each flower upwards of four inches across; sepals and petals nearly equal, deep rose or pink, in different varieties; lip broad and flat, deeply bi-lobed in front, deep rose, stained with yellow, and streaked with red towards the base. As there are now numerous varieties of this plant in cultivation, the flowers are produced nearly all the year round; the typical plant flowers in spring, the var. *rubellum* in autumn. Cool end of the Brazilian House. Andes of New Grenada.

THE LIFE-HISTORY OF PLANTS.

By Dr. Maxwell T. Masters, F.R.S.

RIPENING OF THE FRUIT.

THE ripened or matured ovary, whatever its texture and appearance may be, is botanically the fruit. It matters not whether it is hard or soft, edible or inedible, the ripened carpels constitute the fruit, or seed-vessel. The thing is the same, it is only the superficial appearances that differ, and hence it is most convenient here to use the term "fruit" in its botanical signification. This is rather an inversion of popular custom. In the loose every-day talk of those who do not know better, fifty or a hundred different things are called "Lilies," or "Roses," or "Laurels," because, to them at least, the superficial appearances are alike. The botanist hesitates to employ such vague expressions, for he knows that the things are different.

During its change from the unripe to the mature condition the fruit undergoes many and diverse changes, according to its kind. In general the stigma and style wither after fertilisation, and the ovary, with the ovules in the interior, begin to swell, and undergo various changes.

Forms of Fruit. — The forms of fruit are nearly as diverse as those of the leaves, so that we can only refer those who wish to become conversant with details, to the ordinary text-books. For our purpose it will suffice to say that, after fertilisation, as explained in the last section, the fruit commences to ripen. This ripening process takes place in very different ways, according to the nature of the plant. Sometimes the carpels merely dry and shrivel up, forming a membranous bag around the seed (Fig. 88); at other times they become hard and woody, or soft outside and hard within, as in the so-called "stone fruit" (Figs. 89, 90), or entirely fleshy, as in the Grape or Currant (Fig. 91). And between these several conditions there is every possible intermediate stage. Nor is this all; the "fruit" is often constituted, not only by the ripened carpels, but by those organs combined with others.

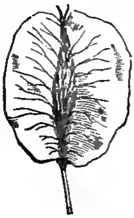


Fig. 88. — Fruit of Elm, membranous and winged.

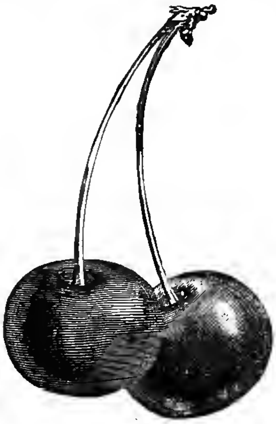


Fig. 89.—Fruit of Cherry, succulent.

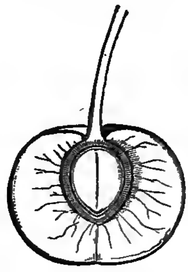


Fig. 90.—Succulent Fruit of Cherry, cut open to show the stone enclosing the kernel or seed.

Fig. 91.—Succulent Fruits of Currant.

Fig. 92.—Legume of Pea opening when ripe by two valves.

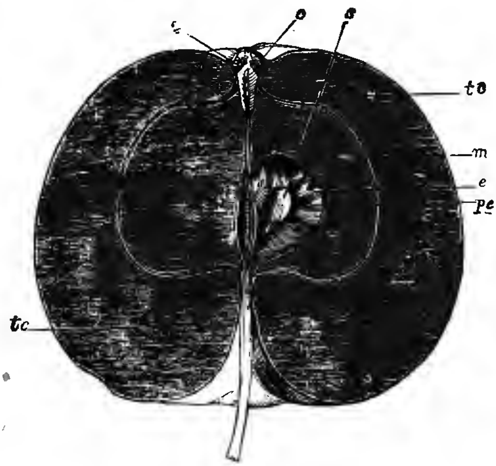


Fig. 93.—Section of Fruit of Apple, composed of the swollen top of the flower-stalk, surmounted by the remains of the calyx or "eye." The section shows the stalk, *f*, dilating into the fleshy portion, *tc*, surrounding and enclosing the true fruit-carpels or "core," *e*, which in their turn enclose the pips or seeds, *s*; *c* is the eye or remains of the calyx; *st*, the remains of the stamens.

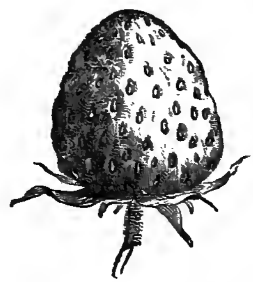


Fig. 94. — Strawberry. The thalamus or axis of the flower is swollen above the calyx, and bears the "pips" or true fruits, as it were, sunk in its surface.

In the legume, or Pea-pod (Fig. 92), and in the stone fruits, the carpels alone constitute the fruit, the outer coats of which in the latter case are soft, the inner hard and woody; but in pippin fruits like the Apple or Pear the edible portion of the fruit is not the ripe carpels, but the fleshy flower-stalk which has grown up around them (Fig. 93). The carpels here are represented by the "core." In the Melon and the Cucumber, the Currant and Gooseberry, the upper end of the flower-stalk in like manner grows over the true carpels, which thus become embedded in the interior. That this is so is shown by watching the mode of growth, and, where that cannot be done, by observing the remains of the calyx *at the top* of the fruit, as in the eye of a Pear.

A calyx in such a position would be wholly anomalous, were it not readily explicable by the cause just mentioned. In the Strawberry (Fig. 94) the true fruit consist of the little pips or carpels, which bestrew the surface, or are partly embedded in the top of the flower-stalk, "thalamus," or "receptacle," as it is indifferently called, and in which, after fertilisation, the constituent cells swell and multiply, and fill themselves with savoury juices of their own manufacture. In the Bramble or the Raspberry (Fig. 95) the case is altogether different. Here each little fleshy pip represents an entire carpel, springing, not from a fleshy, but from a dry receptacle. We eat the luscious receptacle of the Strawberry, but we throw away the corresponding part in the Raspberry. We swallow the pips of the Strawberry, because we cannot avoid doing so, but if we could reject them we should do so; while in the Raspberry we eat them from choice. The pips of the latter fruit, in fact, are miniature stone fruits (drupes).

Fig. 95.—Raspberry, showing the persistent calyx and the numerous small fleshy fruits aggregated on the dry floral axis.

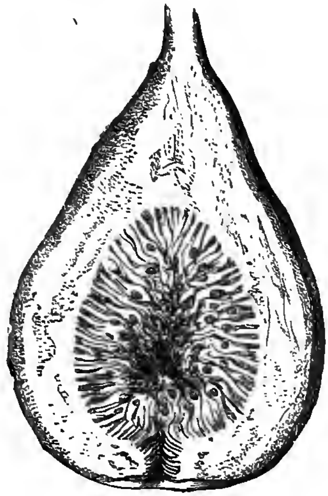


Fig. 96.—A section through a Fig. The flower-stalk expands to form a top-shaped cavity, from the sides of which the true fruits proceed.

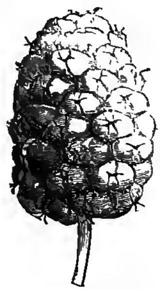


Fig. 97. — Mulberry. The "fruit" is here composed of a number of originally separate *flowers*, all parts of which have become more or less fleshy, and ultimately combined in one mass.

Fig. 98. — Pod of Wallflower bursting by two valves.

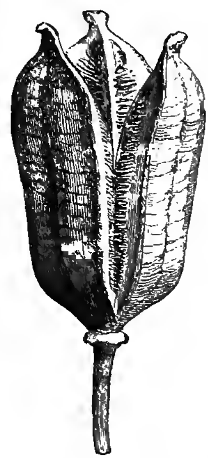


Fig. 99. — Pod of Tulip bursting into three pieces.

The fruit in all the cases hitherto mentioned has consisted of the ripened carpels of one flower, with or without the addition of other parts of that flower. But other fruits are of a more complex character. A Mulberry, a Pine-apple, or Fig, is not one fruit, it is not the ripe state of any one flower, but it is an aggregation of several flowers and other constituent parts (Figs. 96, 97) into one fleshy mass. Such fruits are like "catkins," or inflorescences in which all the flowers have become fused into one succulent mass.

The effect of all these variations is seen in the dispersion of the seed. Where the "fruits" are light and membranous they are wafted away by the wind; where they are bony they fall to the ground and slowly rot, or they split into several pieces (Figs. 98, 99), and thus liberate the seed; while in the case of the fleshy fruits the colour, perfume, flavour, are all so many allurements to birds or insects, which here, as in the process of fertilisation, in the pursuit of their own selfish aims, are made to fulfil an unconscious but most important part in the great scheme of Nature.

Structurally, the ripening of the fruit consists either in the shrivelling of the fruit from the drying up of the water, in its hardening from the deposition of woody materials in the constituent cells, or in its increased succulence from the multiplication of the cellular components.

There are certain points in the ripening of fruits, well known to practical men, but which have not as yet received from botanists the attention they deserve. Thus the maturation of Peaches and Grapes, for instance, is not marked by one continuous increase in size, but there is as it were a check for some weeks during the "stoning period." Then occurs the "second swelling," which goes on uninterruptedly if circumstances be propitious. The explanation given by gardeners is that the increase in size is temporarily arrested during the development of the stone, in the case of stone fruit, or the formation of the hard seed in the Vine, and that once these latter processes are satisfactorily accomplished the second swelling occurs. The facts are beyond dispute, but the explanation given has not as yet been accurately tested; at any rate, practically it is well known that if the fruits be over-stimulated during the stoning period, they resent the interference, and either fall off, as in the Peach, or the fruit suffers in quality, as in the Vine.

Physiologically the ripening of the fruit consists in the transport or formation of various juices and their manifold chemical transformations. Let us take the Grape as an example. The young ovary is of small size, green, soft, tasteless, or faintly acid; after fertilisation it swells, its constituent cells multiply, the watery juice accumulates, the acidity increases, tannin is deposited in the skin and in the seed. All the time the young fruit remains green, the work it has to do is the same in kind as that effected by the leaf; hence to gain an idea of what the green fruits do, and what are the conditions most propitious for the purpose, the reader should refer to the account given of the mode of growth and action of the leaf when exposed more or less to the light. But as ripening advances under the influences of increasing temperature, or what comes to the same thing, of the prolonged exposure to an equable temperature, the green colour gradually gives place to the colour peculiar to the particular fruit, the sour acids disappear, sugar is developed, and slowly but surely the whole composition of the fruit alters. Unripe fruits contain a large proportion of water, and a notable quantity of gummy substance called *pectose*, which undergoes various chemical changes during the process of ripening, and which is the source of the jelly-like substance so familiar to us in "Currant jelly."

The favourite culinary mixture of Currants and Raspberries finds its explanation in the presence of this ferment, "pectose," which acts on the "pectin" of the Currant, and transforms it into an acid jelly. M. Buignet has determined the average amount of acid per cent. in various descriptions of fruit, and from his tables, as cited by M. Dehérain, we extract the following:—

	Acid per cent.	Sugar per cent.
Peaches, unripe	3·9	5·9
Peaches, ripe	0·7	1·9
Grapes, unripe	2·4	1·6
Grapes, ripe	0·3	18·3
Apricots	1·8	8·7
White Currants	1·5	6·4
Raspberries	1·3	7·2
Greengages	1·2	5·5
Apples	1·1	13·9
Cherries	0·6	10·0
Strawberries	0·5	11·3
Pine-apples	3·5	13·3
Pears	0·8	7·8
Figs	0·05	11·5

These figures will suffice for purposes of general illustration; it will, of course, be understood that the amounts will vary according to sort, season, and stage of ripeness; notwithstanding the proportions will remain nearly the same. M. Buignet has also studied, comparatively, several kinds of Strawberries, from a chemical point of view. Princess Royal and Elton are types of a group of Strawberries remarkable for abundance of juice and acid, and a small proportion of sugar. The Alpine Strawberries are much more sugary, not very juicy, and slightly acid; while the "Hautbois" are very slightly juicy, with little acid, and a large proportion of sugar.

In general terms it may be stated that fruits pass through three stages. In the first, which is that of development, the fruit is green, and does the work of a leaf.

In the second period, which is that of maturation, the colour changes; it no longer emits oxygen gas when exposed to the light, but gives off carbonic acid. During this period a series of changes (combustions the chemists call them) occurs, in consequence of which the tannin disappears first, followed by the acid, and, after a time, by the sugar also, when the fruit becomes insipid.

The third stage is one of decomposition, the effect of which is to set the seed at liberty, by the rotting of the fruit. Air enters the cells of the fruit, its sugar is converted into alcohol through the agency of the infinitesimally minute spores of a fungus, which acts like yeast, carbonic acid being given off, while the alcohol, acted on by the remaining acids of the fruit, forms various ethers, to which the fruits owe their fragrance. Finally, the air destroys the cell-walls, "blets" them, and at the same time destroys whatever acid or tannin material may be still left; thus the acid astringency of the Medlar, of the Persimmon (*Diospyros*), which renders the young fruits uneatable, is removed by the process of bletting.

The changes above referred to are, in general, the direct consequences of fertilisation; but in some cases it happens that the fruit ripens, and even the seed forms, after the agency of the pollen, and yet the plant is infertile because the embryo plant is not properly developed. Thus, the fruits of *Musa Cavendishii*, although they ripen under cultivation here, never produce seed. The capsules or seed-pods of Orchids often ripen and produce abundance of seed, but not perfect seed. The fruits (seeds) of Cycas ripen and develop in our stoves, in all respects perfectly, except in the development of the embryo. Hence the mere ripening of the fruit, or even of the seed, though usually consequent upon fertilisation, may occur exceptionally without fertilisation of the embryo having taken place at all.

THE SEED.

While the ovary is ripening into the fruit, the ovules in their turn are slowly ripening into seeds. The seed varies greatly in different plants (Figs. 100—103), but what gardeners have chiefly to consider with regard to it are its coatings, its perisperm, or store of food (see Vol. I., p. 21), and specially its embryo plant, to which all the rest is accessory, and without which the seed is infertile and useless. As the ovule ripens into seed it usually increases in size, its coats undergo various changes in the way of thickenings, formation of outgrowths, hairs, wings, and the like (Figs. 100—103), in the development of colour; the proportion of water, moreover, greatly diminishes, and the accumulation of reserve material, starch, oil, aleurone, either in the seed itself or in the tissues of the embryo, proceeds rapidly.

Fig. 100.—Seed of Cotton surrounded by hairs.

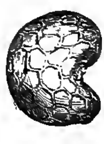


Fig. 102.—Seed of Poppy, with its outer coat marked by a raised network.

Fig. 103.—Seed of Chickweed, with its outer coat provided with small tubercles.

Fig. 101.—Section of Cotton-seed.

While, therefore, the conformation of the seed is such as to insure its preservation and its dispersion, its chemical composition is such as to secure to the nascent embryo within, the air, the water, the food, requisite for it till it can feed itself. Obtuse, indeed, must be he who is not struck with this daily-enacted miracle of provident protection.

One more point of interest may be here mentioned—the relative uniformity of chemical composition in the seed. The varying composition of root, stem, leaf or flower, according to the stage of growth, season, climate, or manure, has been either directly alluded to or must have suggested itself to the reader as a necessary consequence of the activity varying alike in intensity and in kind throughout the plant during its growth. But now things are different. Whatever have been the fluctuations of the past, whatever actions, reactions, and permutations have been carried out, now has come a period of rest, a condition of something like stability.

A very interesting illustration of this is afforded by the Rothamsted experiments. Among these is a series showing the results of ninety-two analyses of the ash of Wheat-grain, and ninety-two of Wheat-straw, grown in each case under known conditions of soil, season, and manuring. The soil has been analysed, the manures also, the climatic features duly recorded and compared; moreover, these results are not derived from one season's growth only, but from that of a lengthened series of years. The outcome of this vast series of experiments is recorded in abstract in the *Journal of the Chemical Society* for August, 1884. The only point we can here refer to is the fact that, in spite of the very widely different character of the manures employed, provided the seed was fairly ripened, there was a marked uniformity in the mineral composition of the ripe grain, even where there was wide variation in that of the straw, dependent on supply or exhaustion of mineral food.

These conclusions are in harmony with what is known of the transfer of materials from the leaves to the seed during growth, and with the general results of the chemical analysis of the seed. In plants under natural conditions the ultimate aim, if we may so speak, is the formation and dispersion of perfect seed. To this all the processes of nutrition are introductory, to this all the details of fertilisation are preparatory.

In the seed thus lie concentrated all the work of the past, all the hope of the future. With the seed entering upon the work of life, we began this series of articles; with the seed representing the close of the life-history of the plant, we here bring them to an end.

BULBOUS PLANTS.

BY WILLIAM GOLDRING.

As so much of the beauty and interest of our gardens is derived from bulbous plants, they are highly important; and for this reason, and because they constitute a class of plants so distinct from others, a series of chapters in the present work is exclusively devoted to them. Without bulbs our open-air gardens would lose a great deal of their attractiveness, as they represent fully one-half of the showiest hardy plants, while they are indispensable for adorning stoves, green-houses, and window-shelves; in short, it might truly be said that there is not a more popular or more valuable class of plants than bulbs. A peculiar interest centres around them, inasmuch as they were among the earliest plants cultivated, and probably as long as gardening has existed bulbous plants have been favourite objects of culture. The hardy bulbs especially possess an historical interest, for centuries ago they were loved and cherished by our forefathers, and have been handed down to us absolutely unchanged through all the vicissitudes they must have seen. Many of the bulbs of to-day, particularly some of the Lilies, Fritillaries, Squills, and Daffodils, are known to have been cultivated fully three hundred years ago, therefore they may truly be classed among old-fashioned flowers.

The nature of bulbs has been so well explained by Dr. Masters in the chapters on THE LIFE-HISTORY OF PLANTS (see first volume of this work), that there is no need to revert to the subject. Any one interested in bulbous plants would do well to re-peruse those chapters relating to the structure, physiology, and varieties of bulbs, and it is quite necessary for a bulb-grower to be well acquainted with the life-history of bulbs, as a key to their successful cultivation. Those who possess a knowledge of the nature of bulbs are far more likely to succeed in cultivating them than those who are ignorant of it. As an instance of this, how often do we see the leaves of spring bulbous plants cut off after flowering, while yet green! in ignorance of the fact that so long as leaves remain green on the plant they are adding strength to the bulb, and that cutting them away prematurely does much harm by weakening the bulbs. Again, how often do people choose bulbs, particularly Hyacinths, by size! whereas a knowledge of their nature would suggest that they should be chosen by weight, the heaviest bulbs always proving the best, as those have the strongest flower-spikes in embryo.

Although there is no need here to inquire into the nature of bulbs, a few words are required in order to explain the term "bulbous plants," because vague ideas are prevalent as to its precise meaning. Commonly, any plant having a fleshy or tuberous root is classed with bulbs, so that in this sense the term has a very elastic application. For instance, tuberous and fleshy-rooted Anemones, Ranunculuses, Begonias, Achimenes, Caladiums, are often sold as bulbous plants, although none of them are really so, and for this reason these plants are not included in the following chapters on Bulbous Plants, but will form a separate chapter under the head of Tuberous and Fleshy-rooted Plants. Although in a strictly botanical sense there is no sharp line of distinction between bulbs and tubers, the difference between them from a cultivator's standpoint is so well defined, that there is little likelihood of any one confusing the two kinds of roots. In a broad sense a true bulb is usually regularly shaped and mostly globose, more or less pointed, the apex being the growing point. Tubers, on the other hand, are usually irregular in shape, and possess no distinct growing point, and are rarely scaly or coated, while true bulbs are nearly all tunicated or coated like an Onion, or scaly like a Lily bulb, or solid like a Crocus or Colchicum. To render the term more definite, it might be said that all true bulbs belong exclusively to one of the three great families of monocotyledonous plants, viz., *Amaryllidaceæ*, *Iridaceæ*, and *Liliaceæ*, and while in these families there are species which have not true bulbous roots, every bulb mentioned in the following chapters belongs to one of these groups. The term "corm" is only used in a strictly botanical sense for a solid bulb, as that of a Crocus, therefore all corm-bearing plants are included here. Dr. Masters, in the chapters already referred to, explains the mode of growth in each variety of bulb, tuber, root-stock, or rhizome.

A family likeness prevails throughout the whole range of bulbous plants, for, although often so dissimilar in stature and general appearance, their flowers invariably possess the same characters, their parts being arranged in whorls or sets of three; thus, three or six stamens, three sepals, three petals, and so on.

Bulbs are natives of all parts of the world, and though they are not found in high latitudes, they overrun the tropics, and as the plants of the various regions require different cultural treatment, some knowledge of the plant's native habitat is of service to the cultivator. Europe, especially the central and southern parts, as well as Asia Minor, is a great centre for bulbs, and so is California, and especially the Cape of Good Hope, for from this region a large proportion of garden bulbs have been introduced. The majority of the European bulbs are hardy enough to withstand our climate unprotected, as are also the greater number from North America; but those from the Cape can only be grown successfully in the open in the most favoured localities in these islands. South America is a great centre for Amaryllidaceous bulbs. These sometimes inhabit the hottest valleys; others ascend the mountainous parts so high that some of them may be grown successfully with frame protection; and those that are natives of Chili, and other southern parts of the American continent, are also open-air plants with us. The extreme Eastern world yields many bulbous plants, including the many beautiful Himalayan and Japanese Lilies, which may be grown here out of doors. The Eastern tropics are the headquarters of several rich genera, and from Australia and tropical Africa several fine garden bulbs have been introduced.

Hence, we have bulbs to suit every class of garden and every part of a garden. Coming as they do from all regions, they flower at all seasons, so that the garden may be enriched with the flowers of bulbs from January to December. The majority of bulbs are deciduous, that is, their foliage decays and dies away so soon as the current season's growth is fully perfected. A smaller proportion are evergreen—that is, the foliage does not periodically die away—and these, for the most part, are natives of the tropics, requiring to be grown in either stove, green-house, or frame. Examples of these are Eucharis and Crinum, and familiar examples of deciduous bulbs are Tulips, Snowdrops, and nearly all the Lilies. Deciduous bulbs necessarily need different treatment from evergreen, although the main principles of growth apply to both classes.

The chief point that the cultivator should bear in mind is, that a bulb is a store-house of food elaborated by the plant during the previous season's growth. This is a provision of nature to enable it to survive excessive drought, heat, or other contingencies to which it may be exposed. Thus, in countries where protracted periods of drought occur, the vegetation of such regions either partakes of a bulbous, tuberous, or succulent nature. For example, in South Africa, where bulbous plants preponderate so largely, the long, hot, and dry season is inimical to herbaceous vegetation unless they are provided with some sort of store-house of reserve food. The bulbs of this region have generally a short period of growth. The rainy season begins, vegetation awakens, bulbous plants develop foliage and flower, and soon the dry season sets in, when the foliage dies away, having added a fresh supply of food to the bulbs or formed new ones, and they then rest perfectly dry and inert until the next rainy season.

With tropical bulbs the case is different. There is not such a marked distinction between rest and activity, although the alternation of dry and wet seasons is much the same; but instead of the atmosphere being arid during the rainless and cool period, it is sufficiently moist to preserve evergreen plants. Hence, such plants as Eucharis, though they do not lose their foliage yearly, have a season of rest, characterised by a lower temperature, and comparatively drier atmosphere. These, then, are briefly the principles which should guide the cultivator.

Bulbous plants, from a cultivator's point of view, may be classed under four heads, namely, (1) Stove, (2) Green-house, (3) Frame, or Half-hardy, and (4) Hardy. The first includes those tropical plants that require abundance of heat and moisture during the growing season. Among these are some species of Amaryllis (*Hippeastrum*), Crinum, Eucharis, Hymenocallis, Griffinia, Pancratium, and other evergreen species. Green-house bulbs are those which belong to sub-tropical regions, and require moderate heat and moisture during growth, but a cool and dry treatment while at rest. Among these are such as Albuca, Hæmanthus, Cyrtanthus, Nerine. Frame or half-hardy bulbs comprise a great class, and include the majority of the natives of the Cape of Good Hope. Hardy bulbs are those that are capable of enduring all weathers without any artificial heat or protection whatever, though some of them are benefited by shelter when in flower, especially the very early or very late flowers.

All the plants described or mentioned in the following chapters fall under one of these four heads.

Stove Bulbs.—These being for the most part evergreen, they may be grown under precisely the same conditions as ordinary stove plants, directions for which are given in other parts of this work. The only exception with bulbs is, that they must in all cases be allowed a season of rest, otherwise, if kept in a continual state of activity, the bulbs are weakened. No definite rule can be given when this resting reason is to take place; that must be decided by the cultivator; but, generally speaking, the end of summer and autumn is the natural resting period for stove bulbs—that is, after they have flowered, and their foliage is fully developed. Then water may be applied moderately; but in the case of evergreen bulbs it must not be entirely withheld, which would cause the bulbs to shrivel. A period ranging from a few weeks to three months is required for resting stove bulbs; when signs of activity in the bulbs are apparent they should be re-potted, if necessary—that is, if the roots have impoverished the soil and filled the pots; but above all it is necessary to caution inexperienced cultivators against the practice of over-potting—that is, putting their plants in pots too large for them. Generally speaking, bulbs of all kinds thrive best and flower most freely when the roots have quite filled the pots, or become pot-bound, as it is termed. It is far better to let the bulbs remain pot-bound, and stimulate them by liquid manure occasionally, than pot them in a mass of soil, which soon becomes soured in a hot-house. When potting becomes necessary all the old soil and old decayed roots should be removed from the bulbs. Good drainage in bulb-pots is very necessary, for although the plants require abundance of water while growing, stagnant water proves fatal to their roots. Ordinary potting-soil will answer for most bulbs; but the best of all soils for the majority is fibry loam and sand, for being for the most part coarse-rooted plants, they do not require the usual dose of peat which gardeners as a rule use for other plants.

Green-house Bulbs, being for the most part deciduous, are of easy culture, nor can any mistake be made as to their proper period of resting. This begins when the foliage of the current season has become thoroughly ripened—generally yellow—and dies away, and simultaneously the roots become inactive. During this period the bulbs need nothing in the shape of food, only require to be kept in an equable state of moisture or dryness. The prevailing error is to keep them too dry, although some, such as the majority of Cape bulbs, are not injured by being kept dust-dry for months. The approximate period of rest will be stated under the various genera. Bulbs of all kinds keep better during their resting period in soil than under any other condition, though sand is a good substitute. In some cases the interval between the decay of the foliage and the recommencement of growth is very short, as in the case of some Cape bulbs; therefore, if re-potting is required, it should be done before the tender roots are emitted from the bulbs. The swelling of the apex of the bulb is an invariable sign that growth is beginning, and at the same time roots will be emitted. Water should be given gradually, more and more, until full growth is developed. In the case of those plants that have not been re-potted, it is a good plan, if the soil be dust-dry after the resting period, to submerge the plants for a time in water, so that the soil may become thoroughly saturated, and thereby induce active growth at once.

Frame or Half-hardy Bulbs include all the South African or Cape bulbs, as they are commonly called, besides those from other regions that are not sufficiently hardy to withstand the full severities of our climate. They are nearly all deciduous, and require a decided resting period, varying from a few weeks to two or three months. On the whole half-hardy bulbs are easily managed if careful attention is paid to their requirements in growth and rest. Being so numerous, and of such a varied nature, no definite rule can be given as to the exact season for resting the bulbs, and therefore the cultivator must use his own judgment, and the general directions already given need only be reiterated. The interval of rest, being so varied, will be stated in the cultural notes applying to each genus. They dislike artificial heat, yet they are not sufficiently hardy to withstand the average climate of this country. Most of them being natives of the Southern Hemisphere commence to grow in our autumn, which corresponds to the southern spring; therefore they require to be planted during this season, and our winter happens just when their growth is tender, but the protection of a glass frame, with the addition of a covering during frosts, is generally sufficient to keep the plants from injury. Pot-culture is the most convenient for frame bulbs on a small scale, as then the plants are more easily managed as regards their resting; but when quantities of a few select kinds are grown, such as Ixia, Sparaxis, Babiana, Freesia, and bulbs of a similar nature, it is better to plant the bulbs out in beds of soil in the frames or pits. The beds for frame bulbs should be carefully made in order to insure success, and it is far better to make them well at the outset than to be continually remedying defects. The site should be fully exposed on all sides; but it is better if the frames are sheltered from north and east winds. Full exposure to the sun is essential, as Cape bulbs, above all others, require all the light and heat our climate affords; but as a hot morning sun is liable to injure the foliage while wet with dew or rain, it is advisable to place the frames a little towards the west, so that the sun will not shine upon them until the plants become tolerably dry. The sides of the frames should be raised about a foot in front and a little higher behind, so as to keep the bed of soil above the surrounding level. A depth of about a foot or so should be taken out a little larger than the frame, and be filled with about a foot in depth of brickbats or rubbish, to insure proper drainage. A surface layer of turfy sods should be placed upon the drainage, and upon this about 12 or 15 inches of soil, consisting of good turfy loam, sharp sand, sifted leaf-mould, and peat, in equal parts, well mixed and sweetened by exposure to the atmosphere. Such a bed will last good for several seasons, and if made during the summer, the bed will be in a good condition to receive the bulbs in autumn. The majority of the Cape bulbs, if planted in such a bed as this, will not require to be lifted for two or three years, and even then they may be re-planted without renewing the soil. September is the best time to purchase and plant Cape bulbs, and never later than October, for after this date the bulbs, if kept out of the ground, become weakened. Almost as soon as planted they begin growth by emitting roots, although there are no signs of leaves; but no water should be given before spring, as the soil is generally moist enough to maintain healthy root-action. During winter the frames will require to be ventilated in order to keep the soil in a sweet condition, and during frosty weather they must be protected by mats or other material. It is a very good plan to sprinkle a layer of dried fern or litter over the soil, but this must be entirely removed so soon as the bulbs begin to push up leaves; then the lights must be taken off during fine weather, and only put on to keep off excessive rains. After the bulbs have flowered, and growth is ripened, the lights may be kept on so as to favour the ripening of the leaves, and all that is necessary in autumn is to give a thin surface-layer of compost.

For pot-culture in frames, the bulbs when purchased in autumn should be at once potted in moderate-sized pots, in compost such as that recommended for beds. The pots should be well drained, and the bulbs should only be placed just beneath the surface. It is a good plan to plunge the pots in the frame in a bed of ashes up to the rims, which tends to maintain an equable state of moisture in the soil. The same directions as those given above apply to pot plants, always remembering these plants require abundance of light and air, all the sunshine possible, plenty of water when in active growth, and dryness while at rest.

Hardy Bulbs the cultivator may conveniently divide into two classes. The first are those that are perfectly hardy and vigorous growers, quite able to take care of themselves from year to year without attention, therefore, if well planted at the outset, do not require to be lifted for years, and then, only for the sake of increasing the stock. This class includes such as Snowdrops, the hardy Scillas, most of the Daffodils and Lilies, Crown Imperials, and the like. The other class includes those which, though as hardy as the others, are benefited by periodical lifting, either annually or every second or third year. Examples of this class are the Dog's-tooth Violets (*Erythronium*), Millas, Brodiæas, Crocuses, and bulbous Irises (*Xiphion*). The directions under these heads will be given under each genus. There can be no definite rule laid down either with regard to the most suitable soil or the best position for hardy bulbs; but, generally speaking, the situation should be fully exposed to the sun, yet, if possible, sheltered from the north and east, for this reason, that by far the greater number of hardy bulbs flower during the first four months of the year, when northerly and easterly winds are prevalent, and these often injure the flowers badly. The best soil for a general collection of bulbs is a good friable loam. It should be deep, as the roots of most bulbs penetrate deeply, and though a moist soil is essential, well-drained beds are indispensable, to prevent the possibility of stagnant moisture. In damp localities it is a good plan to make bulb beds as Asparagus beds are usually made—that is, raised above the surface, with alleys between them. The beds being narrow, the soil becomes warmed by the sun, and this conduces to the ripening of the bulbs. Of course in a light, dry soil such a plan would not answer, as the bulbs would not get enough moisture.

One general rule may be laid down, which applies to all bulbs, and though it has been before alluded to, it is so important that it will be well to reiterate it; and that is, to always allow the foliage to *decay naturally*. It is the baneful practice of tidy gardeners to cut off the leaves of bulbous plants immediately they show the least signs of decay, and often as soon as the flowers are over. The same applies to those kinds with stems, such as Lilies and Crown Imperials, and it is a well-known fact that if Crown Imperial stems are cut off, the bulbs are weakened. They should be allowed to drop off.

LIFTING AND STORING BULBS.

As success in bulb-culture depends so much on the proper lifting, drying, and resting of bulbs, and as no definite rules can be laid down which would apply to every class of bulb, the cultivator should base his practice on a few general principles.

The condition under which a bulb grows naturally is always a safe course to follow, although it is often difficult to closely imitate these. The knowledge of the native habitats of a bulb is therefore useful to the cultivator. For example, European bulbs, inhabiting central or northern parts, are hardy, and need neither lifting, drying, nor resting, unless for purposes of propagation or change of soil. If a native of South Europe, or in fact any part of the Mediterranean coast, then its perfect hardiness in this country is more doubtful, and in order to rest the bulbs they must, as a rule, be lifted, or, if grown in pots, kept dry, because their natural period of rest occurs generally during the hot and dry period in summer, and no rains occur until autumn to stimulate the bulbs into active growth. Central Asian, and the majority of Chinese, Japanese, and North American bulbs may be classed under two heads—those from the Eastern States and Canada, which are perfectly hardy unprotected in this country; and those from the warmer States, such as Texas, Florida, and some parts of California. The hardy kinds do not require an artificial rest, while those from the warmer parts do. The natives of the Southern Hemisphere grow under somewhat different conditions, inasmuch as the seasons are reversed. The growing season of the bulbs usually takes place during our autumn and winter, and after the plants have flowered in spring the bulbs require to be artificially rested, by either lifting, or protecting from rains, which would unduly stimulate them into growth.

For the convenience of trade it is, of course, necessary to lift bulbs, and store them, so as to be ready at hand for sale; and, unfortunately, they are often stored too long, becoming thereby shrivelled, and consequently weakened. This is particularly the case with hardy bulbs, such as Narcissi, many of the Lilies, bulbous Irises, Snowdrops, Fritillaries, Squills, Crown Imperials—in fact, all those European and American bulbs which really do not require to be lifted annually, and to which a protracted period of dryness is highly injurious. Indeed, these bulbs undergo a resting stage even while in moist soil, and though root-growth is usually active throughout autumn and winter, the leaf-growth does not generally take place until spring.

Such bulbs should not be kept out of the ground any longer than is necessary for drying and cleaning them, and separating the young offsets for increasing the stock. When it is considered necessary to lift the bulbs, either because they show signs of deteriorating in growth or for propagation, the operation should be done so soon as the foliage is quite matured and decayed, which, in the case of most hardy bulbs, is from June till August. Dry open weather should be chosen, and after lifting the bulbs they should be allowed to remain in the sun and become dry, and after cleaning the soil off, and separating the young offsets, the largest bulbs should be set aside for planting out permanently, while the bulblets may either be planted in nursery borders, or at once in their permanent positions. Whenever it may be necessary to store hardy bulbs, so as to keep them over the winter, which should always be avoided as much as possible, the best plan, after drying and cleaning the bulbs, is to lay them in layers on shelves in an unheated shed, and cover the bulbs with a layer of dry soil or sand, so as to exclude the air and light from them, which tends to weaken and shrivel them. When there are but a few bulbs of each sort, they may be placed in pots, and covered with soil or sand. When bulbs are not re-planted immediately after lifting, they cannot be kept out of the ground later than October or November, at the latest, without injury; but in the case of those kinds that are not perfectly hardy, such as some of the Japanese and Californian bulbs, they may be kept till February under the condition that excessive dryness or excessive moisture is avoided. It is, however, in all cases the best and safest plan to re-plant such bulbs immediately after lifting, or before the end of October. Bought bulbs are frequently subjected to rough treatment in a dry warehouse, from the time they are lifted until sold; consequently, if bought late, they are generally weakened, and not unfrequently shrivelled, so that their strength is greatly impaired. Therefore, hardy bulbs should be purchased as soon after August as possible, and planted at once. Very late-planted bulbs are seldom satisfactory.

It is often a question with amateurs as to what should be done in cases where such bulbs as Hyacinths, Tulips, Crocuses, are grown in beds required for the usual summer flowering plants, as Pelargoniums, for at the time these require to be planted, towards the end of May, the bulb-leaves are yet green. In such cases, the best plan is to lift the bulbs, with as much soil as possible clinging to their roots, and transplant them in a reserve bed in an open sunny spot—that is, if they are required for another season's bloom. To lift bulbs while green necessarily weakens them, and they consequently shrivel, and frequently rot. In order to avoid this, spring bulbs ought not, if possible, to be planted in beds required for the summer plants, but allowed to remain undisturbed till the foliage is ripened, although the decaying leaves may have an untidy appearance. In some gardens the plan is to plant Pelargoniums and other plants between the bulbs in May, and when these have grown they hide the decaying leaves, and the bulbs can be pulled up a few weeks later, thus leaving the beds to the summer plants.

Dutch bulbs after being forced are very often thrown away under the impression that they are useless. They are certainly useless for forcing into bloom early, but are valuable for planting in the open borders, and to these they should be consigned, and if the position is warm and dry they will appear year after year and yield good crops of bloom. A border at the foot of a south wall is a capital place for planting forced bulbs; a shrubbery border is generally too impoverished for them.

The foregoing remarks apply to hardy bulbs, but with half-hardy or green-house deciduous bulbs the case is different; for as most of them are natives of countries in which a hot and dry period occurs at the time the bulbs are leafless, a perfectly dry resting period is therefore not only not injurious to, but essential for, them; moisture stimulates them into growth or prevents them from having a perfect rest. As a general rule, the bulk of Cape bulbs, for instance, require to be perfectly dry after their foliage is ripened or decayed in about July, and from that time till re-planted in October should be kept perfectly dust-dry, and in addition subjected to as much sun-heat as possible. The best practice, therefore, in private gardens, is to lift the bulbs after the leaves are decayed, and spread them on the surface of the soil under a hand-light, so that no rains will reach them. After a month or six weeks they may be kept in a dry place until about the middle of October, when all should be planted. If planted earlier leaf-growth will be advanced too much, so rendering it liable to be injured during winter treatment; on the other hand, if planting is deferred later than October, or even till early spring, the bulbs suffer by shrivelling, and consequently will not develop vigorous growth. The exceptions to this general rule of dealing with Cape and other half-hardy plants from dry regions, occur in the case of late-flowering families, such, for example, as Gladioli and Tigridias, which do not bloom before August, and whose growth is not even decayed before October, when they require to be lifted. Such as these require to be kept dry and airy till about March, and then planted. In gardens where a fruit-room exists no better place could be found for wintering Gladioli and such bulbs as need to be planted in spring, as the fruit-rooms are usually, and should be, dry and well ventilated. In all cases a careful cultivator will frequently examine his bulbs during winter, whether in or out of the ground, and use his judgment in dealing with them accordingly.

Evergreen bulbs, such as Eucharis, Crinum, Pancratium, Hymenocallis, and others, are usually bought from the nurseries in a growing state, but in the case of imported bulbs, which arrive leafless, they generally develop foliage as soon as they are placed in a warm and moist atmosphere. Water should be withheld, or very sparingly given, to an evergreen imported bulb before it has commenced to throw out foliage, otherwise there is danger from rotting.

The Depth of Planting Bulbs varies in the various genera, but as a general rule all scaly bulbs, such, for example, as Lilies, and all solid bulbs or corms, such as Crocus and Colchicum, require to be planted more or less deeply; on the contrary, all tunicated or coated bulbs, like Hyacinth, Crinum, Amaryllis, or, indeed, any whose structure is akin to the Onion, may be grown either on the surface of the soil or only half buried. There are many exceptions, of course, to this rule, but nevertheless it may be some guide to the amateur. Deep planting for all kinds of perfectly hardy bulbs is recommended for several reasons, the chief being that they are out of harm's way from severe frosts, and they never become too dry. Six inches is the average depth for hardy bulbs, but some, such as Narcissi, Scillas, and others, rise from as much as a foot below the surface. Crocuses, again, should be deeply planted, inasmuch as each generation of bulblets are produced on the top of the parent bulbs, and consequently arrive nearer to the surface every season.

Half-hardy bulbs, such as those from the Cape, also require to be deeply planted if grown in open-air frames, so as to prevent injury by frosts. About six inches is the usual depth these are planted. The directions for planting will be given under each genus. Deep planting in pots cannot be carried out in the ordinary pots, therefore it is advisable to grow those bulbs which require to be planted a few inches beneath the surface, in deep pots, commonly called Hyacinth or bulb pots, an illustration and description of which occur at page 7 in Vol. I. of this work. Though these are called Hyacinth pots they are practically useless for Hyacinths, and are seldom used for them, because, as Hyacinth bulbs are never more than half buried, an unusually deep pot is not required. The special bulb pots are useful in growing a great number of bulbs, and if they were more commonly used than they are, better success would result than from using the ordinary pot. Thorough drainage, so as to avoid stagnant moisture about the bulbs, is as necessary for open border culture as pot culture, for very few bulbs are by nature swamp-lovers.

Raising Seedling Bulbs.—Those who take a special interest in bulbous plants, invariably resort to propagation by seed as a ready means of acquiring an abundant stock of plants, as well as obtaining new and different varieties. All that is required is care and attention, and above all patience, as the majority of seedling bulbous plants do not arrive at maturity for three or four years, and some not for ten years. The general principles to follow are: first, to thoroughly ripen the seed, then gather it and sow it immediately, even if in midwinter, always remembering that seeds as they fall naturally from the plant are generally in the best condition for germination, and if their tissues become hardened by time, germination is retarded. Besides, a season is often lost by not sowing the seeds the same season. For instance, in the case of the Amaryllis (*Hippeastrum*), which usually ripens its seed in August, a season is quite lost if the seeds are kept until spring before sowing; whereas if sown as soon as ripe the seedlings will be ready to pot off in the following spring. Seedling bulbous plants require great attention, for if they suffer from undue dryness or excessive wetness they are much checked. They require to be grown on steadily from the infant to the adult stage without protracted seasons of rest, which mature bulbs require.

Offsets and bulblets, like those produced on Tiger Lily stems, need the same careful attention, as they do not possess the same power of enduring rough treatment as adult bulbs. Seeds of bulbs vary so much in character, that no general rule can be given as to the depth they should be sown and other special treatment they require. These will be alluded to under the genera.

FERNS.

By James Britten, F.L.S.

The Cystopteris, or Bladder Ferns.—Taking the standard of specific rank adopted by the authors of the "Synopsis Filicum," there are three of the five known species of *Cystopteris* represented in the British flora. All are delicate, flaccid, deciduous ferns, with small, twice or thrice-divided, thin green fronds, and free veins. Amongst ferns this genus is exceptional in its geography on account of its head-quarters being in the temperate zones of both hemispheres. The name *Cystopteris* was given on account of the bladder-like involucres.

C. alpinum, a very elegant little plant, has only recently been thoroughly settled as a truly British species, it having been discovered in Teesdale by Mr. Backhouse. In the other localities whence the plant was obtained it was doubtfully native, or finely-cut forms of *C. fragilis* had been taken for it. The finely-cut bright green fronds generally are about four to six inches high. The extra-British distribution is the mountains of Europe and Asia Minor.

C. bulbiferum takes its name from the large fleshy bulblets which are formed in the axils of the upper pinnæ; these fall to the ground and often produce new plants. This species is the largest of all the *Cystopteris*; its lanceolate, elongated, twice-cut fronds sometimes attain—in shaded ravines in the United States—as much as a couple of feet in length.

C. fragilis, a native of arctic and north and south temperate regions, varies considerably both in the size and cutting of the fronds; three or four more or less well-marked varieties occur in Britain and have received distinctive names. It has a tufted root-stock and ovate-lanceolate, pale green, once or twice-pinnate fronds four to eight inches long.

C. montanum, one of the rarest of our native ferns, has a creeping root-stock, very slender stipes, and deltoid thrice-pinnate fronds as broad as long (four to six inches.) In Britain it is found only on the mountains of Perth, Forfar, and Aberdeen, at elevations of from 2,300 to 3,600 feet.

Cultivation. — With the exception perhaps of *C. bulbiferum* (which, however, succeeds in the open air in some localities), the species above described are quite hardy. *C. fragilis* and *alpinum* do well in rock-work, and not unfrequently establish themselves readily on old shaded walls. *C. montanum*, in its native habitats, affects damp moss-covered ledges, the creeping rhizomes finding a congenial home amongst the short scanty plant-growth of the mountain-sides; it requires more moisture than the other species enumerated, but is easily grown if shade and moisture be forthcoming; we have seen plants grown under a glass case in a crowded city thoroughfare, far surpassing in size and beauty any of those noticed in the very locality whence they were originally procured. *C. bulbiferum* is a pretty cool-house plant, and only requires a well-drained situation and a mixture of loam and leaf-mould in which to make itself perfectly at home. If grown in pots this and the others —with the exception of *C. montanum*—only require to be guarded from excessive moisture during the winter months, when the fronds have died down and the plants are at rest.

The Woodsias.—About fourteen species of *Woodsia* are known, and of these about half are in cultivation. Our two British species are grown more on account of their rarity and the almost inaccessible places in which they occur than from their beauty. Some of the exotic species are larger and more easily cultivated than our native ones.

W. hyperborea has linear-lanceolate fronds with ovate-cordate pinnæ and few broad lobes. In its distribution it is similar to *W. Ilvensis*.

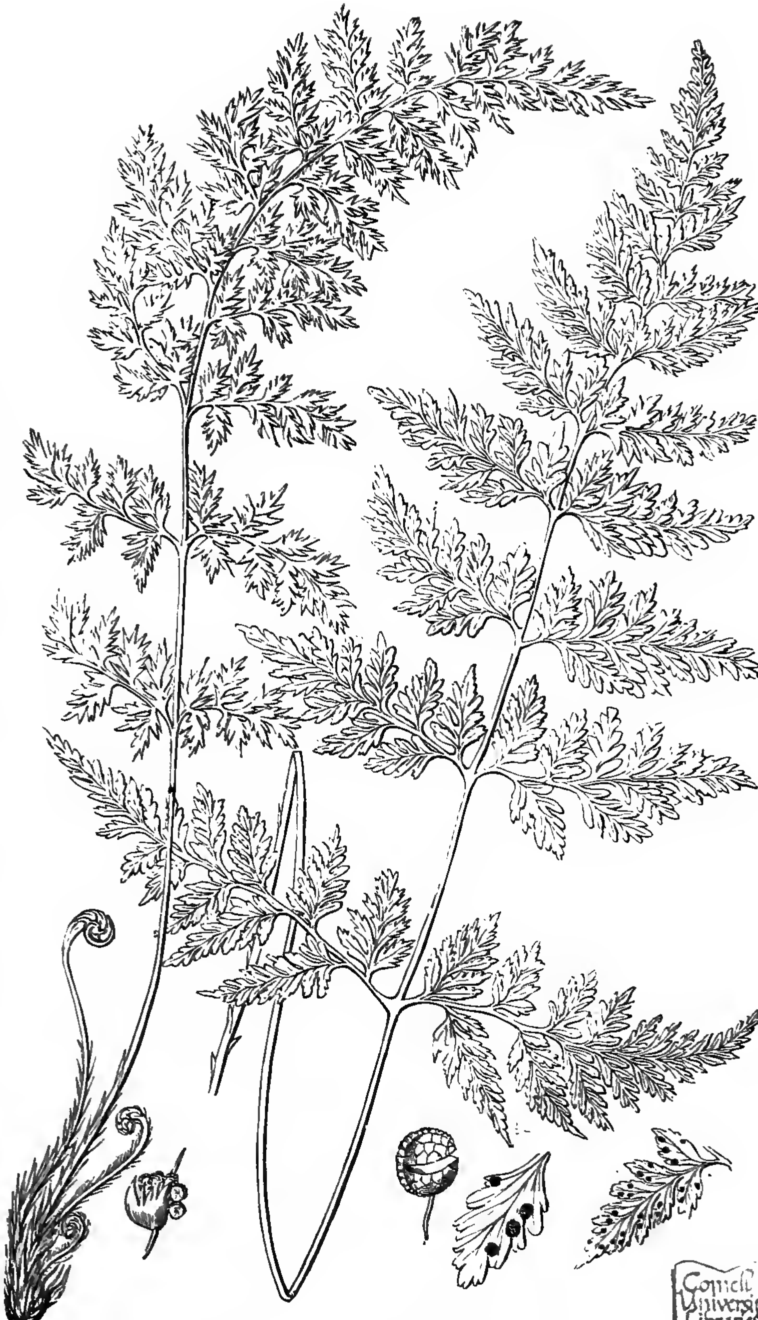
W. Ilvensis has broadly-lanceolate pinnate fronds, two or three inches high, of a dull green colour, both surfaces being clothed with minute bristle-like scales. The American form of this species—for it occurs on high mountains in the temperate zone of the Northern Hemisphere, as well as in arctic regions—is a much more vigorous one than the British.

W. Oregana has densely-tufted chestnut-coloured stipes two to four inches long, and oblong-lanceolate bi-pinnate fronds three to four inches long, narrowed to both ends. It differs markedly from the species already described in its glabrous fronds and minute involucre. A native of the Rocky Mountains, Oregon, and Lake Winnipeg.

W. scopulina has densely-tufted stipes two to three inches long, with large lanceolate scales and oblong-lanceolate bipinnate fronds four to six inches long, narrowed to both ends. The upper surface is slightly and the lower densely glandular hairy. A native of the Rocky Mountains.

Cultivation.—When grown in pots the Woodsias should be placed in thoroughly well-drained loamy soil mixed with small pieces of porous stone. They must be carefully guarded against excessive moisture, and should not be disturbed at the root. On rock-work they like a shady spot, and are best wedged between pieces of rock where their roots can run into the cool damp interstices, and at the same time be continuously free from anything approaching stagnant moisture.

The Aspidiums, or **Shield Ferns.**—The Aspidiums do not exhibit so marked a range in the form and cutting of the fronds as many other genera, but there are among them many very desirable and handsome plants. As a rule, they are less suited for pot culture than for planting out in the rockery, either of the in-door or out-door fernery. As the genus is here understood, Cyclodium, Cyrtomium, and Polystichum, to which latter section the British representatives of the



CYSTOPTERIS FRAGILIS. CYSTOPTERIS MONTANUM.

genus belong, are included. There are about sixty species, distributed over almost all countries. The name Shield Fern is a translation of the Greek root from which the name Aspidium was coined, and was given on account of the form of the involucre.

STOVE SPECIES.

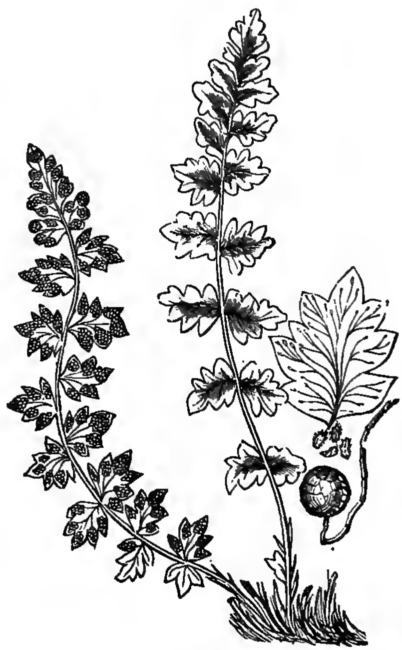
Comparatively few of the numerous Aspidiums in cultivation do not succeed under green-house treatment; even the three mentioned under this heading will thrive in a cool house, but as they grow more freely in the warmer temperature of the stove, they are given by themselves.

A. anomalum, a curious Cingalese species, is perhaps, as suggested by Mr. Baker, an abnormal condition of our native *A. aculeatum.* It has tufted stipes, one to two feet long, densely clothed with large, lanceolate, pale brown scales, especially the lower portions, and fronds two to three feet long by a foot or more in breadth. The texture is firm, and the fronds, which are naked, both above and below, are dark green in colour. This species belongs to the group in which the lower pinnæ are only once divided.

A. mucronatum, from the West Indies, closely resembles in texture and appearance our native Holly Fern. It has stout erect stipes, two to four inches long, densely clothed with large, reddish-brown, lanceolate scales; the very leathery evergreen fronds are pinnate throughout, and measure from twelve to eighteen inches in length, by an inch and a half to two inches in breadth.

A. trifoliatum, a variable plant, widely distributed throughout tropical America, has tufted brownish stipes a foot or more long, scaly only at the base, and thin-textured fronds, twelve to eighteen inches long, by six to twelve broad.

WOODSIA ILVENSIS.



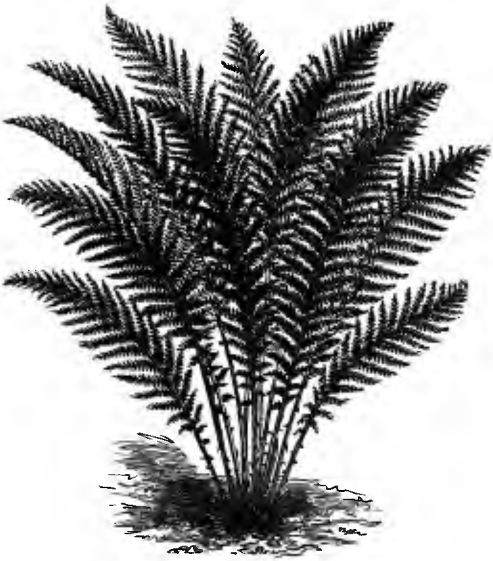
WOODSIA ALPINA.

The var. *heracleifolium* is a handsome form, with bright green fronds, with the pinnæ pinnatifid on both sides at the base.

GREEN-HOUSE SPECIES.

A. amabile.—In this, the lower pinnæ of the fine fronds are only once pinnate, the rachis and both surfaces being naked. The fronds themselves measure a foot or more in length, by six to nine inches in breadth; the slender polished stipes are six to nine inches long. A native of India, Ceylon, Malacca, Formosa, and Japan.

A. aristatum has a creeping rhizome, and deep,



ASPIDIUM ACULEATUM.

glossy green, finely-cut, firm-textured fronds, one to two feet long, by nine to twelve inches broad.

The variety *coniifolium* has still more finely-divided fronds, with copiously-toothed segments. There is a variegated form of the type, which is an interesting and pretty fern, a portion on each side of the rachis being a greenish-yellow colour.

A. aristatum extends from Japan to Ceylon, and from Norfolk Island, Fiji, and Samoa to New South Wales and Natal.

A. auriculatum has somewhat leathery, tufted fronds, twelve to eighteen inches long, by two to four inches broad, the numerous pointed falcate pinnæ having spinosely serrated edges. It is found in Formosa, Ceylon, and throughout India, where, in the Himalayas, it ascends to 9,000 feet above sea-level.

A. Capense has scattered, firm, erect, greyish stipes, densely scaly below, a foot or two in length, and sub-deltoid, twice-cut, very leathery fronds, one to three feet long, by twelve to eighteen inches broad. This is a noble fern, requiring plenty of root-room, and also space overhead in which to develop its handsome fronds. It is widely distributed throughout the southern parts of the Old World, and also occurs in the Western Hemisphere from Cuba to Patagonia.

A. falcatum, frequently mentioned in books and horticultural journals under the name of *Cyrtomium falcatum*, is a handsome and distinct fern, with dark green, leathery, glossy, simply-pinnate, evergreen fronds. The tufted stipes, densely clothed below with large dark scales, are from six to twelve inches in length, and the fronds from one to two feet long, by six to nine inches broad.

The Himalayan var. *caryotideum* has rather larger, sharply-toothed, slightly-lobed, opaque pinnæ; and var. *Fortunei*, introduced many years ago from Japan by Fortune, is like *A. falcatum*, except in the narrower dull green (opaque) pinnæ. In many places in this country these are hardy, and form wonderfully attractive objects in the out-door fernery, where their somewhat massive fronds contrast so markedly with the more finely-cut and delicate ferns. In one or other of its forms *A. falcatum* is found from Japan and China to the Sandwich Islands, Madagascar, and South Africa.

A. frondosum, from Madeira, has scattered, strong, straw-coloured or pale brown polished stipes, one to two feet long, and firm-textured, sub-deltoid, naked fronds, a foot and a half to two feet long, by a foot or more broad.

A. laserpitiifolium, the *Lastrea Standishii* of gardens, has finely-cut, light green, firm fronds. It differs from *A. amabile*, which it somewhat resembles, in being more compound, with smaller cuneate, oblong, less-toothed segments, and larger sori. In many places in this country this pretty Japanese fern is quite hardy.

A. lepidocaulon.—This has the habit and texture of *A. falcatum.* It has drooping dark green fronds,

ASPIDIUM ANGULARE GRANDICEPS.

which frequently root and develop young plants from the whip-like tips. From its habit of growth this is well adapted for growing in a bracket attached to the wall of the fernery, or suspended in a basket from the roof. A native of Japan.

A. triangulum, from the West Indies, has tufted stipes, two to six inches long, with large dark brown scales at the base, and leathery dark green fronds, one to two feet long, by one to two inches broad, the pinnæ bearing numerous blunt or spinose teeth on their margins. This curious and interesting species does well grown in a basket either in the warm or cool fernery.

HARDY SPECIES.

A. acrostichoides is an evergreen species from North America, where it extends from Canada to Florida and the Mississippi. It has tufted stipes, six to eight inches long, densely clothed below with pale brown lanceolate scales, and simply-pinnate firm fronds, one and a half to three feet long, by three to five inches broad.

A. aculeatum.—In sheltered situations the ovate-lanceolate, twice or thrice-pinnate fronds of this species are evergreen. In one or other of its numerous varieties it is distributed throughout almost all regions, but is most uncommon in the Arctic regions and in Eastern North America. What is regarded in the "Students' Flora of the British Islands" as typical *aculeatum* has rather flaccid fronds, with sessile pinnules (the lower ones being free) and spinulose serratures.

The var. *lobatum* has bi-pinnate fronds, with rigid, sessile, decurrent pinnules, which are confluent below.

In the var. *angulare* the fronds are sub-membranous, the small, lax, stalked pinnules are sometimes again pinnatifid, with large awned teeth. In addition to these varieties, there are numerous other exotic ones, as well as a host of crested and other forms of garden origin.

A. Lonchitis, the Alpine Shield Fern, or Holly Fern, owes its last-mentioned name to its rigid and prickly appearance. It is a handsome evergreen, with simply-pinnate, linear-oblong fronds, twelve to eighteen inches long, and one to two inches broad. It is widely distributed throughout the Northern Hemisphere, but in Britain occurs in rocky clefts of the mountainous districts of Wales and the northern part of the island.

A. munitum, one of the most distinct and desirable of all hardy evergreen ferns, is a native of Western North America, from Nootka to California. It has strong, tufted, straw-coloured stipes four to nine inches long, the lower portions of which especially are densely clothed with large, glossy, lanceolate scales; the dark green fronds are one to two inches long, by four to eight inches broad. The numerous closely-set firm pinnæ are acuminate at the apex, and the margins finely spinosely-serrated throughout.

Cultivation—Most of the Aspidiums are of easy cultivation, all thriving in a mixture of loam and leaf-mould, with an addition of peat and sand. The stronger-growing sorts do well in well-drained loam, and all like an abundance of water, provided stagnation be guarded against.

A. Lonchitis is perhaps one of the most difficult to manage, and it is rarely seen under artificial conditions in anything like the luxuriance it exhibits in the damp elevated rocky spots it naturally affects. Wedged between stones in somewhat shaded and sheltered positions in the out-door rockery, where its roots are kept constantly moist, and its leathery fronds cannot suffer from drying winds, it makes a beautiful object.

A. aculeatum makes a bold and handsome plant in almost any shaded spot, provided root-room and good soil be afforded it; along the shady margins of ornamental water it attains a large size, and grows very luxuriantly; this, and any or all of its varieties, deserve a prominent position in the fern garden.

The Blechnums.—The genus *Blechnum* comprises about a score of species, and is widely diffused throughout tropical and south temperate regions. Nearly all resemble each other closely in general aspect, in having pinnate or pinnatifid fronds. Only two vary from this arrangement. One has simple fronds (*B. lanceola*), and the other bi-pinnate ones (*B. vittata*); the latter, however, has not yet been introduced to cultivation.

B. Brasiliense, frequently met with in gardens under the name of *B. Corcovadense*, is a small-growing tree-fern, with a stout, erect stem, a foot or more in height, densely clothed at the crown with dense, brown, fibrillose scales, short, stout, densely scaly stipes, and oblong-lanceolate leathery fronds, two or three feet long, by a foot or more broad. A native of Brazil and Peru.

B. cartilagineum has an oblique stem, densely clothed at the crown with blackish scales, and strong, erect, rough, scaly stipes, surmounted by ovate-oblong leathery fronds, one to two feet long, by six to nine inches broad. A native of temperate Australia.

B. lanceola has lanceolate undivided fronds, four to six inches long, by half an inch broad, springing from a slender, creeping, stoloniferous rhizome; in texture, too, they are less leathery than those of the other species mentioned. A native of tropical America.

B. occidentale has a stout erect caudex, clothed at the crown with lanceolate-acuminate scales, erect stipes, and ovate-acuminate leathery fronds, nine to eighteen inches long, by four to eight inches broad. This species extends from the West Indies and Mexico to Chili and South Brazil.

B. unilaterale, with a geographical distribution similar to the last-named, has an elongated caudex, slender erect stipes, and thin-textured lanceolate fronds six to twelve inches long, by one and a half to two inches broad.

Cultivation.—The first-named species does well as a stove-plant, but will thrive in an intermediate house; it is often inserted in the crowns of dead tree-fern stems, and soon makes a pretty object when so treated. The other species succeed either in the intermediate house or cool fernery. The smaller growers require peat; the others do better in fibrous loam. They all like shade, plenty of moisture when growing, and are by no means averse to watering or syringing overhead.

The Hemitelias.—Comparatively few of the thirty species of *Hemitelia* are known to cultivation, and of these the following five—of which the first and fourth are green-house species, and the other three require stove treatment—are the best and most distinct. The *Hemitelias* are mostly tropical and arborescent, with the habit of *Cyathea*. As they form a kind of connecting link between that genus and *Alsophila*, they are not always easy to recognise. Their cultural requirements are the same as *Alsophila* and *Cyathea*, therefore the reader is referred to those genera for notes on cultivation.

H. Capensis is not solely a South African plant, as might be inferred from the name, but also occurs in Brazil and Java. It is a fine tree-fern, with thin twice or thrice-cut fronds and unarmed stipes, scaly at the base. The stem attains a height of twelve or fourteen feet.

H. horrida, a native of the West Indies and New Grenada, is another arborescent species, but with stipes beset with strong prickles, and clothed with deciduous scales; the fronds are very large, pinnate, seven to ten feet long, by two to four feet broad.

H. setosa, from Brazil, has ample tri-pinnate, rather firm fronds, glabrous and green on both surfaces.

H. Smithii, perhaps the most desirable of the group, is an unarmed species of tree-like habit; the lower portion of the stipes are densely clothed with rigid, elongated, serrulated scales, and the glabrous fronds are bi-pinnate. A native of New Zealand.

H. speciosa, from New Grenada, has rough stipes, and ample, pinnate, very long, satiny fronds, the extremity of which is only pinnatifid; when young, they are clothed with glossy, chestnut-coloured scales, with a very pale narrow fringe.

THE HARDY FRUIT GARDEN.

By D. T. Fish, assisted by William Carmichael.

DISEASES AND INSECTS AFFECTING THE APPLE.

FORTUNATELY the Apple, under skilful treatment, is almost exceptionally free from both. It is chiefly when injured by mismanagement, or starved or cropped into weakness, that either disease or insects gain much of a foot-hold, and cause serious injury. Hence, our advice to prevent disease by good management, and grow out or off insect pests by the same sensible means, is the best that can be given, and may save much future trouble, and the serious injury or loss of the trees. Doubtless, soil and climate are powerful factors in the production of disease, and also frequently invite, as it were, the attacks of insects. But these do not equal in their evil influence the greatest producing cause of both—mismanagement.

The chief causes of disease, and also of insect ravages among Apple-trees, are the two extremes of grossness and weakness of growth. Just as a well-balanced circulation is the best antidote to disease among ourselves, so is a happy mean of vigour among trees. This happy condition ought to be aimed at by every Apple-grower; for prevention is not only better, but so very much easier than cure, a maxim that extends to all the diseases and insects among fruit-trees, and, indeed, plants in general. The skilful fruit-tree doctor of modern times believes less and less in surgery, medicine, or special nostrums, and more in fortifying, and so establishing the natural forces of the trees as to render them proof against disease, and also insect pests. No practical man who has carefully noticed his Apple or other fruit-trees, but must have noticed how disease and insects invariably link their forces together to their injury or destruction. So close is the correlation of these destructive forces, that it is often difficult to say which has taken the lead; but they act and react, and coalesce together in the work of destruction with a faithfulness of comradeship worthy of a better cause. Insects follow swiftly on the heels of disease, and the disease seems further strengthened by the destructive agency of the insects; and so on in a duality of mischief till the trees are disfigured or destroyed. As a rule, probably, disease takes the lead, and hence the reason of dealing with this first, chiefly by way of prevention, as already pointed out, and should that have been too late or failed, then by way of cure.

Canker.—Only three diseases of the Apple deserve prominent notice: canker, mildew, and American blight, which may be treated of as a disease as well as an insect. Canker is, or rather has been—for it is far less prevalent than formerly—the worst disease of the Apple, and the most troublesome to cure. In fact, it may almost be said to be incurable. It yields to treatment, and may be thus modified and checked, but it is seldom that a tree once badly cankered is ever wholly cured. Of course, where the first speck is seen, and at once and wholly cut out—like a cancer in the human frame, to which canker bears a very striking resemblance—it might not reappear. But it has mostly made considerable progress before being observed or subjected to treatment, and hence, in great part, the difficulty of eradicating the disease.

For, though canker mostly manifests itself on the outer bark, and may at times be originated by a frost-bite or a chill, it more frequently has its seat in the sap or the roots; hence, the importance of keeping the first pure in quality and moderate in quantity, and the latter in a genial medium. Canker—like gout, in the human frame—also seems to be partially constitutional and hereditary. For example, it is no uncommon thing to find the Ribston Pippin, and Old Hawthornden, eaten up with canker, while all other varieties in the same garden may be tolerably or wholly free from its ravages. In all such cases, or localities, begin the cure by promptly getting rid of all varieties predisposed to the malady. External wounds and injuries, and severe amputations, are also apt to end in canker, and should be avoided.

The fact of this disease among Apples being far less prevalent than it was, affords powerful indirect proof that much of the canker, once so prevalent, originated in the severely barbarous prunings of the olden time. Yet cutting back and heading down was, and is, one of the usual receipts for the mitigation and cure of this troublesome disease; and more marvellous still, it not seldom succeeds. It summarily gets rid of the cankered parts; and, provided the disease originated from exhaustion, the new and vigorous growths produced on the heels of the knife remained for a time, at least, free of canker. Too often, however, the remedy was very short-lived, and ended in exaggerating the disease by the excess of vigour thus induced.

To insure a moderate supply of sap, pure in quality, is undoubtedly the best mode of preventing or curing the disease. To keep the sap pure, plant in suitable soil, such as we have already described, without, as a rule, any addition of manure whatever; or if any is used, it must be thoroughly sweetened by decomposition first. But it is safer to use none, for—without entering into such puzzling vital or chemical questions as to what and how elements of rank manures can be absorbed by the roots of plants—practical observation and experience demonstrate beyond all controversy that such manures add to the volume and change the quality of the sap. Gross wood varies from other wood chiefly in having an excess of what is called crude and watery sap. This exudes at the first cut or bruise or chill on the bark, spreads into brown blotches, runs into ulcerous wounds, and finally penetrates and dries up, and probably kills the tissues, eating right into or through the pith, and so killing the wood. Now it is found that when the sap is pure in quality and moderate in quantity, none of these results ensue; or if canker should ensue, it is much more easily modified and arrested.

In low-lying northern localities where the rain-fall exceeds thirty inches in the year, the soil can hardly be too poor in which to plant Apple-trees. Growth being thus subdued into moderate strength, the trees may be easily stimulated by mulchings of manure on the surface, and waterings of liquid manure, to enable them to swell and ripen their full crops of fruit. So soon as, or rather a month or six weeks before this is harvested, the stimulating *régime* may be withdrawn, to enable the trees to thoroughly mature their moderate-sized wood.

When all other cures have failed, planting on surface mounds or ridges has proved effective. If deep-rooting, into wet or ungenial soils, seems among the more fruitful causes, lift the roots into higher places of warmth, and better and more immediately available supplies of food, and the trees have grown out of canker into health; and if the cure has not been complete by root-elevation, it has proved to be so nearly so, that they have continued to grow and fruit well for years after. A yard of earth on the surface will make a sufficient mound for a goodly-sized Apple-tree. Ridges and banks may also be thrown up to any desired height. Often the soil on the spot answers well if this is thrown up a yard or more above the surrounding level. Of course, should a little maiden loam be added to it, all the better; or should the soil be too stiff, a liberal admixture of coal-ashes, cocoa-fibre refuse, mortar rubbish, or road-sand, will open it up, and endow it with canker-resisting force.

A wet bottom has been the most fruitful cause of this most dire disease. Wherever orchards with stagnant water within a yard of their surface are found, there also is canker sure to be seen; and since thorough drainage has been laid down, and generally practised as the first basis of horticulture, canker has declined. Marvellous mitigations of canker have also been seen by the simple expedient of draining old orchards and fruit gardens.

Grafting at times has seemed successful, and where the canker arose from weakness, or the constitutional tendency of varieties, the remedy has been complete. Ribstons cut back and worked with King of the Pippins, or Golden Reinette, have been cured of canker; or, in other words, the new scions have not been affected by it. Not seldom, however, such cures have been short-lived, partly from faults of cultivation, but chiefly from failings of soil and climate. The first, as we have seen, is very much under our control, and climate is far more amenable to our modifying influences than is generally supposed. Thorough drainage may raise local climates from five to ten degrees, and by placing Apple or other trees on southern sloping banks, another great amelioration of climate is brought to bear upon them.

The use of dwarfing and surface-rooting stocks is the most potent antidote to canker that has yet been noticed. Doubtless, it has in thousands of cases proved a complete prevention, which is infinitely better than cure, as it prevents the necessity of the latter. Seldom or never does one see modern miniature Apple-trees cankered. The roots seem too small and regularly distributed to produce those gross shoots and timber-like branches that furnished food for canker as well as the knife; and hence, as we have seen, canker has vanished under the *régime* of pure sap, and moderate supplies.

One of the oldest and most radical remedies for canker consisted in lifting the roots out of the mud or clay, slashing off most of them in the process, cutting back the head to a similar extent, in accordance with a rough-and-ready rule, re-planting, and thus recuperating the trees. And the system answered so far, that the tree most cankered before these fearfully severe surgical operations not seldom remained free from it afterwards.

But all that is changed now, and the slightest pruning of the roots of the Paradise and other dwarfing stocks generally suffices to keep canker so far away from our Apples, that it may be hoped the time is near at hand when modern pomologists will hardly know what canker is like.

So much for constitutional remedies. Now for a few local ones. Cleanliness is the parent of health, and some have held, with some show of reason, that dirt on the stems and branches is sometimes the cause of canker. This is doubtful. Still the mere suspicion may suffice to have most lichens or other impurities removed so far as practicable. Even Mistletoe when it abounds may result in canker, and should be removed. Many an Apple-grower would gladly sacrifice one or more Apple-trees to have it establish itself in his gardens and orchards. Still in the Southern and Western counties, where it luxuriates, it may not only become a nuisance, but an active source of canker, and should be destroyed. Mosses and lichens should also be scraped off with a small garden hoe, an old bill-hook, knife, or other blunt instrument. Smears of thick lime-wash, formed of water in which an ounce to the gallon of sulphuric acid is added, prove very useful as a branch-cleaner, the hot lime and acridity of the acid making short work of mosses, lichens, or any other extraneous animal or vegetable life that adheres to stems or boughs. Where these or other incrustations overrun the twigs, as well as branchlets, such washes may be applied thinner, through a garden engine, in winter, until the entire tree is covered over with the cleansing mixture.

Local remedies cannot be much relied on, though great faith was placed in them in olden times. Smears of equal parts clay and cow-dung, so stiff as to form a sort of cement, were often used. These excluded water from the wounds, which were cleared of all dead wood and bark before it was applied, and seemed so far to favour the healing of the cankering part, enabling young bark to be formed along the sides and ends of the wounds. Stockholm tar (not coal tar) may be used as a dressing, and cart and other stiff greases may also be employed. The best emollients for canker-wounds are probably sweet oil and colza oil; and the worst, perhaps, dressings of Portland and Roman cements.

Attempts were also made at times to bridge over the wounds with sheaths of bark, thus bridging over the scarred wood with a waterproof as well as a vital covering that occasionally linked itself along the sides of the wounds, and made all sure, so far as external appearances were concerned.

In cases, too, where the end and side bark closed up the sides of the wood, a coat of common paint was useful over the scar, or cut portion of the cankered wood, to render it waterproof, and so preserve it from destruction. But a mere statement of the nature of these direct nostrums for canker best reveals their comparative worthlessness, and gives additional emphasis to our earnest advice—prevent canker by some of the more radical means already indicated.

Mildew.—Apples in suitable localities, and under skilful treatment, are seldom attacked with mildew. It at once gives evidence of its presence by a white coating of dust along part or the whole of the young shoots. It mostly attacks the tips of Apple-shoots, making them look as if they had been exposed to the fine impalpable powder of a flour-mill for a few hours. It consists of myriads of minute fungi, and the safe and direct remedies are hot lime and sulphur, either alone or in a half-and-half compound, dashed on to the leaves and shootlets affected, first dressing them overhead with the finest spray of water, to make the caustic dust stick closely to the affected surfaces. Natural preparations, dew or fine rain, are the best before the application of the dust. If too wet with rain or heavy syringings, the minute particles of the dust do not get close enough to the mildew, but are carried off or too much diluted.

But these whitened leaves and shoots are signs of constitutional distress, as well as the visible and sure proofs of a troublesome disease. Like canker, mildew arises from many and the most opposite causes, such as over-feeding, over-cropping, excess of heat or of cold, of drought or moisture, shelter or exposure, excess of vital force, or drooping weakness; so that everything that has been advanced about the preventive cure of canker is also applicable to that of mildew.

A damp situation, with a wet bottom, may be said to generate mildew most rapidly. Nevertheless, a hot burning spell of drought of six weeks' duration will also produce it. Hence, in the first case, drain it out; in the second, water it out, would be the best advice. And so in other cases, a permanent cure is hopeless unless one were familiar with all the local and general conditions that caused the disease. But if the precautions against and cures for canker are carried into practice, any mildew that appears will be readily arrested and cured by the local application of lime and sulphur, or either with a little powder of dry soot, as already described.

American Blight.—This is, as a disease and an insect, of the most terrible sort. Canker, mildew, Aphides, or any check of growth, seems to favour its production. It establishes itself with augmented devouring force around cankered wounds where it exists at all, and combines the evils of rheumatic gout with those of canker. American blight is almost invariably accompanied with a sort of granular swellings of the wood and bark, and these seem still further to arrest the flow of the sap, and bring or keep more of it in or around the blight colony. The term blight is somewhat misleading, as anything and everything that checks growth, induces disease, or causes the flowers or fruit to drop off is called a blight. But this so-called American blight is really an insect or Aphis; it was thought at one time to be *Aphis lanigera*, but differing so widely from this destructive family as to be distinguished by creation into the genera of *Eriosoma*, and as it confines its depredations mainly to the Apple, *E. mali*, or the Woolly Aphis, or Apple Bug; the former being, on the whole, the more expressive name, as the long filamentaceous threads almost wholly cover the insects, as well as protect them from the effects of rain. These appendages give the Apple Bug at first very much the appearance of the Mealy Bug of our hothouses, the *Coccus Adonidum*, the most troublesome of all pests to such plants as Stephanotis, Gardenias, &c.

Unfortunately this troublesome disease and pest does not confine its operations to the tops of trees, but also attacks their roots with equally disastrous results. Hardly have they fastened on them before they produce the granular swellings already described, the supply of sap is diverted or cut off, and, instead of being sent to the front about its proper business, the extension of the top-growth, the formation or filling of fruit-buds, and the nourishment of the fruit, it is too often worse than wasted in the production of quantities of root-suckers, that further impoverish and weaken the tree. Nor only this; their active interference with function and force are fruitful causes of mildew and canker. This is so generally the case, that it is quite rare to see bad cases of American blight without either or both of the others. Nor does this exhaust the evil effects of the Apple Bug. It violently arrests the sap, modifies its character, and probably augments its sweetness. Be this as it may, and the point has not yet been very clearly established, it is certain that the common Green-fly, or Aphis, and nearly all other pests that attack Apples, are subject to cluster around and multiply with amazing rapidity, upon trees already infested with the Apple Bug.

It may seem like idle reiteration to assert that all that has been included under the heads of skilful culture is the surest antidote to this disease, and the best means of eradicating these insects. Apply also the radical cures prescribed for canker and mildew. Still it must be admitted that the Apple Bug is not so frequently the product of mistakes in soil, site, climate, or treatment, as either of the other diseases. It comes suddenly at times on vigorous and healthy trees, and may work sad havoc before it is much observed. It not seldom originates in a dry state of the soil, and preys upon the roots before it climbs to the top, and, like the Vine Louse, it works most mischief underground. Fortunately it can be drowned out, and if house sewage or powerful liquid manure can be used for the flooding of the roots, the sooner will our wool-clad foe vanish. It is seldom or never found on roots with much destructive force where the soil is wet, and could a stream of water be made to flow over Apple-roots for twelve, eighteen, or twenty-four hours, there would be an end to most of the bugs.

On the trees one heavy syringing is of little use, unless the water is driven on with sufficient force to strip the insect of its filamentous appendages. They never seem to get over such a real denudation, or to be able to grow fresh whiskers. But there are many liquids that make an end of them by the merest touch. Among these, turpentine, spirits of wine, pure or methylated, any of the mineral oils—benzoline, paraffin, and petroleum—are the more efficient, killing instantly where they touch. Weak solutions of carbolic and sulphuric acids also deal death to the

Apple Bug. Ammoniacal liquor and tobacco-water and liquid ammonia are also effectual. Some of these, however, must be used with caution, and concentrated upon the insects, as if too strong they would penetrate and injure the bark and wood of the trees, these being already soft and rendered abnormally pervious by the operation of the bugs. Hence, among the safest remedies for these pests, and also one that tends to heal, and not further to blister or injure the already diseased parts, is to smear the affected parts, or the whole tree over, with coarse whale or other fish oil. The filamentaceous appendages get hopelessly entangled in this, and the insect either perishes in the oil bath, or seeks less rich and slippery quarters. The remedy is still more efficacious if a hard brush is used on each visible patch of insects before the oil is applied. This crushes and annihilates all the older bugs, and the oil is sufficient to smear over and hold fast all the young ones, and is in fact as effectual as thicker smears of lime, sulphur, or other matters, made into a thick paste with tobacco-juice, soap-suds, or other smears, poisoned by dangerous additions of nux vomica, arsenic, and other drugs.

Another great advantage of the oil smear is that it makes the trees so offensive to the bugs in their winged state, that they will shun such trees as hatching-grounds for many years afterwards.

The great difficulty with large trees is how to get at the pest. Much, however, may be done with brushes mounted on long handles, and, fortunately, the Apple Bug reveals itself afar off by its long white whiskers. However, it must be confessed that most of our cures are far more applicable to the miniature trees of our gardens than the larger Apple-trees in parks, or in orchards. For the latter, powerful overhead washings with the garden engine, with weak sewage; a half-and-half of ammoniacal or gas-water, of ordinary strength, and clean water; strong tobacco-water; a quarter of a pint of paraffin to a gallon of water, well mixed, or with clean water, so soon as the leaf falls, repeated several times, will sensibly reduce, even if it does not absolutely destroy, this troublesome pest. Then, in the spring the trees ought to be gone over carefully, and any speck seen, and all the old premises where they have been, touched with some of our killing mixtures. This repeated several years in succession, and the roots soaked through to drown it out from them, and the Apple Bug disappears. In the garden, and with the miniature trees of modern times, the cure of American blight is merely a matter of careful manipulation and good culture.

Aphides or Green-flies.—These seldom prove very troublesome to the Apples. Now and then, however, they come in a sudden flight, mostly after an east wind; hence, the common saying, the Green-fly comes on the wings of the east wind, the fact being probably that the wind checks, and thereby sweetens the sap, and makes it worth while for the Aphides to try Apple diet for a few weeks. If noticed on their arrival, run the hand lightly over the shoots, and rub or squash off all the flies between finger and thumb. If this seems impossible, syringe them with tobacco-water, diluted with about four parts of water, according to the strength of the former; or should they appear, as they often do, rather late in the season—say the middle of June—cut all the Aphides-infected tops clean off, and lay them carefully in a box or basket to be burned, thus cleaning and summer-stopping the Apple-trees at one operation.

The Brown or Apple-tree Mussel Scale (*Aspidiotus conchiformis*).—This is not very common, but is occasionally troublesome, and should be removed. It seriously injures the tree by feeding on its bark, and clings so closely to it that it is apt to escape detection. The best remedies are hot soap and water, and a very hard brush, and an immediate smear of equal parts of quicklime, sulphur, and clay, made into a paste with strong tobacco-juice, to make sure of smothering any that may have escaped washing off. These washings and smearings are best given in the autumn, but should any still escape, it is good practice to renew the scrubbing in May, when, however, a dry hard brush is perhaps more effective than a wet one. The young scales will then be on the move, and if roughly and hardly scrubbed, they are readily smashed; and when once disturbed by force, they seldom lay hold a second time. Some have applied tar dressings, but these need care, and only vegetable tar must be used, reduced in strength by mixing clay and water with it. Paraffin and other oils are also obnoxious or destructive to scale, and it is found that a coat of oleaginous matter of any sort clogs their vital powers or destroys them, or makes them decamp, which latter is a slow and uncertain process.

The Apple Maggot or Codling Moth (*Carpocapsa pomonana*).—This, though by no means the only Apple Moth, is by far the most common, and the most destructive. It appears somewhat later than the other insects, and attacks the firmer parts that these have left undevoured. The moth appears early in the season, and lays its eggs in the eyes of the Apples in May. If it does not succeed in its election of this part, it chooses a spot just near the stalk, the first however being its favourite spot, though the hollow that forms the eye, and surrounds the stalks, suits the moth almost equally well. The eggs hatch with amazing rapidity, and slender white grubs are the products. These instantly turn their attention to piercing through the Apple, either from top or bottom towards the core. During its progress the grub grows rapidly in size, and having reached the core, it finds more room, generally partially or wholly devours the seeds, and from about a month to six weeks from the time of entering the fruit, finds its way out of it, having accomplished the ruin of the fruit. No sooner does the latter find itself the prey of the ravenous worm than it seems doomed; and when it reaches the core, and begins to prey on the seeds, the Apple generally lets go its hold of the tree and falls to the ground, the maggot, however, being mostly equal to the occasion, and quitting the fruit before it falls. But this is not always the case, as many are found on the ground with the destructive maggot inside them. No sooner is the maggot at large than it changes into a chrysalis, weaves itself into a cocoon, and attaches itself to the stem. More moths are speedily produced, which again begin the work of destruction, and this largely accounts for the two series of Apple-droppings—one early, and another late in the season. Both arise from the serious depredations of two separate families of the same or kindred maggots or moths, such as the Lackey Moth, *Clissiocampa neustria*, the Gipsy Moth, *Bombyx dispar*, and others.

There are three obvious periods and modes of destruction. Catch and kill the moths on the wing in the early spring, and the second brood of them in the summer. This requires a good knowledge of the insects and much industry and patience, still it is worth the trouble, and numbers may be thus caught and destroyed. Drive them away by forming a smothering smoke of brush-wood and weeds among the trees about the season of their greatest prevalence—say April and June. This, in dull heavy weather, may also suffocate not a few of the moths, as well as ward off the others. Render the trees distasteful by nauseous washes over-head, such as sewage, tobacco, and gas water, all weak, yet sufficiently strong to give out noxious odours.

Destruction in the cocoon or chrysalis state is comparatively easy. Collect so soon as seen; place in a flower-pot, with a cork in the bottom, or a box; convey to the nearest fire and burn. A whole garden may thus be cleared of the second brood in a few hours. The whole of the summer and winter hiding-places for chrysalis or larvæ, such as the loose bark of trees and rough and uneven cankered wood, &c., should also be smeared over.

The grubs may also be trapped as they are making their exit from their feeding-grounds. They are sluggish and lazy when full, and seek shelter in the first secret place, such as a crevice in the bark, a soft hayband or a lath fixed around the branch or bole. If such traps are set and frequently examined, quantities may be found and destroyed before they reach the chrysalis state. But the best way is to catch the maggots in the Apples before the latter fall. Of course, all maggot-bored Apples are useless. So soon as they fall, they should be collected and burned. A good many maggots will thus be destroyed, but a sharp eye will detect these maggoty Apples on the tree; they loose their verdure and hasten to put on a look of forced maturity. Each Apple manifesting such symptoms has a grub eating out its substance at its core, and it ought, if within reach, to be softly and promptly gathered and destroyed. This insures not only the destruction of a grub, but of a colony of future maggots.

The Apple Saw-fly, *Tenthredo testudinea*, pierces the fruit in a similar way to the Codling Moth, and with similar results as testified by the falling fruit, and should be prevented and destroyed by the same means.

Caterpillars.—Numbers of varieties of these prey on the leaves and young shootlets, so as not seldom to almost wholly defoliate the trees, to the total ruin of the current year's growth. Among these the caterpillars of the Wood Leopard Moth, *Zeuzera æsculi;* the Goat Moth, *Cossus ligniperda;* the Small Apple Moth, *Yponomenta malivorella;* the Figure 8 Moth, *Episema cæruleocephala;* and the Winter Moth, *Hybernia brumata*, are the more troublesome. Several of these, notably the last, use the ground for a resting-place, which rather increases the difficulties of their destruction. The caterpillar of the Winter Moth is specially destructive, clearing off young fruit as well as leaves and tender shoots. They are very small when they first appear in the spring, and are not very easily seen; but they speedily enlarge in size, and finish their work of destruction on the trees about the second week in May. They let themselves down gently to the earth, with a long gossamer thread, after the manner of spiders. So soon as they reach the ground, they bury themselves to a depth of two or three inches, and change into pupæ, in which state they remain till near the end of the year, at which period they crawl up the stems, and deposit their eggs, which are changed into caterpillars in the early spring.

Two modes of destruction at once suggest themselves, arising out of the habit of the insects. The females have no wings, and hence if a band of any sticky mixture, such as tar or manure, is made round the stems, it will either set them fast, or arrest their upward career, and so baulk the progress of the insects. Another mode is to make them prisoners in the ground. Heavy surface mulchings applied any time after June prove tolerably efficient for this purpose. It is a good plan to move some of the surface soil before applying the mulch, as the pupæ are likely to be removed with it. Mulchings of spent tan, and cinder-ashes, have also been effectual in shutting in the pupæ for good. Strong doses of sewage or other manure water, and the careful clearing away of all old dry soil around the boles, have also moderated or wholly remedied the plague of caterpillars. Another mode of destruction consists in picking them off. Most of them are sufficiently large to be seen, and should be looked for and destroyed. A good plan also is to place two small sheets round the trees so as to meet in the middle, then give the trees a smart and sudden shake, which results in placing many of the caterpillars on the sheet, when they may be gathered up and destroyed.

Weevils.—There are many varieties of these, some of them boring into the fruit in the same way as the Codling Moth and the Saw-fly, such as the Purple Apple Weevil, *Rhynchites Bacchus*. Another, the Stem-boring Weevil, *R. alliariæ*, deposits its eggs in the stems—the grubs, when hatched, scooping out the pith of the young shoots, and so destroying them. The Apple-borer, which is not exactly a Weevil, confines its operations chiefly to the collar of the tree, which it often weakens and not unfrequently destroys. Then there is what is termed by many, by way of pre-eminent destructiveness, the Apple Weevil, *Anthonomus pomorum*. This beetle sleeps in the bark or on the ground during winter months, comes forth in early spring, and deposits a single egg in each flower-bud. Early in April, the egg is hatched into a grub, which feeds on the pistil and other organs of fructification. So soon almost as it has destroyed the fair promise of a crop, the grub is transformed into a beetle, and immediately begins to feed upon and devour leaves and even shoots. As these fade and decay, it burrows or hides itself for the winter, and emerges in the spring, and resumes the cycle of destruction. By noticing carefully the first withered bloom, the grubs may often be seen and squashed at work on the buds and blossoms, and if seriously injured, it is better to gather these *en masse*, grubs and all, and destroy them. Surface consolidation and mulchings, as already described, will also destroy many more, and only by persevering by such methods can these and the other Weevils be destroyed. The Branch-boring and Collar-piercing Weevils may likewise often be killed in their lairs by a thrust of a small wire, or smeared in with messy and sticky smears, or even a patch of cement. The constant scarification and annual removal of the surface soil for Apple-trees would also bother the Weevils, while, were the same soil charred into burnt earth for seed-sowing, potato-planting, and other purposes, a speedy end would be made of many of the insect pests, which work such sad havoc among our Apple-trees. Still, when all is done that experience can suggest to wage a successful war against disease and insects among our Apple-trees and bushes, cleanliness and good culture are our best allies, and prevention our only perfect cure for both.

GLASS STRUCTURES AND APPLIANCES.

VENTILATION.

By William Coleman.

THE ventilation and heating of horticultural structures being so closely connected, the satisfactory working of one depending so much upon the other, the preceding chapter on heating cannot be considered complete without a few remarks on, and diagrams illustrative of, ventilation. If we apply artificial heat to a Vinery, no matter how efficiently, the hot-water pipes do not radiate their heat properly without a circulation of air. If we ventilate a Pine and plant stove, we can lower the temperature by letting out at the top the heated or vitiated air, and by the introduction of a cold current near or below the ground-line; but this is not scientific ventilation. It is a system that may answer in what are termed "cold" houses, or for hot-houses when the external summer temperature is equal, or nearly so, to that of the interior. But at other times, when the discrepancy is very great, other means must be provided for warming these cold currents before they come in contact with the tender foliage of the plants; and here, in this particular case, heating and ventilating are so closely dovetailed together as to render it simply impossible to carry out the one without the aid of the other. All ventilation rests upon the simple principle that cold air is heavier and has a tendency to descend, while warm air is light and rises to the top. But how the air is to be warmed and made to take any particular course through a glass structure, the roof of which is exposed to intense solar heat, or the reverse, is a question which has long occupied the minds of scientific and practical men. For a long time nearly all that was thought of was a system to prevent the atmosphere of the structure from becoming over-heated, and this was accomplished by making openings at the base and apex, but this created draughts, which are always objectionable. The late far-seeing Dr. Lindley justly said: "The importance of *aeration*" (he discards the term *ventilation*) "cannot be over-estimated. It is the one thing which now requires to be secured in order to render our artificial climates natural. A man's reason, indeed, must tell him that a plant condemned to pass its life in a still atmosphere is like nothing so much as a criminal set fast in an everlasting pillory. In order to secure motion in the vegetable kingdom, currents of air are made to do the work of the muscles, limbs, and volition of animals. It is not at all improbable that, in addition to the mechanical effects of motion in the propulsion of the sap, it may be important that the stratum of air in contact with the leaves of plants should be incessantly shifted, in order to enable them to procure an adequate supply of food; for we find that water in motion feeds them better than that which is stagnant. Leaves are continually abstracting from the air the very minute quantity of carbonic acid which it contains. When the air moves quickly over their surface, fresh supplies of that food are incessantly presented to it, and the operation of abstraction may be facilitated, while, on the contrary, if the air is stagnant the absorption of carbonic acid may be much slower.

"Perspiration is another function which must be maintained in healthy action. The quantity of water that flies off from the surface of a plant will, *cæteris paribus*, be determined by the rapidity of the motion of the air passing over its surface. In an absolutely still air perspiration will be reduced to its minimum, and it will increase, within certain limits, in proportion to the quickness with which the air sweeps over it." "If the motion of air is thus favourable to the two great operations of feeding and perspiration, we shall find that it is equally needed day and night; for perspiration goes on principally during daylight, and feeding in the hours of darkness. A good system of aeration *must then be constantly in action*. How to secure that, is the great horticultural problem which now remains to be solved."

From the preceding remarks, which will stand the test of all time, and which every zealous young gardener should have printed in letters of gold, we gather that the aeration of modern hot-houses by night as well as by day is now of paramount importance, otherwise it can only be serviceable to the plants so far as perspiration is concerned, which goes on principally during the day; while feeding, the other great operation, goes on during the night. Formerly, under the old system, the chink of night air, now so well understood, was of less importance, as plants prospered fairly well where the squares of glass were small, because there were more openings for small currents of air from within and without. Modern glazing has swept all these minute safety-valves away, and practical men, who have devoted their attention to ventilation as a science, have substituted methods by which the temperature can be regulated to a nicety, and the plants can be treated to a continuous supply of warm fresh air, without which they would languish and die.

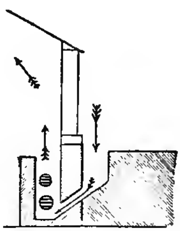


Fig. 74.

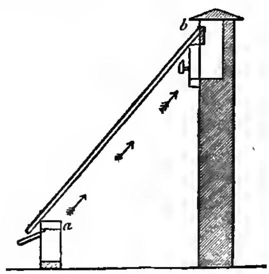


Fig. 75.

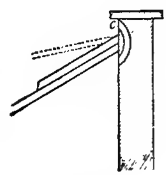


Fig. 76.

Size of Ventilators. — Before proceeding to describe some of the best modes of admitting fresh air into hot-houses, it may be well to consider the size and position of the inlets and outlets needful to provide for the escape of vitiated and the admission of fresh air to take its place. Mr. Hood, in his remarks on Ventilation as applied to Rooms, says he recommends "that the aggregate area of the openings for the admission of fresh air should be larger than the total area of the openings for the efflux of the vitiated air. By this arrangement the velocity of the entering current is reduced, and draughts are avoided. It is also expedient to divide the entering current as much as possible." "Provided the aggregate openings for the admission of cold air be not less in size than those for the emission of the heated air, the quantity of air which enters depends less upon the size or number of the openings which admit the fresh air than upon the size of those by which the vitiated air is carried off. This arises from the room being always absolutely full of air; no more air can enter until a portion of that already in the room be removed." Now, although these remarks apply to rooms, they to a certain extent apply also to forcing-houses, at least so far as velocity of circulation is concerned. Hence it follows that the front ventilators of our hot-houses should be equal if not superior in area to that of the openings at the apex. The nearer to the ground-line and the more divided the openings for the admission of cold air, the fewer the currents; but, unless a sufficient quantity of cold air be admitted in this manner, a counter current will descend and upset the circulation, if it does not produce an injurious effect upon the foliage. This fact does not, however, prevent our making provision for abundant ventilation along the highest part of every hot-house, as there are periods which necessitate and justify the throwing of every light and ventilator wide open, and allowing them to remain so during the season of rest, or when fruits, like the Peach, are laying on colour and ripening. Those who have to ripen Peaches and Grapes early in May, find it useful to strip their houses from base to summit as soon as the crop is removed.

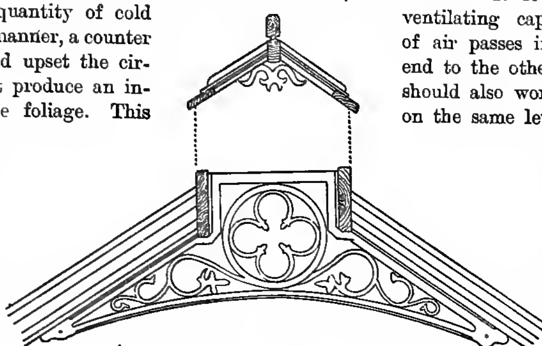


Fig. 77.—Lantern Ventilator.

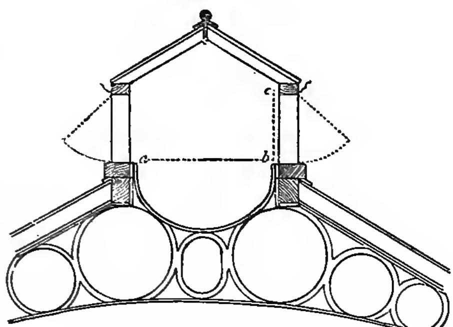


Fig. 78.—Lantern, with Side Lights.

Position of Ventilators.—Front ventilators, owing to the density of the cold air, should be placed as near the ground-line of the house as possible. Under some systems the fresh air is admitted by underground drains, which can be carried a considerable distance before they enter the house, but in all cases they should enter in a horizontal line as shown in Fig. 74, and so that the cold air will come into contact with the hot-water pipes, which will warm and rarify it before it reaches the foliage of the plants. This mode of admitting air is not, however, solely depended upon for reducing the temperature in hot weather, as there are times when the gravity of the external column is very nearly balanced by the atmosphere of the house, and the rapidity of motion is greatly reduced. But for keeping up a constant movement by night and day, whenever the front sashes are closed, this health-giving system is worthy of general adoption. If space admitted, instances could be given where this underground ventilation not only kept plants in the rudest health, but actually restored valuable collections of Orchids to that state, after being half ruined in the unwholesome atmosphere of double-glazed houses. The front sashes hinged to the top plate and worked by improved machinery open outwards, all on the same level, and being of equal ventilating capacity, an even stream of air passes into the house from one end to the other. The top ventilators should also work in the same way and on the same level.

Apex Ventilation. — The original mode of ventilating houses having fixed roofs, by means of ventilators let into the back wall, immediately below the roof, as in Fig. 75, and opening to the external atmosphere at *b*, although a very important step in advance, and still in extensive use for night or wet-weather ventilation, has been greatly improved upon by the addition of hinged lights, generally from two to three feet in depth, and running the whole length of the roof. Generally they are hinged to a fillet fixed along the tops of the rafters, and open upwards by means of ordinary ventilating gear, worked by a lever from the back path. Fig. 76 is a fragment of the top of a lean-to Vinery, showing a section of the wet-weather ventilator, *c*, built like a semi-circular flue in the thickness of the wall; the hinged lights can be opened up to the horizontal line, beyond which they should not go, or the water, in case of a storm, would flow into the house. Many old conservative builders, for a considerable time, set their faces against fixed roofs with continuous ventilating lights attached to the apex, but the moderate cost of a fixed roof soon made them popular, and this mode of glazing and ventilating is now accepted as one of our greatest modern improvements. Span-roofed houses of ordinary dimensions, and running from east to west, require a ventilating light on the south side of the ridge only; but when very large, and running in an opposite direction, *i.e.*, with one end facing the south, the other the north, the lifting lights should be attached to each side of the ridge-piece, not only to admit of giving air on the lee side in windy weather, but also to form separate and moderate-sized outlets for the two currents of air rising from the base ventilators fixed on the east and west sides of the house. When the ventilating lights are placed on one side only, and the base ventilators on each side are of equal capacity, the two currents do not flow evenly, consequently this mode of apex ventilation is imperfect.

Lantern Ventilators. — For a considerable time after cheap glass was introduced, the lantern mode of ventilation was confined to the roofs of large structures, including conservatories, requiring an abundant outlet for the heated air; but of late this excellent system has been applied to smaller span-roofed houses devoted to the culture of fruit, notably to Peach-houses and Vineries. Messrs. Foster and Pearson, of Beeston, Notts, who have made the lantern a speciality, have recently favoured me with a most elegant design for a roof bracket and lantern, Fig. 77. The inventors say: "It allows the heated air to escape at the highest point. The cover moves up and down like a parallel ruler, and is raised by a worm and wheel apparatus which works very easily, and being glazed it causes but little obstruction to the light; arrangements are made also to prevent the rain entering at either end when the cover is raised. These ventilators have been found to efficiently ventilate a house up to thirty feet in width."

Fig. 78 is another lantern ventilator, which can be made any size up to three feet in width, from *a* to *b*; but three-feet openings are quite sufficient for the largest span-roofed houses where the temperature is not expected to exceed that of an ordinary green-house. The side lights are hinged to the top plate at *c*, and open outwards by means of ventilating gear attached to rods running down the sides of the columns.

Front Ventilation.—Having glanced at the best modes of letting out the vitiated air, we now come to the equally important methods of introducing a continuous stream from the external atmosphere to take its place. Fig 79 is a section of a Vinery designed for himself by Mr. W. Thomson, of Clovenfords, and in which he has grown those magnificent Grapes that have made his name known and honoured throughout the horticultural world. The roof, as will be observed, is *fixed.* The apex ventilating lights are raised by machinery, wet-weather ventilators are provided, and the front lights, hinged to the upper plate, open outwards by means of rule-jointed levers keyed to a horizontal rod of iron, or gas tubing, running the entire length of the house.

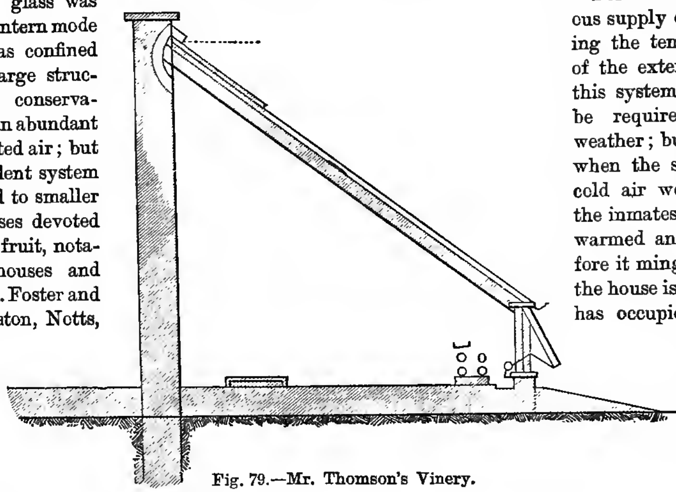


Fig. 79.—Mr. Thomson's Vinery.

For admitting a continuous supply of air, or lowering the temperature to that of the external atmosphere, this system is all that can be required during hot weather; but there are times when the sudden ingress of cold air would be fatal to the inmates. How to get it warmed and broken up before it mingles with that of the house is a problem which has occupied many minds, as it is generally necessary to the health of the plants that it be moist as well as warm.

Use of Warmed Air.—Weeks's Hydro-caloric Ventilator (Fig. 80) possesses all the necessary advantages, for the same apparatus will supply cold fresh air, warm fresh air dry, or warm fresh air moist. In construction, it is a copper vessel three feet long, one foot high, and eight inches wide, encased in a wood frame, to be built into the front wall of the house. From end to end are apertures through which the air is made to pass. The ventilator is attached to the hot-water apparatus, and can be made hot with or without the apparatus at pleasure. Upon the face, B, an indicator tells whether it is at work as an introducer of cold or warm air, or as a hot-water apparatus; C is a hit-and-miss slide worked in connection with the flap D. When D is at the angle shown, the slide C is open, and the ventilator being hot, the air of the house is passing through, and it is serving as a hot-water apparatus. When D is horizontal, as shown at E F, the slide closes and the apparatus becomes an ordinary ventilator. When the flap, D, is at the angle shown by the dotted lines

G H, external air passes through C into the ventilator, and after being warmed to about 90° enters the house; at K is an evaporating trough, rendered hot by means of the circulation through the ventilator, and by keeping this either charged or otherwise, hot air moist or dry is obtained at pleasure. A two-inch pipe, leading direct from the main, renders the ventilator efficient, while the ordinary heating apparatus remains cold.

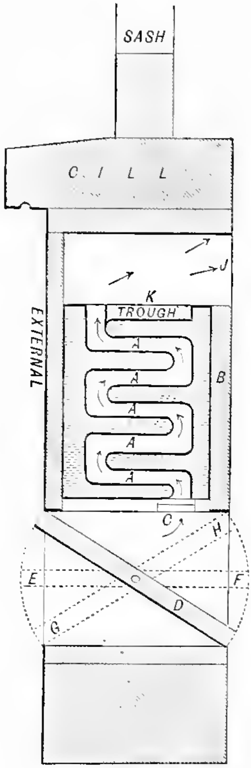


Fig. 80.—Weeks's Hydro-caloric Ventilator.

A simple and efficient mode of warming the entering air before it comes in contact with the plants in stoves will be found in Fig. 81. To prevent a rush of cold air into the house through the ordinary ventilators, A, the hot-water pipes are enclosed in perforated zinc, B, which being made hot by its proximity to the pipes, causes the air which passes through it to divide into a gentle stream on its way to the body of the house. Another stream of hot air passes up at the back of the table D, which is solid, and entering at C, protects the plants nearest the glass from the ill-effects of cold. As a cold-weather mode of ventilating plant or fruit houses this is very satisfactory, especially when the hot-water pipes are well furnished with steaming-trays.

Thomson's Hot Air Ventilator (Fig. 82) although originally constructed for warming the air on its way into Vineries, is equally well adapted to all kinds of fruit or plant houses where tender exotics require careful ventilation in cold weather. Mr. Thomson says: "This apparatus consists of a sheath of copper placed over a row of the front pipes. The diameter of this sheath is one inch more than the hot pipe it encloses, consequently there is an open space of half an inch all round the pipe inside the sheath. This cavity is fed with fresh air from the exterior of the house by a pipe five inches in diameter, which springs from the lower surface of the sheath, and passes through the front wall of the house to the external air. There is a valve in this feed-pipe to modify the supply of fresh air at pleasure. In the upper surface of the sheath is a double row of small holes, so that the moment that the cold air comes into the chamber round the pipe, and gets hot, expanded, and lighter, it makes its exit through these holes into the general atmosphere of the house."

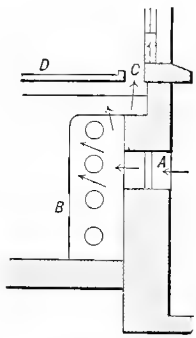


Fig. 81.

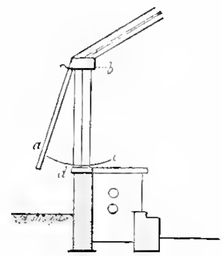


Fig. 83.

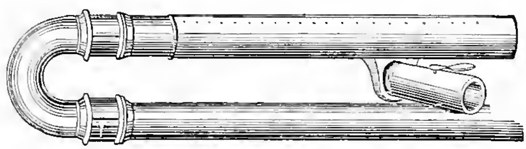


Fig. 82.—Warm Air Casing for Pipes.

The Amateur's Ventilator.—The amateur who builds a small green-house or Vinery upon strictly economical principles, and does not wish to incur the expense of ventilating gear for so small a structure, may adopt the older system of opening the lights by hand. Fig. 83 is a section of a portion of the front of a small house containing a longitudinal table for plants. The sash, *a*, is hinged to the top plate *b*, and is opened to any extent by pushing out the handle *c*, which is furnished with holes that fit on an iron stud fixed in the lower wall-plate *d*. This handle is fixed to the sash by a universal joint, so that when the handle is drawn in on shutting the sash, the handle instead of lying amongst the plants is turned aside, and laid upon the wall-plate containing a second stud corresponding with one of the holes, which, when fastened, will prevent the light from blowing open in windy weather.

The apex ventilator can be opened in a similar way, that is, provided the lights are hinged to the top wall-plate.

AQUATIC PLANTS.

By R. Irwin Lynch.

BOG AND MARSH PLANTS.

Acorus Calamus (Sweet Flag).—A native Flag of our river-sides, chiefly in Norfolk and Suffolk. The leaves are sword-shaped, and from three to six feet high, borne by a creeping stem or rhizome. In foliage it is ornamental, and is suited for the margin of a pond. The leaves when bruised have a sweet aromatic smell, and the rhizome has been used in medicine and in confectionery. A variegated form of this is known as *A. japonicus argenteo-striatus*, and it is considerably ornamental. The only other species is *A. gramineus*, a dwarf and extremely pretty grass-like plant, with bright green leaves. Of it there is also a variegated form. This species is a native of Japan, and *A. Calamus* is a native of Europe, Asia, and North America. The last flowers in June and July; flowers of *A. gramineus* we have not seen. *Aroideæ.*

Alisma Plantago (Water Plantain).—Though not showy in blossom, this plant is stately in habit, and a clump well placed is decidedly ornamental. The leaves are erect, and broadly lance-shaped; the flowers, of pale pink or rose, grow profusely in panicles. It is common in ditches, and produces itself freely from seeds, but as a weed it is not troublesome. It is widely spread in the North Temperate regions. Flowers from June to August. *A. natans* is a rare and pretty British species worth growing, and *A. ranunculoides*, also British, may be regarded for collections. *Alismaceæ.*

Anagallis tenella (Bog Pimpernel).—One of the loveliest of native bog plants, and not difficult to grow in spongy or moist ground in company with other lowly herbage. The flowers are sometimes mingled in the wild with those of the blue *Wahlenbergia hederacea* (*Campanula hederacea*), and it is difficult to imagine any prettier association. It is a perennial creeping plant, with small, round leaves, and during July and August the rosy flowers form quite a sheet of blossom. In pots or pans it is easily cultivated, but if planted by the flowing water of a rivulet the happiest success is most likely to be attained. It extends south to North Africa. Flowers in July and August. *Primulaceæ.*

Arundo Donax (Provence Reed).—This is a noble large-leaved and distinct Grass, which attains in the West of England a height of ten feet, and in less favoured parts of the country attains fine dimensions. It should have a sheltered position, with good soil of sandy character, and be planted by the side of ornamental waters. There are few plants which afford a more tropical effect. This is figured in "The English Flower Garden." The variety *versicolor* is splendidly variegated and is even more highly ornamental; but, so far as we have seen it, it is less robust. In the work just referred to we have the information that propagation may be effected by placing a stem in a tank of water, when little plants with roots will soon start from the joints. These should be potted, and soon make fine plants. Both these plants are much less used than their merits deserve. As they are lost during severe winters, some protection should be afforded them. Native of South Europe and the Levant. The British *Phragmites communis* (*Arundo phragmitis*) is also ornamental, especially when in flower, and is worth planting in the shallow margins of large pieces of water.

Caltha palustris (Common Marsh Marigold).—There are few brighter flowers of the marsh than this, during the spring months, and as Tennyson expresses it, "The wild Marsh Marigold shines like fire in swamps and hollows gray." It is a showy and variable plant, effective in all its forms, but most excellent in some of them. There is a double variety of the common, the double variety called *monstrosa*, and a double dwarf variety, distinguished as *nana flore-pleno*. *C. radicans* is a distinct variety of the preceding, with depressed stems, rooting at the nodes, and triangular leaves. It was supposed to be extinct in Forfarshire, where it grew, but it has not long since been found again. *C. natans* is distinct from the above kinds in its procumbent stems and cordate-reniform leaves, and the flowers are white. This is Siberian. *Caltha leptosepala*, not long since introduced from California, has a one-leaved stem, which bears one or two flowers. *C. purpurascens*, another new kind, is said to have purplish stems and bright orange flowers. All these will grow in moist ground, but the finest luxuriance is obtained close to water. There are several other kinds not cultivated, and two of them, at least, belong to a distinct section, with persistent sepals. *C. palustris* and varieties flower from March to May. *Ranunculaceæ.*

Cardamine.—Several kinds are suited to moist places in the bog garden. There is a double form of *C. pratensis*, the Cuckoo Flower, worth the distinction of being planted in it. *C. rotundifolia*, of North America, and the European *C. asarifolia*, are cultivated species, which also love moisture; these have round undivided leaves. The Cuckoo Flower was known to Shakespeare as the Lady-smock, and he writes—

> "When Lady-smocks, all silver-white,
> Do paint the meadows with delight."
> *Love's Labour's Lost.*

It flowers from May to June. *Cruciferæ.*

Carex acuta variegata.—This is a very pretty and not coarse plant, with long narrow leaves effectively variegated. It is the best of the variegated forms. Several of the Sedges are ornamental, and desirable for the rougher borders of a pond; apecially so is our British *C. pendula*, with broad leaves and tall panicles of drooping slender spikelets, from three to five inches in length. *C. Pseudo-cyperus* is also a good kind. Of exotic species we should include *C. Fraseri* and *C. Grayi*, the first being very curious, with broad short leaves and white inflorescences, while the latter has large ball-like spikelets. *Cyperaceæ.*

Crinum capense.—The merits of this noble and perfectly hardy bulb entitle it to a position in the bog garden, since it loves moisture well, though it will grow in the driest soil. It attains a height of about three feet; the leaves are broad and ornamental, the flowers funnel-shaped, of considerable size, from ten to fifteen in each umbel, and pink or white in colour. It is said even to grow in water, but we should plant it rather on ground through which the water percolates. For this a conspicuous position should be chosen, and, like many other fine plants, we should grow it in masses. There are several varieties, and the white one is one of the best. Seeds are freely produced, and they should be carefully sown, as they perish if left on the ground. They grow very easily if potted in a frame. A cut is given in "The English Flower Garden." Cape of Good Hope. Flowers in July. *Amaryllidaceæ.*

Cyperus longus (Galingale).—Of very elegant appearance from the long leafy bracts which radiate from the umbel. The habit of the plant is ornamental, and it attains a height of from four to five feet. *C. vegetus* is also good, and both are suited for planting close to the water, but not among small-growing plants. *Cyperaceæ.*

Darlingtonia californica.—Undoubtedly the best place for this Pitcher-plant is under glass, where it is grown with the most complete success; but out of doors also it is worthy of trial, and we should plant it in a spongy mixture of fibrous peat with Sphagnum, which should be in good condition so that it may grow. A sheltered position open to the full sun should be chosen, and where Sphagnum grows well this may be expected to succeed. The pitchers are about two feet high, hooded at the top, and the mouth opens downwards, bearing a divided leafy appendage, like two ribbons; in colour the pitchers are green below, but crimson-red above. A bell-glass may be used to protect it from cold winds, which injure the young leaves. At Glasnevin we have seen it growing satisfactorily. It is increased by removing carefully the side-shoots which are produced in well-established plants, and seeds are also raised. It is figured in the *Botanical Magazine*, t. 5920, and a cut is given in "The English Flower Garden." California. *Sarraceniaceæ.*

Drosera rotundifolia (Sundew).—This is the most familiar of the British species, which alone are grown out of doors, and it is perhaps the prettiest of them. The leaves are beautiful and remarkable on account of the glandular hairs or tentacles with which they are furnished. They secrete a clear mucus, which glistens in the sun, and on account of which the popular name was given. Many insects are caught in it. This plant is insectivorous, and the tentacles bend over upon the victim, and by a digestive process take up its nutritive matter. So exquisitely sensitive are these tentacles that they respond to influences unfelt by the most sensitive parts of the human body. The millionth part of a grain is weight sufficient to excite their movement. The exceeding beauty of this little plant claims for it a place in the bog garden, where it must be planted with Sphagnum, in a wet but well-drained spot. The leaves of this kind are round and spreading, but of *D. anglica* and *D. intermedia*, the two other British kinds, they are narrow and erect. They flower in July and August. *Droseraceæ.*

Epipactus palustris.—Interesting as one of the most easily cultivated of British Orchids. It removes safely from the wild, and succeeds if planted in ordinary soil near water, or better if planted in spongy peat with Sphagnum. The flowers are dull in colour, the sepals green and purple, and the lip white streaked with red. It is slender, with lanceolate leaves, and grows about one foot high. Flowers in July.

Equisetum maximum (*E. Telmateia*).—This is the finest of the British Horse-tails, and it produces a splendid effect when well established. The barren stems grow from three to six feet high, and from base to apex have whorls of slender, slightly drooping branches, which are extremely graceful. In a dell in Mr. Wilson Saunders' garden at Reigate, some years ago, it formed a fine feature. Owing to the habit of its growth, good pieces are difficult to get, and it is therefore difficult to establish, but it is worth many trials. It requires to be planted in a moist, shady position. *E. pratense* (*E. Drummondi*) is a beautiful dwarf kind, about eighteen inches high, of bright green colour, and very feathery from the number of slender branches. *E. sylvaticum* is also very graceful and suited to the bog garden. These are all figured in "Illustrations of the British Flora." *Equisetaceæ.*

Eriophorum polystachyon (Cotton Grass).—On wet moors the cottony heads of the seeds are pretty and conspicuous. It is easily grown by planting on wet ground; but it does not appear to be capable of very good effect when cultivated. It is, however, interesting, and this is the best kind. May and June. *Cyperaceæ.*

Ficaria grandiflora.—This apparently is but a large form of our British Pilewort, or Lesser Celandine, but it is very showy, and it grows best in a moist situation, such as the bog garden affords. The flowers are golden-yellow, and two inches across. South Europe and North Africa. Flowers in spring. *Ranunculaceæ.*

Gunnera scabra. — This fine plant, which bears immense leaves reaching a height of eight feet, resembles some great prickly Rhubarb, and is magnificent in its effect when planted in deep, rich, and moist ground. It is illustrated in "The English Flower Garden," and is a native of Chili. Still finer is the more recently introduced *G. manicata*, from South Brazil, which is recorded with leaves nearly seven feet across and stalks five feet long. They are of similar habit, but quite distinct. A sheltered position is required for them; and rich soil, with plenty of moisture, is essential. Seeds are freely produced and grow readily; increase is also effected by division. During winter the crowns should be protected with dry leaves or fern, and in summer a mulching of manure is beneficial. Other kinds in cultivation are not ornamental. *G. dioica* is a tufted plant scarcely reaching a height of one inch. *G. magellicana* has creeping stems and round leaves, a few inches in height. *Halorageæ.*

Hierochloe borealis (Holy Grass.)—One of the best of our British Grasses for garden culture. It is perennial and grows about one foot high, bearing light panicles of very sweetly-scented flowers. It grows in wet ground, and comes up in the water if planted near to it. It is called Holy Grass from having been strewed formerly on church floors. It is widely spread, but in Britain is found only at Thurso. Flowers in May and June.

Houttuynia cordata.—If not showy, it is at least attractive and pretty. It is perfectly hardy, and spreads and grows easily if planted six or eight inches above the level of the water on a bank. Its height is about one foot; the leaves are heart-shaped and dull red in colour. The flowers are quite inconspicuous, but the spike on which they grow is subtended by four or five white bracts. It is a native of Japan. Flowers in August and September. *Saurureæ.*

Juncus effusus spiralis.—This most curious Rush is well deserving of the room it occupies. It forms a dense tuft of spirally-twisted leaves, some being scarcely turned at all, while others form a spiral as close as that of a cork-screw. It is interesting that the plants come true from seed. *J. glaucus* forms rather a handsome specimen, if allowed full room for development, though on wet lands it is a common and troublesome weed. *J. conglomeratus variegatus* is a form with golden stripes, but this colouration is not conspicuous. *J. acutus* is one of the handsomest on account of its large needle-pointed leaves and fine capsules. *Junceæ.*

Juncus zebrinus, Hort.=Scirpus Tabernæmontani, var. *zebrinus.* (See AQUATICS.)

Justicia pedunculosa.—Quite a rare plant, not very ornamental but interesting, especially as being one of the very few hardy Acanthads. It grows well if planted a few inches above the level of the water. The stems are erect, the leaves narrow, and the flowers white spotted with purple. August and September. Native of North America. Sometimes known as *Dianthera americana.*

Lychnis Flos-cuculi (Ragged Robin.)—An extremely pretty British plant of which double red, white, and single white varieties are cultivated. It grows very easily in any moist soil, and the feathery-looking flowers peep out very prettily from amidst the stronger bog plants. Propagation is effected by division, and in August or September good shoots may be obtained, which by being separated make strong specimens. Flowers in May and June. Native of Europe and Siberia. *Caryophyllaceæ.*

Lysimachia (Loose-strife.)—The members of this genus all love moisture, and are better suited to the bog garden than to the dry border. They are all perennial and are propagated by division, or in some cases by cuttings. *L. nemorum* (Yellow Pimpernel) and *L. Nummularia* (Creeping Jenny or Money-wort) are creeping plants, and serve to cover with verdure the otherwise bare ground between tall specimens. Of the last species there is a yellow-leaved form, sometimes used in bedding-out. Tall-growing kinds are *L. vulgaris* and *L. thyrsiflora*, the former best suited for rough ground. These are all British, and have yellow flowers. The Spanish *L. Ephemerum* makes a noble specimen; it grows erect, the leaves are lanceolate and glaucous, the flowers white, in long erect racemes. One of the prettiest of all is *L. clethroides*, with white flowers, from Japan. It grows about two feet high, and frequently makes a good border specimen. There are several others, but none more ornamental than the above-mentioned. *Primulaceæ.*

Lythrum Salicaria (Purple Loose-strife). — The variety of this British plant cultivated as *roseum* is much favoured as an ornament in moist situations. It is worth having, but should not be allowed among choice or delicate kinds. This species is of great interest, having acquired, through Darwin's laborious experiments, so important a place in the question of the origin of species. July to September. North Temperate regions and Australia. *Lythraceæ.*

Mimulus luteus (Yellow Monkey Flower).—A native of North America, now established in Britain. In a proper position, this is a very useful and showy plant for the bog garden; it requires no care, and it never fails to produce a bright mass of yellow flowers. If allowed near delicate or small plants it may over-run them, if not attended to. It reaches a height of three or four feet, and is easily grown from pieces of the creeping stem or from seeds. At a few inches above the level of the water it is perfectly at home. This kind is glabrous, or but slightly hairy, thus differing considerably from *M. cardinalis*, the only other tall kind grown in gardens. The garden Monkey Flowers are derived from this species, and would probably flourish where this does. July to September. *Scrophulariaceæ.*

Mimulus cardinalis (Monkey Flower). — Though not necessarily grown in the bog garden, it merits a position there, on account of its showiness, and because it likes a moister position than is found generally elsewhere. It grows erect, two or three feet high, has hairy leaves, and bears scarlet flowers, though there is a rose-coloured, and several other varieties. Easily increased by division or seeds. California.

Narthecium ossifragum (Bog Asphodel).—Though not showy, this plant is attractive when planted to form a colony. It grows six or eight inches high, the leaves are sword-shaped and yellowish, the flowers bright yellow with white filaments and bright orange anthers. Should be planted in wet peat or spongy soil. The plant is British and widely spread in North Temperate regions. Flowers in July and August. *Liliaceæ.*

Nephrodium cristatum.—A rare British Fern which requires constant moisture at the root. Though not so beautiful as some others, it is deserving of culture. The root-stock is shortly creeping, and the fronds are erect, one to one and a half foot high. It prefers peaty soil and shade. The variety *spinulosum* occurs with the above, which is found in bogs and marshes of the Eastern counties, Nottingham, Chester, and Lanark. Known often as *Lastræa cristata.*

Nephrodium Thelypteris (Marsh Fern).—Few of our British Ferns are prettier or more easy to grow than this. It must have the moisture of a bog garden, and peat is probably the best soil. The rhizomes are slender and far-creeping; the fronds lanceolate and about six or eight inches in height. Belongs to the *Lastræa* section of the *Nephrodium*, and is often called *Lastræa Thelypteris.* Widely spread over the world.

Onoclea sensibilis.—This is a handsome Fern, with sterile fronds about two feet in length, the pinnæ of which are cut into large angular teeth. It grows well in a moist position, or planted a few inches above water so that the roots have easy access to it. The root-stock is creeping. The fertile fronds are distinct. Native of North America and Asia.

Osmunda regalis (Royal Fern).—This is a well-known favourite, and the noblest of all our native Ferns. The coriaceous and substantial fronds grow from one to eight feet high, and the root-stock is often massive, with many heads. It grows in bogs, by river-sides, and in marshy woods, and should be planted on dwarf mounds, so that the roots can reach water. Native of all quarters of the globe.

O. palustris.—This is referred by botanists to the last species, but for horticultural purposes the plant grown under the name is abundantly distinct, and may be characterised by the feature which makes it attractive—the redness of the young fronds. Other kinds, which like moist peaty soil, are *O. Claytoniana*, *O. cinnamomea*, and *O. cinnamomea*, var. *angustata.* These are natives of North America.

Parnassia (Grass of Parnassus).—The five cultivated kinds are charming plants for growing in wet, peaty, or spongy places. They have white flowers on slender stalks, raised above pretty tufts of dwarf foliage. Our British *P. palustris* is the most familiar, and is well deserving of culture. It blooms very profusely during August and September, and the flowers are about one inch in diameter. *P. fimbriata*, from North America, is one of the newest and best; beautiful and attractive on account of its fringed petals. *P. caroliniana* and *P. asarifolia* are somewhat similar, and both come from North America. The leaves of the first are heart-shaped, while those of the latter are kidney-shaped. *P. nubicola* is a new kind, but perhaps the least beautiful, as it is stiff-looking and not so graceful as the others. It is described as the largest and coarsest of all the species, attaining a height of eighteen inches. The leaves are ovate, scarcely cordate. It is native throughout the Himalaya range, which is reached by our own species; indeed, the head-quarters of the genus is in India. *Saxifrageæ.*

Pilularia globulifera (Pillwort, Pepper-grass).—An interesting plant, though more from a botanical than a horticultural point of view. It has slender creeping stems, which grow closely together and produce erect needle-like leaves, two or three inches long. The capsules are produced in the axils of the leaves, and are in the form of small pills—hence the name. There is no difficulty in growing it; but there are one or two essential conditions. We grow it in pans of peat soil, which stand fully exposed in summer, and in winter are placed in a frame. The pans are about one foot across, and about five inches deep, and stand in saucers of water during the season of growth. Re-planting is done every spring, the old specimens are broken up and small tufts are planted two or three inches apart. The points to be considered important are peat soil, sufficient moisture, and re-planting. Native of Europe (Britain) north of the Alps. *Marsiliaceæ.*

Pinguicula (Butterwort).—These are very charming and pretty plants, which require well-drained but wet peaty soil, which being artificially prepared may be mixed with grit and pieces of sandstone. They flourish best on slopes sustained by stones, where the right degree of moisture can be secured with this condition. Slight shade assists a fine development. The finest of the hardy kinds, and perhaps the most easily cultivated, is the Great Irish Butterwort, *P. grandiflora*, found in Kerry and Cork, and plentifully in a bog near Penzance, where it has been introduced. It forms rosettes of glistening bright green fleshy leaves, ovate-oblong in shape; the flowers are of great beauty, an inch across, of violet-blue colour. It ranks properly, no doubt, as a sub-species of *P. vulgaris*, from which it is easily distinguished by the much larger flowers, and by the overlapping of the broad lobes of the lower lip. *P. vulgaris* is the most familiar and the most common. It grows easily, and has very pretty violet flowers, the lower lobes of which do not overlap. *P. alpina* and *P. lusitanica* are smaller kinds, interesting, but less showy. *P. alpina*, found in Skye and Ross-shire, has white flowers, with yellow throat. *P. lusitanica*, a still smaller plant, has lilac flowers, with yellow throat, and is found in the South-west of England, West Scotland, and Ireland. Its leaves are marked with purple veins. This is sometimes found growing in loam, and probably all the kinds will grow well in it, if water passes through freely. For *P. grandiflora* loam has been recommended. All these may be grown in pots. They are propagated by buds, which naturally separate from the original crowns. The Mexican *P. caudata* may be grown from the leaves, and other kinds will perhaps do so. It should be tried out of doors, but it is probably not hardy. *Lentibulariaceæ.*

Primula.—Several species are excellent for moist places in the bog garden. *P. japonica* will grow splendidly if planted a few inches above the level of the water, so that the roots are within easy reach of it. If the crowns are close to the water they generally perish in winter. Some of the kinds which do best in constantly moist ground are *P. Munroi*, *P. denticulata* and its varieties, *P. farinosa*, *P. scotica*, and *P. rosea*—one of the most charming of all.

Samolus littoralis.—A desirable plant for moist spots; it has pretty trailing stems, with small evergreen leaves, and pink blossoms in summer. It appears to prefer peaty soil, and is easily divided or increased by cuttings. Its dwarf habit and pretty growth render it suitable for clothing the ground between large-growing bog plants. Native of New Zealand. *S. Valerandi* is an unattractive British weed. Flowers in August. *Primulaceæ.*

Sarracenia purpurea (Huntsman's Cup, Side-saddle Flower).—This is a hardy representative of a genus always singular and generally handsome; it is one of the most ornamental, and grows in tufts of several short stems, each with several leaves, which are pitcher-shaped, spreading out, but curved upwards, and bellied on the outer side, with an erect lid or blade, the pitcher being formed of the petiole. They are green in shade, but of a dull red colour when exposed to the sun. The flowers are curious and handsome; they are produced singly on the tall stems, which turn at the top and invert the flower; the petals are red and drooping, and the style is dilated into a wonderful umbrella-like expansion, from which the early English settlers in America termed it the Side-saddle Flower. This plant is not difficult to cultivate. It requires moist peaty soil, with Sphagnum, and if the Sphagnum grows the *Sarracenia* is not likely to fail. Good drainage is essential, but constant moisture not less so. It should have a sunny but sheltered position. It grows in the Central and Northern United States, where, M. Roezl says, "It spreads among the Sphagnum and finds in the damp moss everything necessary for its existence." Good specimens have been grown on an ordinary border protected by a hand-light and properly watered. Seeds sown on Sphagnum, if good, grow readily, and tufts may be divided, but imported plants are generally cheap. *Sarracenia flava* is the next hardiest kind, and splendid pitchers, equal to any but those of the highest culture, have been grown out of doors. It does not appear to be safe in the open air, but it is worth trying, and good success may be obtained for a season at least. In Louisiana it sustains 10° of frost, F., but in summer the temperature rises to 100° F. M. Roezl, the well-known collector, found the plant growing in water six to eight inches deep. The culture recommended is the same as for *S. purpurea*. *S. flava* has erect pitchers of yellowish-green colour; the lid in a young state arches over the mouth, but it is afterwards erect. It is found from Carolina to Florida. *Sarraceniaceæ.*

Saxifraga.—Several species so love moisture that the most suitable place for them may often be found in the bog garden. *S. peltata*, for instance, is a magnificent plant, which, on dry soils, never attains fine development. It likes deep moist soil, and will flourish very close to water. *S. Hirculus major* is a pretty plant which loves moist soil. *S. diversifolia* is a fine plant belonging to the same group as *S. Hirculus*, and as it inhabits boggy places, the bog garden affords the conditions it requires. This is a recent introduction; it has erect stems, about a foot or more in height, ovate or cordate Parnassia-like leaves, and numerous yellow flowers, half an inch or three-fourths of an inch across. This grows splendidly on the ordinary border in moist climates like that of Dublin.

Selliera radicans.—A creeping plant, not ornamental, but extremely curious, on which account it is rather frequently cultivated. The stems are closely applied to the ground, rooting at the nodes; the leaves are erect, spathulate in shape, about four inches long, succulent, and bright green in colour; the flowers are inconspicuous, the corolla is brownish-white, a third of an inch across, and is split on one side, so that the petals spread in a semi-circle. Apparently not quite hardy, so that a reserve must be kept in a frame. Native of the coasts of Australia, New Zealand, and Chili. Flowers in August and September. *Goodeniaceæ.*

Soldanella.—The several species are moisture-loving plants, which rarely do well on ordinary rock-work, but in the bog garden there are always moist spots where they will succeed without trouble. In the Cambridge bog garden they flourish on a moist peat bank. They are all extremely pretty and small-growing, with roundish dark green leaves. *S. alpina* has purple flowers, deeply fringed; those of *S. minima* are fringed and nearly white; *S. montana* resembles *alpina*, but the flowers are of a bluer purple and the leaves are larger. Other kinds obtainable are *S. crispa* and *S. pusilla* (*Clusii*). Natives of Alpine Europe.

Spiræa.—Several species are splendid for the adornment of the bog garden, and flourish amazingly in the copious moisture or wet which is there afforded. The very fine *S. palmata* is best suited here, in rich soil, constantly moist. *S. Aruncus* is beautiful in flower and habit, and somewhat like it is *S. astilboides*, to which attention has lately been drawn, though it is not new. *S. lobata*, with rosy-carmine flowers, is one of the most beautiful of the herbaceous kinds. Our native species, *S. Filipendula* and *S. Ulmaria*, must not be forgotten, as they are very beautiful, and there are fine double varieties of both. There should be a damp border in the bog garden where these can be cultivated.

Swertia perennis.—A curious plant for a moist peaty spot. It is tufted, with oblong leaves and erect stems, one or two feet high, bearing greyish-purple flowers spotted with black. *S. speciosa*, introduced a few years ago, is perhaps finer. Propagated by seeds or division. The first is European, the latter Himalayan. We have lately received *S. multicaulis*. *Gentianaceæ.*

Symplocarpus fœtidus (Skunk Cabbage).—Ornamental in foliage, but without attractiveness in flower, except that the fleshy hood which encloses the spike is curiously marbled with bronzy-brown, violet, and green, and is beautiful when closely observed. The leaves are large, ovate or cordate, and give the plant somewhat the appearance of *Lilium giganteum*. It requires a moist position. Is employed medicinally in North America. It is a native also of Northern Asia. *Aroideæ.*

THE ROSE AND ITS CULTURE.

By D. T. Fish.

DISEASES AND INSECTS AFFECTING THE ROSE.

UNFORTUNATELY disease, and even insect-pests, run abreast with the improvement and more extended culture of the Rose. The better and finer the strain the weaker, has almost passed into a proverb; for often what the Rose gains in quality it loses in vigour of constitution, and its consequent power of resisting insect pests and diseases. Weakly Roses go to the wall and so become the prey of disease and of insects; while the stronger escape both. Hence, one of the surest means of keeping Roses in good health is to choose those Roses only, or chiefly, that do well in any given locality, and adhere chiefly to such; for Roses have their favourite bowers, gardens, localities, counties, and some of them refuse to thrive much beyond these very local geographical boundaries. For example, two of the finest Roses, A. K. Williams and Reynolds Hole, have never grown into creditable size at Hardwicke, whereas in other sites and situations they grow like weeds; and it is so in degree with not a few other fine Roses.

Hence, the first step before planting a Rosary should be to take a general survey of the condition of the Roses in the immediate neighbourhood, noting all that thrive best in several different gardens, and placing a black mark against the weakly or miffy growers. Very little experience will suffice to show whether the weakness arises from bad culture, or has its deeper roots in the constitution of the Rose, or local climate. If the former, it may easily be removed by a change of soil or of treatment; if the latter, it is almost impossible of cure, and is seldom worth the trouble involved in the effort.

From these general principles it will be well to proceed to notice the particular diseases of the Rose, and the best means of preventing or curing the same. They are chiefly frost-bites, canker, extravasated sap, mildew, and red rust, or orange fungus, gout, and suckers.

Frost-bites.—In our fickle climate these are marvellously common, and they are also among the most powerful of all causes of mischief among Roses. The multiplication of Perpetual and very late-blooming Roses has greatly weakened the cold-resisting powers of the Rose, and opened out, as it were, the citadel of life to the ingress of cold. The hardiness of most plants may be measured by their dormancy, hardly any being frost-proof when in a state of actual growth. Hence the mischief wrought by early spring frost among late autumnal-blooming Perpetual and Tea Roses. At first sight only the flower seems cut off, which may seem a small matter, but generally the entire length of the wood is ruptured or injured from base to summit. These injuries are frequently unseen at the time, but as growth becomes active in the spring the frost-bites develop on the shoots into irregular-looking scars or bruises, that often destroy what seemed the most promising shoots. Fortunately for Rosarians, several simple antidotes to frost-bites are within reach—a paper cap, a wisp of straw, or long dry litter from stable manure, or, best of all, a small handful of the dried tops of the common Bracken, suffice to carry the tops of Tea and other tender Roses safely through frosts that have wrecked those unsheltered close by.

Canker.—Roses are not, as a rule, subject to this dire disease, though it occasionally affects them. When it does it mostly arises from frost-bite, or extravasated sap. It has, however, been so fully treated under diseases of the Apple, that readers are referred there for full practical instructions as to the best remedial measures. In severe cases an entire change of soil, site, and a fresh start with new plants, is the best course.

Extravasated Sap.—This is apt at times to follow on the heels of severe frost-bites and barbarous pruning, and it increases the evils of the other two, and hastens the disease or destruction of the Rose wood. The sap is mostly excessive in quantity or inferior in quality when it is thus forced through the bark, wood, or leaves. A poor condition of growth, or plethoric condition of the sap, is mostly the chief cause of this disorganisation or disease. The sap being rather excessive in volume, and often inferior in quality, is the more easily arrested by artificial or natural constrictions of stem or branch, wounds, bruises, frost-bites, drought, sudden alternations of heat and cold, &c. By moderating the volume of sap by root-pruning, or semi-starvation, by withholding water, &c., so far as practicable, there will be less danger of its oozing through in unnatural places, such as wood, bark, or surface of the leaves. Of course, all such abnormal diversion of sap from its normal courses and functions results in the debility and disease of the Rose-trees. A species of gangrene on the stem, and honey-dew on the leaves, is the direct product of the extravasation of the sap. The latter is not only a disease, disorganising the natural functions of the leaves, but it also acts as a decoy for Aphides, which come in such strength to feast on the honey-dew, that not a few have thought the Aphides the cause rather than an indirect effect of it. Very possibly, however, they are both to a considerable extent; as their feeding on the leaves causes more sap to escape, and thus the insect pests and the food for them grow in strength, to the corresponding weakening and injury of the Roses.

Honey-dew should be at once sponged or washed off, as otherwise its clammy saccharine qualities completely block up the pores of the leaves, and prevent them from performing any of their vital functions. The block is made the more thorough and severe by the excrementitious matter that the Aphides leave behind after consuming the honey-dew. This enforces the need of prompt cleansing of the leaves. But this is simply a local remedy. A more radical and constitutional one consists in watering the roots with a very weak solution of salt and water, at the rate of about a quarter of an ounce to a gallon, or a little old brine in the water. Whether this acts as a check on the absorbing powers of the roots, or shortens the supplies sent to the plant—that is, the leaves—is uncertain. Possibly it does both to some extent; but assuredly salt water tends to check honey-dew, and the oozing through of the sap in unnatural places and states generally, and as a remedy is as useful as it is safe, provided always that it is sufficiently weak.

Mildew.—This is one of the most virulent diseases among Roses in many places. Certain soils and sites favour its production and rapid development. If not absolutely so infectious as it is mostly considered, the same conditions produce identical results in similar localities with so much rapidity, that it generally over-runs a garden or house in a few days after its first appearance. Nor is it to be wondered at, for the air is probably filled with myriads of spores of the fungus called mildew, and these are ready to fasten upon any plant that is in a condition to afford them a proper nidus for their establishment and growth. It is a common saying, confirmed by observation, that severe and sudden checks produce mildew, and probably the chief cause of this is a slight exudation of their fluids on the pervious surfaces of their tender leaves and shootlets. On these prepared surfaces the spores fall, obtain a foothold on the saccharine bases, and speedily develop the perfect mildew, rendering the leaves and shootlets as white as a sheet. In this state it develops more spores, that replenish the air with seeds, which seem able to retain their vitality for months—perhaps years—and bide their time for suitable growing-fields, when they arrive. Three conditions or more seem needful for the growth of mildew: vital spores, which are probably always present, a prepared seed-bed—that is, leaf or stem—and a genial atmosphere. The first and the last are very much beyond our power, but the seed-bed we can control to some extent. First of all, protect leaf and stem from the very appearance of honey-dew, and as far as possible by care and culture against extremes of drought, moisture, heat, cold, weakness, and luxuriance. It is also of great importance that the root and top should be, as nearly as may be, forced to grow under parallel conditions; for example, the roots must not be parched while the tops are drenched by rain, nor *vice versâ*. Should the roots be too low or too wet, they must be lifted. All this to prevent mildew.

The first step towards the cure of mildew is prompt treatment; the moment that a leaf is seen whitened in part with mildew, pick it off and then dust the entire tree over with dry sulphur powder through a fine dredge. Some use sulphur vivum instead of the above, or mixed with it; but powdered sulphur, as fine as it can be made, passing it through a mortar if necessary to insure its being fine, and applied as dry as it can be made by sun or fire-heat without the risk of ignition, is best, and most easily applied. If out of doors, apply the sulphur in the early morning or late at night, when the Roses are dewed over. If there is no dew, spray them over only, then dust and leave the sulphur on for a day or two before washing off. Should any mildew reappear, dust again in a few days, and so on, till the fungus ceases. Sulphur is the only sure and certain cure, and unless the mildew has its seat in the unfavourable conditions of the Rose, it seldom or never fails to speedily arrest, or altogether cure, this troublesome pest.

Some gardeners prefer applying the sulphur in a liquid state, at the rate of a pound to a gallon of water, and an ounce of black soap, the whole boiled for half an hour, thoroughly mixed, then another gallon of water added to it, and the leaves and shoots dipped in the mixture, or the same carefully syringed over the affected parts. But the liquid is no more effective than the dry sulphur, and it is besides more difficult to apply and ruinous to the appearance of the Roses.

Red Rust or Orange Fungus.—This is a far worse disease than the mildew; it is not only that the colour is different, but the destructive force and the mode of attack. The white mildew spreads itself with about equal thickness over the entire surface of the leaf or boughs attacked; the red rust gathers itself together into little heaps, each centre forming the nucleus of fresh colonies, and thus it distributes itself with an energy and rapidity almost unknown to any other pest or disease of the Rose. This and mildew, and almost all the ills Roses and other plants are heir to, used to be called blight, and the term is most expressive in regard to the red rust or orange fungus, for so rapidly does it spread that the fairest, cleanest, sweetest Rosary of to-day may be utterly ruined or blasted and marred with red rust the day after to-morrow. Its effect on the trees is also most disastrous; its touch seems to paralyse their vital force, and to an alarming and disastrous extent confuse and derange their vital functions. The functions of the leaves are deranged, their verdure lost in huge patches of brownish-red, their free growth is arrested, the flowers dwindle in size, the plant droops into weakness, disease, or death.

Comparatively little is known about the origin of red rust or orange fungus. It certainly is not begotten of cold, as many affirm to be the case with mildew. On the contrary, it mostly appears during or immediately after a spell of hot, dry weather, of shorter or longer duration. Plants also the most fully exposed to the full force of the sun suffer most from red rust. Hybrid Perpetuals too are, as a rule, more subject to it than Teas, Noisettes, climbing, or other Roses. So much is this the case that the writer has never seen red rust on an Ayrshire, Boursault, or Banksian, or common China Rose. But these facts are given as data for the future rather than guides for the present.

Unfortunately we have but little to offer in regard to modes of prevention or cure of this disease. Heavy root waterings and surface mulchings in dry weather have proved the best antidotes against this most dire disease. The choice of a Rosary shaded by trees or buildings from 11 a.m. to 2 p.m. throughout June and July would also probably mitigate the evil. Prevent any and all sudden checks to the Roses during the growing season, and try so to order blooming and pruning that the wood shall be of moderate size and well matured before the winter.

During the period of perfect dormancy, wash over the trees carefully, branch and stem, right down to the collar, and under it, with clean soft water, to which has been added a wine-glassful of paraffin to the gallon, removing all loose bark in the process, and working the mixture well into every crevice and cranny. During the time the orange fungus is on the Roses, great care should be taken not to allow an atom of it to fall on the soil, and in the early autumn the whole surface soil of fungus-affected Roses should be carefully scraped off bodily and charred, and returned, or used for other purposes, and fresh soil, compost, or spent tan, a capital antiseptic, put in its place.

The only cure, such as it is, consists in picking off the first colony, and pegging away at the fungus, and the leaves it is found upon, until not one speck can be found. All sorts of nostrums, such as sulphur, powder and liquid; caustic lime, applied hot; soot; mixtures of mineral oils and sulphuric acid, and many others, have been used, to little or no purpose. Persistent hand-picking, carrying carefully away and burning all the infested leaves, handling them softly as if one loved them, for fear of distributing the spores, are among the only known methods of subduing this, one of the very worst of all the Rose pests.

The Gout.—This is not a new disease among Roses, though the Maréchal Niel has developed it into new size and importance. The older and more modern Rosarians were more or less familiar with protuberances on the stems or branches of Roses and other plants. These they designated gangrene or dropsy, the latter name indicating the character of the disease, which was mostly met with in a state of decomposition. This, however, is not at all the disease that has appeared in such pronounced forms on our Maréchal Niels, and is occasionally met with in a few others, mostly, however, in such immediately above the point of union of the scion with the stock. The swelling varies in size, and consists of bark and wood in a state of enlargement, and a condition of partial or complete decay from dry rot. It was mostly thought to arise from deficiency of conductive power between the scion and the stock, but this theory is now exploded, as it breaks out anywhere on the Maréchal Niel Rose, either in the open air or under glass, and goes on enlarging and deteriorating until the dry rot severs the connection between the stem or top below and those above the wounds, and thus the whole of the Rose above the gouty portions dies.

The disease seems to originate partially in bruises and constrictions, for the swelling may invariably be found above neglected ties or old wounds. It must, however, be added that the gout is often found where no such causes exist. So far this new disease, or rather probably old one, arising with fresh virulence, has baffled cure. It takes it about three years to eat through a bole, or thick bough, and the plant must either be cut back or taken up, fresh sweet soil added, and a young or fresh one planted in its stead. The disease is so prevalent and so fatal among Maréchal Niels, that every one should keep a good stock in reserve. It is wise to see that every stem and branch has free space and fresh ground, that all rough bark be removed, and that any swellings or protuberances are dressed with cart-grease or train-oil; when first observed these may defer the work of destruction, should they fail to prevent or cure the disease.

Suckers.—Where these abound to a great extent they are at once a proof and a cause of disease, in so far as the latter may be described as disorganisation and subversion of vital functions. The sap designated for the nourishment or further extension of the top, is quite wasted in growing suckers, and the top is starved into weakness and disease in consequence of its supplies of food being thus diverted and perverted. This misdirection of energy and vital power is one of the most frequent causes of failure in not a few gardens, and where it prevails to any great extent it becomes a disease in itself. It sometimes arises from the working of weakly Roses on strong stocks, at others from repressive pruning, and yet others from the attacks of mildew, red rust, and Aphides, suddenly arresting top growth, and thus shutting up the natural outlets for the sap.

The following are among the most powerful causes of suckers: the hardness and dryness of the bark of the stems; the exposure of their roots during winter, the reckless destruction of such roots through careless digging, unsuitable soil, &c. The roots should also be carefully overhauled for these before planting, and every bud or shoot likely to run into a sucker be removed. Vigorous suppression, so fast as they are produced, has a tendency to stop their production. After a continuous contest persistently waged, the suckers give up in despair, and turn their supplies into roots proper for the nourishment of the plants. The old plan of using a small hay-band around the stems of Roses and other trees, and keeping it more or less moist throughout the growing season, was a useful antidote to suckers, as well as the practice of making vertical slits in the hardened bark—the first acted as a gentle emollient to the stem and assisted its enlargement; the second gained a similar advantage by a swifter surgical operation, that left many dangers, such as those of canker, gangrene, &c., in its train. Both, however, fostered and prepared the stem for the freer and more copious conveyance of fluids, and in so far as they did this they suppressed or abolished suckers.

Imperfect Union between Scion and Stock.—This is another very common cause of disease; the smaller the uniting surfaces between the two, the less cause of disease; hence the superiority, on the ground of health and longevity of the future tree, of budding to grafting for Roses. Owing possibly to the extreme hardness of the wood of the Rose, the union between the scion and the stock, where the former are grafted, is seldom so sound and perfect as similar unions are among Apple or Pear trees.

Careless budding not seldom leads to future unsoundness and permanent disease. The crown of the stem of the stock is very often the cause of this. The general practice of budding on one or more of the side branches, some little way down from the crown of the stock, leaves the latter finally bare and uncovered; and though certain smears, such as paint and tar, are used to render the barkless crown waterproof, this may render the matter worse by preventing the possibility of a living cap being provided by the bark. The buds on the branch grow so rapidly that the end of the branch is soon lost sight of in the advancing growth of the bud. Were stem-budding generally adopted and the head of the stock carefully cut over close to it soon after the bud had taken, or the following spring, the disease of stem-rotting and pith deterioration would be greatly checked if not actually abolished. As standard Roses are now generally manipulated, the wonder is less that the wood often perishes and the pith suffers through the exposure to all weathers of the barkless, bald, non-waterproof head, than that so many of them live so long under such unnatural conditions.

Insect Pests and Remedies.—Although, as we have seen, disease abounds among Roses, insects are still more numerous. In fact, it is doubtful if any plant is preyed upon to such a serious extent by insect pests as the Rose. They are of all forms, families, colours, and sizes, and are at work night and day, seeking what they may devour. Their rate of increase is so rapid in point of time, so enormous in regard to numbers, that the soberest facts concerning their generation and countless hosts would read like exaggerated romance. This is not written to cause despair, but stimulate enterprise; for powerful and numberless as are those devouring hosts, if encountered in time and warred against with skill and energy, they may all be vanquished before any great injury is done to the Roses.

Aphis rosea.—This is well named; for though the genus is one of many species, there is not one of them probably so common and so destructive as the Green-fly, so well known for its evil doings among Roses. The old flies deposit their eggs in the autumn, both parents being at that time winged, and perfect males or females. After performing this duty the old flies die, and the young broods come forth almost with the first flush of sunshine in April or May. These young ones are however wingless, but have the power, by a process resembling an internal budding, of producing numbers of other Aphides like themselves, and this kind of reproduction proceeds with rapidity all the summer. As the season advances, winged insects of both sexes are produced instead of these wingless ones, and these produce fertile eggs for the next season, as before. Often in the autumn the Green-fly increases to such a prodigious extent that the insects fly in clouds through the air, and become to the Roses a veritable plague or blight.

Even before they are endowed with wings they are by no means rooted to one spot, for a league seems to exist between the Aphides and the Ants, in which the principle of so much service for so much wage is strictly adhered to. The Ants carry the Aphides into fresh feeding-grounds, and straightway milk some of the sweet juices out of them as their reward.

All this is stated to enforce the only useful way with the *Aphis rosea*. Slay the first, and you slay in effect a thousand, tens of thousands, and millions in embryo. And besides they are so easily killed at first. With age they become much more hardy and tough, and such killing dressings as tobacco-water and quassia-tea have far less deadly effect on them.

The mechanical remedy is perhaps after all the simplest, easiest, and best, and no implement of any kind is needed but the finger and the thumb. Gently squeeze the insects between these, and see that all are squashed or disturbed. If sufficiently so to fall to the ground they seldom rise again; though prompt killing on the boughs removes the possibility of their coming back. The Aphis brush is useful for the same purpose. It somewhat resembles a pair of longish sugar-tongs, with flat grippers instead of bowls. They are also lined with fine hair inside, so that the Aphides-infected branch is seized sufficiently firmly to remove the Aphides, while the hair buffers prevent the brush from injuring the leaves or bruising the shoots. The brush is then drawn upwards on the line of growth, and the find of Aphides shaken or combed out. A fresh hold is then taken, and so on, till all the Roses are cleared.

A thorough vibration through the plant, caused by giving the tree a sudden shake or tap, will make all the fullest, fattest Aphides fall to the ground. This should always follow the above. Any left after these processes are mostly on the move, and a sudden shake or vibration will bring most of them to the ground. When once there they seldom succeed in returning. However, some, to make assurance doubly secure, provide an adhesive bed for them to fall upon. The most killing bed is formed of one and a half parts of Burgundy pitch, and one of train oil. The pitch is slowly melted, and when dissolved the oil is added, and thoroughly mixed, and this mixture continues liquid and sticky to a fault. A thin board, or cardboard, or thick paper, smeared over with this, and held under Rose-trees by a simple loop, with a slit in one side for the stem of the Rose, and a hook to hold by, will give account of any Aphis or caterpillar that drops down on it.

Tobacco-smoke, either pure or produced from paper, rags, or refuse dipped into tobacco-water or juice, proves sudden death to all kinds of Aphides, either out of doors or in, if the smother of smoke is only made and kept sufficiently dense for, say, ten minutes. A smoke-proof bag, to hold the heads of standard or other Roses, should be tied closely round the stems. Apply a blow-pipe of sufficient force to fill it and keep it full for the above length of time, and every living Aphis will be cleared off.

To make security doubly sure, so soon as the bag is removed dash water through the garden engine over the entire smoked plant or buds. This completes the work of clearance by dashing any sick Aphides to the ground, to rise no more.

Tobacco, in dust, as snuff, or solution as tobacco-juice or water, either pure or in combination with soft soap, and quassia chips, are among the most potent of Aphides-killers.

A capital liquid dressing may be made of a pound of good tobacco, and half a pound of quassia chips, Gishurst compound, or soft soap, the whole being carefully dissolved in boiling water, or boiled for a quarter of an hour in sufficient water to dissolve and incorporate it thoroughly. Then run it through a sieve and add to this powerful decoction from twelve to fifteen gallons of water, and apply the mixture carefully to the Aphides, or dip the branchlets into the mixture. It will instantly kill all it touches. Such powerful dressings should never, however, be applied during the heat of the day, but in the afternoon or evening, be left on all night and washed off in the morning.

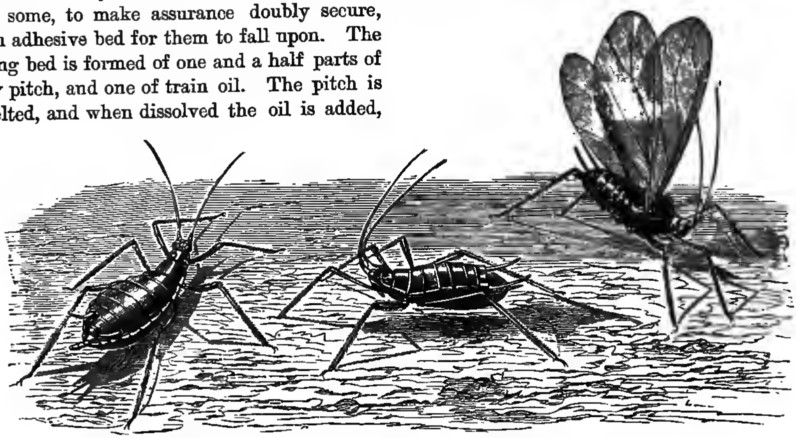


Fig. 49.—The Rose Aphis, Wingless Females and Winged Male.

Snuff, the finest-ground and driest that can be bought, should be dredged on while the shoots are wet. The Aphides fall down on the heels of the dredging, dead. Common and cayenne pepper are generally effective, but though they hardly smell so vilely among Roses as tobacco in any of its forms, yet their presence is about equally objectionable and even more dangerous.

Carbonate of ammonia, or smelling salts, dissolved in water at the rate of an ounce to a gallon, proves most destructive to Aphides, leaves a pleasant odour behind it, and proves, so it is said, a stimulating diet for the Roses into the bargain.

Rose Maggots.—Rose-growers are all too familiar with the worm in the bud that wrecks so many of their best blooms, though the moment we try to determine which worm, we are met with considerable difficulty, not from any lack of worms, but their super-abundance. For as each moth in due season brings forth its worm, grub, or caterpillar, and the majority of these feed on Rose-leaves, petals, or flowers, or wood-buds, and as the species and varieties of moths are legion, it follows that almost each bud has its worm, and at times a good many of them have two, and the writer has seen even three or more in one bud. Most of the worms and caterpillars are 'cute and wary, and the hunting of them with success, so as to make a full bag, needs great prudence and dexterity. The moths even in their grubhood are quick to hear, see, calculate chances, bolt suddenly, lie at ease on their bed, hug it closely, assume its colour, roll themselves up tightly in a leaf, take a wild leap for life and safety to the ground, hide in the long grass or under the clods, or heave themselves off their feeding-grounds with a line till the season of danger is overpast. One learns to respect such foes as one notes these and other traits of marvellous instinct; rapid as thought in action, and often, from the Rosarian's point of view, all too efficient in saving their lives. True, they are small, but their numbers, resources, and skill raise them to the rank of foes worthy of the Rosarian's steel, or rather his fingers. For really our best and surest receipt against the grubs and caterpillars is the very old one of catching them alive. A good deal may be done to reduce their numbers by catching the moths that lay the eggs, that hatch the grubs, that devour the Roses. And yet more may be accomplished by rooting out, or smearing in, or destroying the pupæ or chrysalides in their lairs. Yet the Rosarian's best chances of offensive war often lie among the grubs and caterpillars. Pick them off by hand, tap them off by sudden vibrations on to the ground or into sheets, and destroy them. Repeat the process day by day, and there will soon be few or none left.

Of the many worms in the bud among Roses, perhaps the very worst is the grub of the Bell Moth, *Spilonota aquana*. This is so very grub-looking that it hardly deserves the name of caterpillar. It has a black head with a black plate of mail behind it, as if to strengthen its head in its destructive work of scooping out the centres, or making tracks through Rose-buds. The body is of a dirty-brown colour, with a rough skin, its centre being larger than either end, a form that arms it with very great force and power. This moth is small for the size of the grub, being less than an inch across. It is of an ashy-white colour, with a dark brown patch on the upper wing, just against the body. The chrysalis is pale brown, and the cocoon is carefully laid up in a Rose-leaf or leaves. Unfortunately the grubs appear early—that is, in April, almost before either leaves or flower-buds are ready for them. This enables them to work with a maximum force of destruction, the leaves being small as well as tender, and not a few blossom-buds often pierced through by them and other caterpillars before they are half formed. Of course, once pierced by even such a small worm, the blossom is wrecked beyond recovery. The chrysalis is not of long duration, as the moths appear in June, when war should be waged against them by catching them with nets, or other methods.

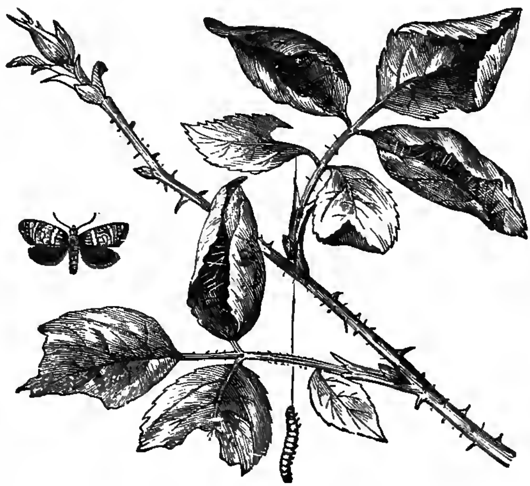


Fig. 50.—Tortrix Bergmanniana and Larva.

Another almost equally destructive variety of worm in the bud is the caterpillar of *Tortrix pyrastiana*. The caterpillar of this appears nearly a month later than the foregoing, and continues to work destruction throughout June. It mostly also joins the leaves together, to form its cocoon in. The caterpillar is greenish-brown, very active, and when disturbed immediately suspends itself on a thread.

Tortrix ribeana is very much like *pyrastiana*, only darker in colour, and it continues much longer in the grub state, and mostly rolls itself in one leaf instead of two.

Tortrix Bergmanniana (Fig. 50).—This is emphatically the Rose leaf-roller. Others roll up the leaves in ones or twos, this small caterpillar not seldom rolls them into scrolls, or rolls up every leaf on a branch or plant. It seems to turn the leaves up or partially over with a semi-glutinous thread, in order the more conveniently and safely to gnaw out and devour the centres of buds and leaves. The caterpillar is small, about half an inch long, thick for its length, has a black head, and a black plate near its hairy tail, the colour of the body varying from dullish green to yellow. It feeds all through May, then spins itself a soft silky cocoon, and goes into chrysalis, and comes finally forth as a butterfly in July. It is a rich mixture of orange, brown, and yellow, the upper wings being golden-yellow. As a rule the eggs are not hatched till the following spring, although sometimes they are said to be hatched in the early autumn.

Another small Tortrix, or Bell Moth, a good deal like this, and equally destructive, is the *Antithesia ochroleucana*. Its habit seems almost identical with that of the foregoing, with the exception that it neither spins a thread, suspends itself from the bough, nor seems to have any power of rising from the ground after reaching it. It is, however, one of the most destructive of all the worms in the buds, not only piercing them through and scooping out their hearts, but massing them into heaps for destruction; and should the buds resent such close packing it cuts them off their stems, and forces them into narrower compass for more convenient manipulation. These well-filled larders are, however, rather conspicuous, and if Rosarians are wide awake, as they mostly are, in vain will such nets be set in their sight, and these presumptuous grasping grubs will meet their reward—destruction for themselves and their bud-traps.

Another, and fortunately far more conspicuous grub, is the caterpillar of the *Noctua Psi* (Fig. 51). This is much larger, of a dark, almost black, ground-colour, and richly variegated with a light or yellow bar down each side, and a long hirsute embellishment, so that it is readily found and destroyed. The name of this insect suggests nocturnes, not the phase of art now so fashionable, but the habit of not a few of these grubs, that of feeding most ravenously by night, and one must time visits accordingly to succeed in catching them in quantity.

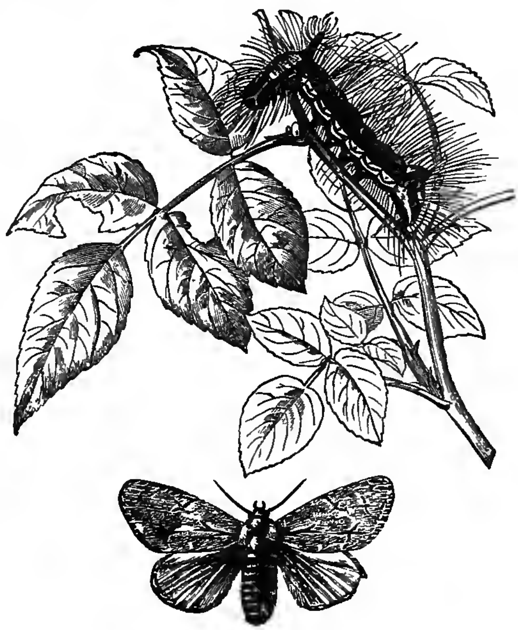


Fig. 51.—Noctua Psi and Larva.

Among other caterpillars that make havoc among our Roses are those of the Gold-tailed Moth, *Liparis aureflua*, popularly known as the Palmer Worm. These, however, as several others that ought to be named here, by no means confine themselves to Rose-diet. The Palmer Worm is frequently found on Rose-leaves, and also in the buds, and proves very destructive in some parts of the country.

The Winter Moth, *Hybernia brumata*, favours fruit-trees more than Roses. It, however, proves very troublesome at times, and as the chrysalis buries itself in the ground, it must be dealt with somewhat after the manner recommended for the destruction of Apple insects.

The caterpillar of the Buff-tip, *Pygaesa bucephala*, is among the largest with which the Rosarian has to wage war, measuring often two and a half inches in length, with an area in proportion.

The Gothic Moth caterpillar, *Naenia typica*, is also met with occasionally, and when found on the Rose, is said to be very destructive in some localities. The caterpillars of the Gothic and the Gold-tailed Moth sleep through the winter in that state, so that they are ready to come forth on their work of destruction so soon as a few warm days foster them into life, in the early spring.

Only two more caterpillars can be noticed here—those of the Jack Moth, *Bombyx neustrea*, and those of the Vapourer Moth, *Bombyx* (*Orgyria*) *antiqua* (Fig. 52). The first, though by no means specially a Rose insect, works sad havoc among Roses when it once settles among the leaves or buds, for it seems as partial to the petals of the half-open bloom as to the leaves. The caterpillars are large and gregarious, all helping to spin a general house over the community, from whence they issue forth at feeding-times with a destructive force that carries most of the leaves and flowers before them. To see twenty or thirty of these caterpillars, each about two inches long, marching out to the feeding-grounds, and cropping them almost bare as they proceed, is a sight to sadden the most sanguine Rosarian. Fortunately the caterpillars of the Vapourer Moth feed on Limes and other trees as well as the Rose; but when they do attack the latter, no other insect can inflict greater injury in the same length of time. Fortunately they are sufficiently large to be seen with ease, and then can be rapidly collected and destroyed.

Besides destroying the caterpillars, something may be done by attacking the moths and the chrysalides. The former may be caught by hand or nets, and also probably by bats and birds. The latter may be smeared over or plastered in. Eggs may also be rooted out or destroyed from hollow crevices, dry leaves, or crotches of wood or bark. The trees may also be rendered nauseous and distasteful for the caterpillars, moths, &c. A dash of paraffin or other cheap, strong-smelling mineral oil, methylated spirit, carbolic acid, &c., renders leaves or buds nauseous to the moths and poisonous or unpleasant eating for the grubs. Tobacco-water, strong sewage, manure-water, in which guano and soot are strong ingredients, have severally deterrent results, and a weak solution of carbonate of ammonia, or ammoniacal gas liquor, strikes terror into the whole race of moths, grubs, and caterpillars.

One word must be added as caution against a grub that is not often found on Roses in this country, unless when they are grown on old fat grass-lands, but which works wreck and ruin among them on some parts of the Continent. This is the grub of the common Cockchafer, *Melolantha vulgaris*. This grub exceeds all others in size and durability, the insect living in the grub state for three years before its conversion into the perfect beetle, and coming forth with such numbers and force as to consume, or utterly destroy, every verdant thing, Roses included, within their reach. In winter they bury themselves at a depth of a foot or more in the ground, so that they are somewhat difficult to reach. Fortunately it has very limited powers of locomotion, and being the largest among grubs, it is not difficult to discover it at work, and to pick it up and destroy it. The grubs, as well as the perfect insects, may also be poisoned with chemical pastes, or decoyed and trapped by attractive vegetables, such as Lettuces or Potatoes. These should be laid in proximity to Roses and examined daily, and the finds of Cockchafers, either grubs or finished products, destroyed. The danger of these pests in force is seldom imminent in this country, nevertheless it is important to keep a sharp look-out and destroy the first white worm seen.

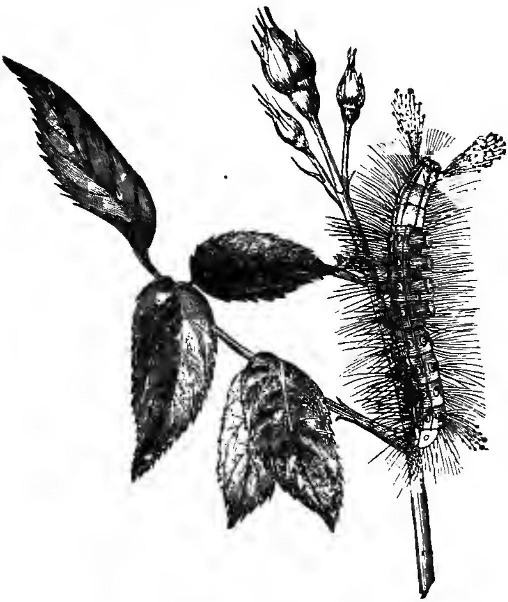


Fig. 52.—Caterpillar of Vapourer Moth.

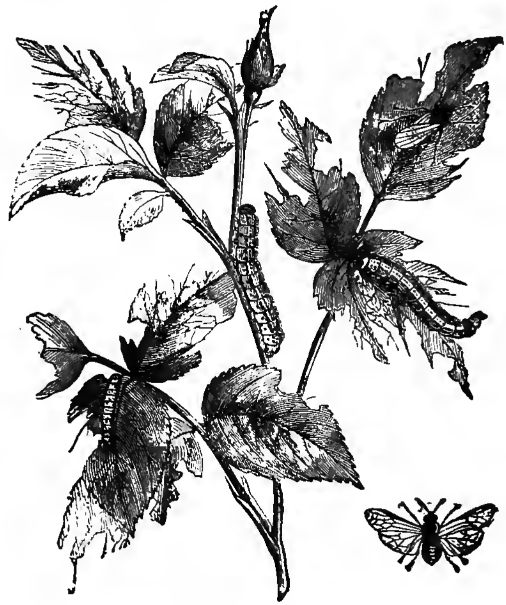


Fig. 53.—Tenthredo Rosarum.

Saw-flies.—Next to the caterpillars of the moths, and hardly second to them in destructive force among the Roses, are larvæ of the Saw-flies. There are many species, such as *Tenthredo* (*Cladius*) *difformis*, *T. agilis*, *T. zona*, *T. cincta*, and *T. rosarum* (Fig. 53). The Saw-flies, as their name implies, do not cease to injure the Roses after growing out of the larva state. The fly, with its saw-like implements, cuts and carves the Rose branch or leaf about as it lists, now cutting a longitudinal section along the bark of the young twig, just like a slit for budding with the exception of the cross, or T-cut; and yet the slit, on examination, is found to be anything but regular or smooth; a series of atoms are chipped out with the intervening chips left in, with the result that each egg, when laid, has its own separate cell prepared thus for it by the saw-like appendages.

In other species the eggs are laid across the twigs, little niches being rather chopped than sawn out for their reception. The eggs are then glued in position in true carpenter-like fashion. They also grow after deposition, a rare phenomenon among eggs, and one that would be welcome to paterfamilias in winter among those of fowls when they average twopence each. The larvæ, so soon as hatched, of some of the species, such as *T. cincta*, immediately make for the pith of the Rose, and work down into and through it, carrying disease and death to the leaves on their passage. So soon as they reach the harder and older wood of the Rose, they are brought to a forcible stop, change into the pupa state, and rest in safety, unless the shoot is carefully cut back to the old wood, with the pith intact, and all above that point immediately burnt. Others, such as *T. rosarum*, feed chiefly on the leaves or part of the leaves, that is, the soft cellular tissue, leaving the harder veins like skeletoned leaves as relics of their destructive power and fastidious taste. The larvæ are very small, pale yellow and whitish. This is a double-brooded species, the larvæ appearing in June and also in September; as is *T.* (*Athalea*) *rosa*, which has broods in June and July. The latter lays its eggs on the upper surface of the leaf, and they either lack the power or the will to turn over. Hence, they remove the top covering and surface of the leaf, and seldom pass below the under side or rib. In *T. difformis* there is a considerable difference between the two sexes, hence probably the name. This species is also perhaps more timid and easily detached than most of the others. It has been said also to affect standard Roses more than any of the other species. The fly is only a sixth of an inch long, and about a third of an inch broad across the extended wings. The larva is pale green, about half an inch long and stouter in proportion. The flies (and the majority of them) are a mixture of yellow and black. They generally roll themselves up in a ball when disturbed, and this, combined with the fact of their dropping promptly when the bushes or trees are agitated, points to a ready mode of destruction, by sharply tapping and shaking the Rose plants and leaves; the shoots should also be collected and burned so soon as they reveal traces of the Saw-flies. The flies are far from being so active as some, and many of them might be caught and destroyed. Nauseous and poisonous devices are also as effectual against the larvæ of Saw-flies as the caterpillars of the moths.

The Rose-leaf Miner (*Tinea Ruficapitella*).—This tiny insect is only about a sixth of an inch long, and slender in proportion. This, unlike the larva of the Saw-fly, eats the upper or under surface of the leaf, not any part of its substance bodily, but channels its own way in mere lines through it, and when full-grown or fully fed, about the end of the season, it crawls out, makes its way down the stem, and finds a snug place to change into a chrysalis, to await the completion of its life in a moth and egg-layer, next spring. Leaves thus tunnelled will reveal the injury, and also the insect, if merely held up between the eyes and the sun, and should be immediately picked off and destroyed.

The Rose Beetle (*Cetonia aurata*).—This ought properly to have been noticed with the May Bug or Cockchafer. It is very destructive in some localities—not as a grub, but a perfect beetle. The wings and body are a beautiful mixture of green and gold, and it is about three-quarters of an inch in length, and, unlike many of our foes, it is bold and brave, coming in the fierce light of the warmest sunshine with a frankness and force as if it were monarch of every Rose it surveys. After flying around a few times with great force and fury, it plunges all of a sudden into the heart of a half-opened bud or choice bloom, and proceeds forthwith to rend, bruise, scatter, and devour the petals and any stamens and pistils there may be found on the flower.

The Carpenter Bee (*Megachile centuncularis*)—It may almost seem absurd to suppose that a veritable bee, endowed with all its gregarious faculties, and the venomous sting of a bee, should bite and devour Rose-leaves, and even small twigs. The bee is about half an inch long, of a brown-black colour, the thorax covered with wool. It builds its nest on the ground, and this particular species of the Carpenter Bees chooses to build and enlarge it with the leaves of the Rose. Others elect other living flowers or plants, such as the flowers of the Poppy. The bees whisk round the Rose-bushes for a few minutes, apparently looking out for a suitable leaf, when they light upon it, grasp hold with their feet, and cut out a large, roughly semi-circular piece, often as large again as the base of the bee, and fly off with it to their nest, returning again and again so rapidly that half a dozen or so of them will seriously disfigure a Rose-tree in the course of a day.

The only remedy consists in the destruction of the bees, for it is impossible to check their ravages should they happen to have a nest, generally an old mouse's hole, or some such place under ground near to the Rose-trees. It is somewhat dangerous to tease the Carpenter Bees, as their sting is sharp, prompt, and venomous, but they may be followed and easily overtaken and destroyed when heavily weighted with a fragment of Rose-leaf many times the size of themselves. The nests may be taken in the usual way by smears, smothers, or explosions, such as tar, turps, and gunpowder.

Galls and Gall-flies.—These seldom abound to such an extent as to become a nuisance. On the contrary, a few of them are so interesting as to add to the enjoyment of any Rosary. Rose galls or burrs, as they are sometimes called, are really among the most curious and interesting of natural phenomena, rather numerous on the Dog-rose and Sweet-briar, but rare among garden Roses. No one seeing the curious rosette of crumpled leaves, arranged mostly in circular form, very much resembling the largest moss of the most richly-clothed Moss-rose, greatly extended and tastefully arranged, could imagine that this object of interest and beauty was not only the home of a small worm or a colony of such, but in some mysterious way was the product of their instinct or genius. The perfect fly only measures a line and a half in length, and the maggot that lives under this rich canopy of green is smaller still. There seem to be several species if not distinct families of Gall-flies, such as the *Rhoditis rosarum*, and the *eglanteriæ;* but the best-known Rose Bedeguar, or Rose Gall-fly, is the *Cynips rosæ*. The term Bedeguar was the common name for these galls when they were used in medicine. The small fly makes a slit in the bark, somewhat in the same way as the Saw-fly, and it is supposed that not only does the fracture check the sap, but possibly the insect poisons it, and so deranges its circulation at the same time. Be that as it may, the punctures, the deposit of the eggs, the presence of line-like maggots, either separate or all combined, result in the production of one of the most beautiful and complicate products within the whole range of vegetable life. Nothing can be easier than to cut off and destroy the galls by burning, should they increase to an extent and in directions where they are not wanted.

The Earwig (*Forficula auricularia*).—These are so well known that description is useless; they are somewhat closely related to the beetles, and like some of them, are most destructive in the perfect form. They are furnished with a powerful projecting forceps, a most formidable weapon of defence and offence. They increase rapidly, and are most formidable in their destructive and consumptive power, eating Roses, fruit, and almost anything that comes in their way. They also choose the choicest Rose-blooms for laying-places as well as feeding-grounds, especially in the autumn, and thus mar the enjoyment of many a Rose in hand or vase of Roses on table. They abound especially in old neglected gardens in the close vicinity of thatched houses, barns, or other buildings, and wherever neglect, decay, and slovenly gardening finds a home. They hate constant disturbance, the rooting out of their lairs in decayed boughs or branches, hid away under old shreds, in holes in walls, even in the ground near the boles of trees. Using the hoe freely among and around Roses, bothers the Earwigs into shifting their quarters. They may also be routed out or snared in dry cut reeds and the hollow stems of any umbelliferous plants, trapped in pots baited with cold potatoes covered with hay; all traps and decoys to be examined, and the contents destroyed daily. Such tactics pursued with diligence will speedily make an end of the troublesome pest of Earwigs among the Roses.

Scale on Roses (*Chermes rosæ*) (Fig. 54).—This —either White, which is emphatically the Rose Scale, or Brown, which is far less common—is mostly a proof of neglect either just then or at some previous period in the history of the Rose. The illustration shows an exaggerated example of White Scale allowed to do its worst, and when a Rose gets in such a condition it is rather difficult to clean it. A hard, dry brush, or a small one dipped in soft-soap lather or a powerful mixture of Gishurst, is the best means of cure. These should be applied when the Roses are in a dormant state, and there is no complication with green leaves and tender shoots.

Frog-hoppers (*Cicadas spumarea*).—These do comparatively little harm to the Rose, though they will greatly mar their enjoyment in gardens where they are prevalent. The white masses of froth are what are called the cuckoo-spit, or toad's spittle. They are really the products of a small brownish-green insect, about a fourth of an inch in length; the froth is simply a concealment or baulk for the larva. The latter has the property of reproducing the spittle if it is removed. The simplest mode of destruction is to carefully remove the froth, and the larva found in its centre or at its base. Dustings of quicklime, soot, and sulphur also tend to check the cuckoo-spit, and every possible means should be taken by hand-picking and these dressings to clear the Roses of this unsightly and unpleasant insect and its appendages.

Thrips.—Unless on very dry and poor soils, these seldom put in an appearance out of doors. The insect, however, frequently attacks Roses under glass, especially when subjected to a high temperature and a dry atmosphere. A dip in tobacco-liquor saturated with soft-soap, and a more humid atmosphere and abundance of water at the roots, will mostly make an end of Thrips on Roses.

Red Spider (*Acarus tellarium*). — Unless on dry sites or soils, or in exceptionally hot seasons, this seldom seriously injures Roses in the open air. It frequently, however, infests them on south walls, and especially if the borders are dry. Root-soakings and overhead deluging are the best antidotes against Red Spider; persistent dusting with sulphur, first damping the surface to make it stick, will also speedily either suffocate or poison this small but destructive insect. Unfortunately it generally accumulates most thickly under the leaves, where there is most difficulty in reaching it or keeping it smothered with sulphur-dust, or wet through. Thus kept dry by the waterproof canopy of the leaves, it returns the service by eating into the parenchyma of their lower surfaces and arresting their vital functions. The water must be sprayed upwards to the spider, and the leaves be turned up to give them a full dose of sulphur. Like Thrips, however, Red Spider on Roses is mostly the proof of neglect or bad treatment.

Fig. 54.—Rose Scale. 1, scale of natural size; 2, larva magnified; 3, branches encrusted.

Insect Friends.—*Ants.* — Yes, so have written many. Save the Rosarian from such friends! Ants are not only a real pest, not to say danger, among Roses, but they help, not hinder, the enemy to the utmost of their capacity. The popular fallacy that they kill and eat Aphides has long been exploded. On the contrary, they find them legs until the winged ones appear, which can very well dispense with the Ants as carriers. The Ants make a thoroughfare of our Rose-trees, form nests among the roots, worry the bole, eat the Rose-blooms, convert our best blooms into drawing-room lounges, and not seldom startle or sting our fair sisters while they are luxuriating among the Roses. Away with them from Rose-trees! Allure them with sugar and honey, or disgust them to a distance with guano and sulphur dressings, dose them with weak solutions of paraffin, and, when the distance is safe, scald them out root and branch with boiling water.

The Lady-bird (*Coccinelliana septempunctata*) is of quite a different character. This does not seem to injure the Rose in any way, and it assuredly eats

Aphides. These insects deposit their pupa on the upper side of the Rose-leaf, mostly among the Aphides. It is nearly round in shape, and after a time the colour and form of the insect may be seen through. No sooner are they hatched than the larvæ feed on the Aphides to the right and left of them, and speedily reduce their numbers. On no account should a Lady-bird be destroyed under any circumstances, as they are wisely set to break and reduce the power of vegetable-eating insects.

What are called the Ichneumon flies deposit their eggs on or just under the skin of other caterpillars, the larvæ, when hatched, consuming their juices and sending them into a galloping consumption.

Fig. 55.—Golden Eyes; 2, eggs.

But space will only permit of one more counteracting insect being noted here. But this is a host in itself, and is popularly known as the Golden Eye (*Chrysopa perla*). (See Fig. 55.) It is one of the most beautiful of all insects, and, alas! it has an odour as bad or worse than that of house bugs. As it is needful, however, for Rosarians to know their friends at sight, and so spare them, it will be useful to wind up our dreary catalogue of insect enemies with a veritable friend. It is a nocturnal insect, and flies somewhat slowly, thus being more easily captured than most of those that ought to be destroyed. It belongs to the great family of Lace-flies, the name being derived from the reticulated character of its wings. It is a long, delicate-looking insect, unlike any other, excepting some belonging to the same family and performing equally useful functions. The eggs are placed on the tips of hairs of a semi-glutinous character, arranged in something of the form of a fan, a dozen or so of such hairs forming a nest; these hairs are first formed by the insect, and the eggs placed on the tops of them. So soon as hatched, the tiny larvæ fall or crawl down the threads, and fall foul of the Aphides and devour them with amazing rapidity. It is said that the insect forms its elevated nest only in the middle of the Aphides already doomed to destruction; and assuredly its eyes, which sparkle like jewels, and hence its name of Golden Eye, are sufficiently bright to take in the entire situation and act accordingly.

Aided by these and other insects, assisted by several beetles, wasps, and flies, hosts of birds, sudden and severe alternations of temperature that destroy myriads of insect pests in a few hours; by the mastery of man over nature, and a destructive, protective, and cultural skill, the rich heritage of the ages of the past as well as the latest knowledge of the present, it is hoped that all Rosarians will at least be able to keep their Roses healthy and clean, if they cannot quite grow them to the highest perfection.

MANURING IN THEORY AND PRACTICE.

By John J. Willis.

COMPOSITION AND EFFECT OF MANURES.

WHAT constituents does a manure contain? This is the first and most important question the chemist has to answer before he can furnish distinct information to the inquiries of the practical horticulturist. How does the manure operate? How quickly does it act? How long does its action continue? What is its worth? Manure operates only by means of the chemical substances it contains; these must be accurately ascertained before any exact data can be afforded respecting it. Were this all, the study of manures would be of easy application; for chemistry is now so far advanced as to be able to detect and define these elements even to the most minute parts. But of what use is it to the gardener to be informed that such or such a quantity of potash, nitrogen, phosphorus, lime, &c., is contained in a manure, if he is not told at the same time how these substances operate, and what is their practical value?

The following classification of manures, according to their ingredients and effects, may be of service to the gardener as a general indication of their value:—

I.—Manures Rich in Nitrogen.

(*a*) *Substances containing Ammonia or Nitric Acid* (Very rapid forcers).

Ammonium salts, nitrate of soda, nitrate of potash (saltpetre), guano, soot, gas-liquor, putrid animal substances—viz., blood, flesh, fish, urine, draining compost, rotten stable-dung.

(*b*) *Nitrogenous Substances that are Easily Decomposed* (Tolerably rapid forcers).

Horn shavings, glue, meat-meal, bones—dissolved, steamed, and finely ground; oilcakes of all kinds, brewers' grains, and stable-dung beginning to decay.

(*c*) *Nitrogenous Substances that Decompose with Difficulty* (slow forcers).

Bone-dust, crushed bones, leather cuttings, woollen rags, shoddy, wool-dust, and stable-dung.

II.—Manures Rich in Carbon
(Forming humus).

Stable-dung, straw, dead leaves, weeds, lawn and garden trimmings, sea-weeds, rotten vegetable mould, peat, and fern-brake.

III.—Manures containing Potash
(Strong forcers).

Potash salts of all kinds, kainit, wood-ashes, sea-weed, urine, brewers' grains, vegetable foliage, stems and leaves, building rubbish, street-sweepings, burnt clay and loam, and various marls.

IV.—Manures containing Soda
(Acting less freely).

Common salt, sulphate of soda (nitre-cake), soap-boilers' "under-ley," urine, soapsuds, soda-felspar and some other kinds of stone.

V.—Manures Rich in Phosphoric Acid
(Seed-formers).

Burnt bones, bone-black or animal charcoal, guano, raw bones, meat-meal, coprolites, phosphates, apatite, oilcakes of all kinds, brewers' grains, stable manure, and animal excrements.

VI.—Manures containing Sulphuric Acid
(Partly direct manures and partly absorbents of other manuring substances).

Superphosphate, gypsum, manures containing sulphates, ashes of pit-coal, peat, and brown coal.

VII.—Manures Rich in Lime.

Quicklime, chalk, superphosphates, marl, shell-lime, gypsum, wood and vegetable ashes, building rubbish, and soap-boilers' ashes.

VIII.—Manures Rich in Silica.

Ashes of all kinds, sand, straw, and stable-dung.

IX.—Manures that Ameliorate the Physical Condition of the Soil.

Lime, marls, loam, sand, chalk, pond-mud, road scrapings, vegetable mould, turf, leaves, long and undecomposed stable-dung.

Manure Effect.—The influence of manures upon plants has been proved by many experiments, and by the experience of both the agriculturist and the horticulturist. Thus the gardener is said to improve his Roses by adding manganese compounds to the soil, and to redden his Hyacinths by watering them with a solution of sodium carbonate. Wolff states that carbonate of potash promotes the growth of the stem and leaves of the Vine; and in the year 1879 Ville said: "Until lately I always thought that the *Leguminosæ* and the Potato were the plants which showed a special preference for potash, but the Vine distances them in this respect in a most surprising manner. In the case of the Potato, the suppression of potash manifests itself by a diminution of the crop; with the Vine, however, little or no fruit makes its appearance, and we virtually get no crop at all." This is shown very remarkably by the three diagrams illustrating the experiments with this plant. These were all grown in impoverished soil, and planted at the same time. No. 1 received no manure whatever, and a meagre growth was the result. No. 2 received a manure containing certain mineral constituents but no potash. A more vigorous plant was obtained than without manure, but scarcely any fruit. No. 3 received a complete manurial supply, consisting of a liberal amount of potash, and nitrogen in the form of ammonium salts. With these ingredients a full-developed plant was obtained with abundance of fruit. "Where potash is lacking, the leaves of the Vine do not attain their full development; in the month of July they become red and spotted with black; after which they become dry, and are easily reduced to powder under pressure of the fingers."

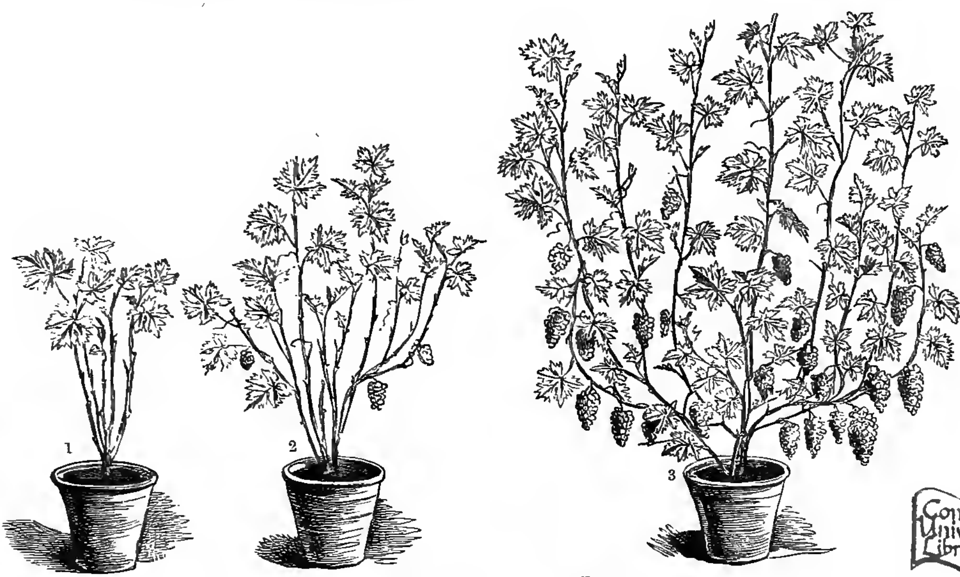
But the element which beyond all others must be considered the most valuable constituent in substances employed as manures is nitrogen, inasmuch as it especially imparts to manure its so-called "forcing power." The action of nitrogen extends to the whole period of the growth of the plant, from its earliest stage of leaves and stems to the full development of blossom and seed. If, however, nitrogen is to be rendered fit for the food of plants, it must first be converted by fermentation and decay into ammonia or nitric acid, which, combining with lime previously existing in the soil, will be easily and rapidly absorbed by growing plants.

That a supply of nitrogen really constitutes the "forcing" ingredients in manures may be proved by the gardener in the following manner:—Wrap the bulb of a Hyacinth round with a few thin horn shavings, and put it into the earth by the side of another without horn; the result by the former will probably be a plant double the size of the latter. Horn shavings contain little fertilising matter except nitrogen; it stands to reason, therefore, that it is to this substance we must attribute the extraordinary increase of growth made by the Hyacinth so treated. The same effect will be produced if plants which are cultivated in pots are watered with thin stale glue-water. But the nitrogen must first be set free by fermentation and decay; for this reason glue operates less briskly if applied in an undecomposed condition.

The increased product stimulated by nitrogenous manures is necessarily attended with an increased demand on the inorganic resources of the soil. It must be remembered, therefore, that the constant use of manures containing a large proportion of

Effect of Manure on Grass Land.—Our meadows, lawns, and pleasure-grounds comprise, as is generally known, not only a great number of genera and species belonging to the natural order *Graminiæ*, but also various members of other families of plants, among which far the most valuable in a pasture certainly is the Leguminous, or Clover and Vetchling tribe. Thus in our meadows, lawns, and pleasure-grounds there are associated members of almost every family of plants that make up the crops of the garden.

Experiments at Rothamsted on permanent meadow land show that there is a considerable range in the



Effect of Potash on the Vine.

nitrogen, without a sufficient supply of the mineral or ash constituents of plants, may for a time increase the yield, but the end will be exhaustion of the available mineral food. Experience shows, however, that the stores of available nitrogen within the soil are sooner exhausted and brought down to an annual minimum than those of the minerals.

A given amount of nitrogen as nitrate of sodium usually yields more produce than an equivalent of ammonium salts, and especially is this found to be the case in dry seasons. This fact is due to the greater solubility of the nitrate, or its products of decomposition, to their action on the subsoil disintegrating and rendering it more porous; thus affording a larger surface for the absorption and retention of moisture and manure and greater permeability to the roots, rendering the plants less dependent on the fall of rain during growth.

amount of produce yielded as hay by the various plots according to the character of manure employed. And with these great variations in the bulk of produce obtained, it is found that there is also a most striking difference in the botanical composition of the mixed herbage.

In the produce grown continuously without any manure, the average number of species found has been 49. Of these, 17 are Grasses, 4 belong to the order *Leguminosæ*, and 28 to other orders. The percentage by weight of the Grasses has averaged about 68, that of the *Leguminosæ* about 9, and that of species of other orders about 23 per cent.

In the produce of the plot the most heavily manured, and yielding the largest total crops, the average number of species found has been 19 only, of which 13 were Grasses, and 6 only of other plants; whilst the average proportions by weight have been

—of Grasses nearly 95 per cent., and of species representing other orders less than 5 per cent.

On the other hand, the plot receiving mineral manures alone—which are of little avail for Graminaceous crops grown separately in rotation, but which favour Beans, Peas, Clover, and allied plants—has given, on the average, 43 species. Of these, 17 in number are Grasses, 4 *Leguminosæ*, and 22 belong to other orders; but, by weight, the percentage of Grasses has averaged only 65, that of the *Leguminosæ* nearly 20, and that of species belonging to other orders less than 15 per cent.

Effect of Manure on Root Crops.—We now turn our attention to the so-called root crops; and the cultivation, habit, and uses of these plants are well suited to form a contrast to those of the cereal crops, or to those of the various species found in the mixed herbage of grass land. The results, previously quoted, of the Rothamsted experiments upon Wheat and Barley, members of the Graminaceous family, have shown that not only is the soil the main source of the nitrogen of these crops, but also that the character of exhaustion which the soil suffers by their growth is primarily nitrogenous.

The greatly varying forms and outward appearance of plants, implying essential differences in the sources of nutriment, have led, from but superficial observation of them, to false assumptions regarding their growth. Thus it is by some maintained that the large surface of leaf put forth to the atmosphere by the Turnip and allied plants bespeaks an almost exclusive reliance upon the natural resources of the atmosphere for their carbonaceous supply; and the direct application of nitrogenous manures has accordingly been recommended, with the view of favouring to the greatest extent the development of leaf as a means of securing bulb.

After forty years' experimenting at Rothamsted on various members of the root-crop family, Lawes and Gilbert say: "It is impossible adequately to state the bearing of the results in a few words, but the following are some of the most characteristic indications:"—

"1. Without manure of any kind, the produce of roots was reduced in a few years to a few cwts. per acre; but the diminutive plants (both root and leaf) contained a very unusually high percentage of nitrogen.

"2. Of 'mineral' constituents, phosphoric acid (in the form of superphosphate of lime) was by far the most effective manure; but, when this manure is used alone, the immediately available nitrogen of the soil is rapidly exhausted.

"3. Really large crops of Turnips can only be obtained when the soil supplies a liberal amount of both carbonaceous and nitrogenous matter (as well as mineral constituents), and when they are already available within the soil, or are supplied in the form of farmyard manure, rape-cake, Peruvian guano, ammonium salts, nitrate of sodium, &c., the rapidity of growth and the amount of the crop are greatly increased by the use of superphosphate of lime applied near to the seed."

EFFECT OF DIFFERENT MANURES ON THE GROWTH OF NORFOLK WHITE TURNIPS AT ROTHAMSTED.

Description of Manure.	Produce per Acre.												Average Weight of Bulbs.
	Bulb.			Leaf.			Increase over Unmanured.						
							Bulb.			Leaf.			
	Tons.	Cwts.	qrs.	Tons.	Cwts.	qrs.	Tons.	Cwts.	qrs.	Tons.	Cwts.	qrs.	lbs.
Without Manure.	0	13	3	0	14	1		—			—		0·11
Sulphate of Ammonia, 3 cwts.	1	13	0	0	18	0	0	19	1	0	3	3	0·22
Rape-cake, 10 cwts.	9	8	3	8	9	1	8	15	0	7	15	0	0·87
Calcined Bone-dust, 400 lbs.	10	4	1	3	12	3	9	10	2	2	18	2	0 92
Superphosphate of Lime	12	18	2	3	16	3	12	4	3	3	2	2	1·18
Superphosphate and Rape-cake	13	18	1	5	14	2	13	4	2	5	0	1	1·33
Farmyard Dung, 12 tons	17	0	3	7	7	3	16	7	0	6	13	2	1·61

Comparing the results here given, it is seen that the undecomposed bone-dust and the supherphosphate tend to increase the size and weight of the bulbs; while the effect of rape-cake alone, with its excess of nitrogenous constituents, is rather to enhance the leaf-forming tendencies of the plant, which it is true may probably aid carbonic acid accumulation from the atmosphere, but at the same time gives a less profitable appropriation of the plant-food resources within the soil. With an application of twelve tons of farmyard manure per acre, the greatest amount of total produce is obtained and the largest average weight of bulb. So far as supply of manurial ingredients is concerned, we may reasonably suppose that every constituent, excepting carbon, was given more fully in quantity, and more favourably for assimilation, in the combination of superphosphate and rape-cake than in the dung; yet the latter, with its greater carbonaceous supply to the root and root-fibres, yields the largest crop and the heaviest weight of individual bulbs in the series.

The effect of an equal amount of superphosphate of lime on land ploughed in the ordinary way, compared with that dug nine or eighteen inches deep in the previous year, is here shown :—

Manure per Acre.	Produce per Acre. Turnip Bulb. Tons.	Cwts	qrs.	Turnip Leaf. Tons.	Cwts.	qrs.	Average Weight of Bulbs. lbs.
Superphosphate, 11 cwts. (Land dug 9 inches deep)	13	8	2	4	9	0	1·20
Superphosphate, 11 cwts. (Land dug 18 inches deep)	14	4	0	4	4	1	1·30
Superphosphate, 11 cwts. (Land ploughed)	12	13	3	4	8	0	1·17

These facts indicate that the extent and direction of the *underground range* of the Turnip is very much dependent on the mechanical condition of the soil: the rapidity of bulb-formation and the amount of crop are greatest where the land is deeply tilled. The land dug nine inches deep shows a slight superiority over that which is ploughed, and shows the character of the conditions required in Turnip culture. It is universally known that *tilth* is of the highest importance to the favourable formation of bulb in *root crops;* and the best relation of bulh to leaf, and in fact the best acreage yield of bulhs, is in the lighter soils, where there is comparatively little obstruction to the development of fibrous root, and it is in these that the special efficacy of superphosphate has been most observable. And if the Turnip is to be valued for its bulh-formation, the aim of the gardener must be not to increase the above-ground organs of collection (the leaves), but the underground fibrous roots.

Effect of Phosphates.—Much controversy has recently occurred regarding the action of *dissolved* and *undissolved* phosphates, as affected by the amount of *free* phosphoric acid supplied to the soil by various artificial manures; it will be admitted by most horticulturists that, in order to be food for plants, phosphate of lime, like other constituents of plant-food, must be soluble to some extent in water, or in the liquid which passes through the medium of the root into the plant. The greater efficacy of phosphate of lime in bones in comparison with coprolite powder entirely depends upon its finer state of aggregation, and consequently upon its greater solubility in the form of bone-dust.

The following results, from Dr. Andrew Aitkin's report, of experiments conducted by the Highland and Agricultural Society of Scotland, at Harelaw and Pumpherston, confirm the opinion that there is great economy in using dissolved phosphates, rather than the raw material, upon those and similar soils.

Table showing Effects of DISSOLVED *and* UNDISSOLVED *Phosphates upon Swedes at Harelaw, and upon Yellow Turnips at Pumpherston, in the Season of* 1880.

UNDISSOLVED PHOSPHATES.

	Swedes. Weight per Acre.	Swedes. Dry matter per Acre.	Yellow Turnips. Weight per Acre.	Yellow Turnips. Dry matter per Acre.
	Cwts.	Cwts.	Cwts.	Cwts.
Bone-ash	157	16·6	297	24·0
Ground Coprolites	202	21·2	339	27·1
Bone-meal	206	21·8	273	21·8
Phosphatic Guano	223	23·8	275	22·0
Ground Apatite	177	18·4	193	13·7
Ground Mineral Phosphates	211	21·7	294	23·2
Aversge	196	20·6	278	22·0

DISSOLVED PHOSPHATES.

	Swedes. Weight per Acre.	Swedes. Dry matter per Acre.	Yellow Turnips. Weight per Acre.	Yellow Turnips. Dry matter per Acre.
	Cwts.	Cwts.	Cwts.	Cwts.
Bone-ash	241	23·1	385	31·6
Ground Coprolites	202	21·0	310	26·3
Bone-meal	246	24·8	308	25·2
Phosphatic Guano	257	26·2	334	27·4
Ground Apatite	236	24·7	390	30·8
Grouud Mineral Phosphates	228	22·8	385	31·6
Average	235	23·8	354	28·8
Excess with Dissolved Phosphates	39	3·2	76	6·8

Thus, the increase in the crop due to the dissolving of the phosphate is, at both stations, about 20 per cent.; the total amount of dry matter per acre is at Harelaw 15 per cent. more, and at Pumpherston 25 per cent. more on the plots which received dissolved phosphates, proving that the increase of crop is not due to water chiefly, but also to solid matter, or substances useful as food.

EFFECT OF MANURES ON SWEDES AND MANGELS.

Growth of Swedish Turnips, Year after Year, on the same Land at Rothamsted. Fifteen Years, 1856–1870. *Average Produce per Acre per Annum.*

Description of Manure.	Bulbs. Tons.	Bulbs. Cwts.	Leaves. Cwts.	Increase over Unmanured. Bulbs. Tons.	Bulbs. Cwts.	Leaves. Cwts.
Without Manure	0	11	3	—	—	—
Superphosphate of Lime alone	2	12	9	2	1	6
Mixed Mineral Manure.	2	16	8	2	5	5
Ammoninm Salts, alone	0	13	3	0	2	0
Nitrate of Sodium, alone	0	19	4	0	7	1
Mix. Miu. Manure and Ammonium Salts	4	12	14	4	1	11
Mix. Miu. Manure and Nitrate of Sodium	5	2	16	4	11	13
Farmyard Manure	6	4	17	5	13	14

Growth of Mangel Wurzel Year after Year upon the same Land. Four Years, 1881–84. *Average Produce per Acre per Annum.*

Description of Manure.	Bulbs.		Leaves.		Increase over Unmanured.			
					Bulbs.		Leaves.	
	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.
Without Manure . .	4	17	0	18	—		—	
Superphosphate of Lime alone	5	7	0	17	0	10	0	0
Mixed Mineral Manure.	5	16	1	0	0	19	0	2
Ammonium Salts alone	6	0	2	18	1	3	2	0
Nitrate of Sodium, alone	12	18	2	19	8	1	2	1
Mix. Min. Manure and Ammonium Salts .	16	2	2	17	11	5	1	19
Mix. Min. Manure and Nitrate of Sodium .	17	14	3	7	12	17	2	19
Farmyard Manure. .	16	15	2	14	11	26	1	26

In reference to the foregoing results upon two members of the so-called *root-crop* family, we observe a remarkable difference in the effect produced upon their development, by one and the same manure, when applied year after year to the same land.

Also, that the same quantity of manure yields a much larger return of Mangel Wurzel, a plant which belongs to the botanical order *Chenopodiaceæ*, than of Swedish Turnips, which belong to the order *Cruciferæ*. Further, the unmanured plot, even after exhaustion by the previous growth of fifteen crops of Swedes and five crops of Sugar Beet (the results of the latter are not given here), produces a weight of Mangel bulbs eight times as large as of Swedish Turnips.

Purely nitrogenous manures, while they are seen to have but little influence upon the growth of Swedes, show a very marked effect upon Mangel Wurzel, which is particularly observable when nitrate of sodium is used. These salts when applied in combination with mixed minerals—viz., sulphates of potash, soda, and magnesia, and superphosphate of lime, which do not supply an atom of organic matter to the soil—yield of Swedes about a ton per acre per annum less than the annual dressing of 14 tons of farmyard dung. While the yield of Mangel Wurzel, under precisely the same conditions, exceeds that of the dunged plot by one ton of bulbs in the case of minerals and ammonium salts, and 4¾ tons by mixed minerals and nitrate of sodium.

Effect of Manures on Potatoes.

Growth of Potatoes Year after Year on the same Land at Rothamsted. Four Seasons, 1876–1879. *Variety—" The Rock." Average Produce per Acre per Annum.*

Description of Manure.	Tubers.						Increase over the Unmanured.			
	Good.		Small.	Diseased.	Total.		Good.		Total.	
	Tons.	Cwts.	Cwts.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.
Without Manure	2	4	6¼	2¾	2	13	—		—	
Ammonium Salts, alone	2	7½	6¾	4¼	2	18¼	0	3¼	0	5¼
Nitrate of Sodium, alone	3	2	6	6½	3	14½	0	18	1	1½
Superphosphate of Lime, alone	2	18¾	8¼	5	3	12	0	14¾	0	19
Mixed Mineral Manure	3	3¾	6½	5¼	3	15½	0	19¾	1	2½
Farmyard Manure	3	16	8	7	4	11	1	12	1	18
Farmyard Manure and Superphosphate . .	4	5½	8¾	8¼	5	2½	2	1½	2	9½
Farmyard Manure, Superphosphate, and Nitrate of Sodium	5	9	7½	19	6	15½	3	5	4	2½
Mixed Mineral Manure and Ammonium Salts	5	14	8¾	15¼	6	18	3	10	4	5
Mixed Mineral Manure and Nitrate of Sodium	5	19	8	18¾	7	5¾	3	15	4	12¾

Average Produce per Acre per Annum. (*Second Series.*) *Three Seasons,* 1880–1882. *Variety—" Scotch Champion."*

Description of Manure.	Tubers.						Increase over the Unmanured.			
	Good.		Small.	Diseased.	Total.		Good.		Total.	
	Tons.	Cwts.	Cwts.	Cwts.	Tons.	Cwts.	Tons.	Cwts.	Tons.	Cwts.
Without Manure	1	9	4¼	0¼	1	13½	—		—	
Ammonium Salts, alone	1	11	5¾	0¼	1	17	0	2	0	4½
Nitrate of Sodium, alone	1	16½	5½	0¼	2	2¼	0	7½	0	8¾
Superphosphate of Lime, alone . . .	4	9½	4	1¾	4	15¼	3	0½	3	1¾
Mixed Mineral Manure	4	9¾	3¾	1½	4	15	3	0¾	3	1½
Farmyard Manure	5	7¾	4	3	5	14¾	3	18¾	4	1¼
Farmyard Manure and Superphosphate . .	5	16¼	4½	5¼	6	6	4	7¼	4	12½
Farmyard Manure, Superphosphate, and Nitrate of Sodium	5	19¼	4¾	10¾	6	14¾	4	10¼	5	1¼
Mixed Mineral Manure and Ammonium Salts	8	0¾	4½	8¾	8	13¾	6	11¾	7	0¼
Mixed Mineral Manure and Nitrate of Sodium	7	10¾	4¾	9	8	4½	6	1¾	6	11

From these most valuable results, which have been compiled from the "Memoranda Sheet" of Sir J. B. Lawes, we see that with both the varieties of Potato experimented upon, just in proportion as the character of the manurial supply was of a more stimulating nature, so the crop increased in total bulk, and the diseased tubers increased in quantity, while the weight of small or "pig" Potatoes remained nearly the same under all the different conditions of manuring. Thus, without manure of any kind, the total crop of "Rocks" dug was 53 cwts. per acre, and the weight of diseased tubers was 2¾ cwts. Whilst under what may considered as the most complete and stimulating manure—namely, a mixture comprising potash, soda, magnesia, superphosphate, and nitrate of sodium—the total crop obtained in the average of four years was 145¾ cwts. per acre, and the quantity of diseased tubers in this crop was 18¾ cwts. per acre. Or, putting the facts in other words, for each 100 lbs. of Potatoes grown without manure 5·2 lbs. were diseased, and for each 100 lbs. grown by the application of the complex manure, 12·8 lbs. were diseased.

Again, with the "Champion" variety, the total crop harvested was, without manure, in the average of the three years, 33½ cwts. per acre, and of these ¼ cwt. or 28 lbs. were diseased; whilst with the combination of mixed mineral manure and nitrate of sodium, 164½ cwts. of Potatoes were obtained, and the quantity of diseased tubers was 9 cwts. With this variety, which is seen to be on the Rothamsted soil much more disease-proof than the "Rock," for each 100 lbs. grown without manure 0·7 lb. was diseased, and with the complex manure, for each 100 lbs. of Potatoes produced 5·5 lbs. went bad in the ground previous to lifting, or 7·3 per cent. less diseased tubers than with the "Rock" variety.

The following table shows some average results of experiments conducted in America with Onions, Potatoes, and Turnips, when grown under the influence of different manures.

From the Report of the Connecticut Board of Agriculture for 1880.

Average Produce per Acre in Bushels.

Manures per Acre.	Onions.—1 Year.		Potatoes.—3 Years.		Turnips.—2 Years.	
	Bulbs.	Increase over Unmanured.	Tubers.	Increase over Unmanured.	Bulbs.	Increase over Unmanured.
Without Manure	290	—	79	—	205	—
Farmyard Dung	390	100	127	48	440	235
Nitrate of Sodium, 200 lbs.	530	240	89	10	425	220
Dissolved Bone-black, 300 lbs.	510	220	105	26	417	212
Muriate of Potash, 200 lbs.	680	390	104	25	388	183
Nitrate of Sodium, 150 lbs., and Dissolved Bone-black, 300 lbs.	620	330	117	38	477	272
Nitrate of Sodium, 150 lbs., and Muriate of Potash, 200 lbs.	500	210	96	17	454	249
Gypsum, 200 lbs.	400	110	90	11	412	207

These experiments are stated to have been made mostly on what would be considered a poor, worn-out soil; and the general conclusions to be drawn from them appear to be that a moderate dressing of nitrate of sodium combined with superphosphate (dissolved bone-black) is equally efficacious, whether employed for Onions, Potatoes, or Turnips; and in the case of Onions and Turnips, these manurial ingredients are superior to stable manure, although it is probable that the carbon of the dung had not had time to operate during the short period over which these experiments extend. Soluble and active manures produce their principal effect at once, being of little benefit to subsequent crops. Sparingly soluble manures, and those that must undergo decomposition in the soil before their conversion into plant-food, will continue to produce an effect over many years.

HOT-HOUSE OR STOVE PLANTS.

By William Hugh Gower.

Dalechampia.—These plants belong to the Spurgewort family. There are, however, few species sufficiently handsome to secure them a place in our plant-stoves. They are plants of easy culture, thriving best in a mixture of loam, leaf-mould, and peat, in about equal parts, adding sufficient sand to make the whole feel gritty when mixed. They enjoy a strong heat and a liberal supply of water. The flowers of *D. Roezlii* are a rich deep rose in colour. There is a variety *alba*, in which the involucres are white. In *D. madagascarensis* the leaves are trifoliate, and the pair of leafy involucres which surround the flowers are greenish-yellow. Spring and early summer.

Darlingtonia.—A genus of North American "Pitcher Plants" (*Sarraceniaceæ*), nearly allied to *Sarracenia*, yet very distinct in appearance, and especially in being entirely destitute of the large umbrella-like stigma so conspicuous in that genus. The soil for the only member of the genus should be peat and sphagnum moss. During the summer season these plants enjoy almost tropical heat, but thrive in a lower temperature in winter. Drain the pots well, and water freely.

D. californica.—This most interesting plant was first introduced into this country in a living state about thirty years ago. The leaves all spring from the root, and when mature attain a height of some eighteen inches. These are hollow, slender at the base, increasing upwards, the top bent over like a hood, on the under side of which is an oval orifice, by which access to the interior of the pitcher is obtained; the blade takes the shape of a triangular or two-lobed appendage, which is curved downwards; ground-colour bright apple-green, becoming darker with age, the upper part marbled and spotted with white, and veined with reddish-pink veins.

DICHORISANDRA MUSAICA.

Dasylirion. — Handsome plants belonging to the order *Liliaceæ*, which thrive admirably in the green-house during the summer months, but require a cool stove during winter. All are natives of Mexico, and have a somewhat Palm-like stem, bearing large and dense heads of narrow rigid leaves, which are spiny at the margins, and are terminated by a little tuft of fibres. The flower-spike rises from amid the leaves, attaining a height of from ten to fifteen feet. Pot in a compost of loam two parts, peat and sand one part, drain well, and during summer water freely, but in winter very little will suffice. Intermediate House in winter.

D. acrotrichum—stem some two or three feet high, bearing a large dense head of dark green, rigid, linear leaves, which are about three feet long, and less than an inch broad, profusely armed on the margins with small teeth-like spines; these, when old, point downwards. The variety brevifolium has much shorter leaves.

D. glaucophyllum.—This is a handsome plant, as also is the variety latifolium. It bears a dense head of narrow leaves, which are nearly thirty inches long, and deep bluish-green.

D. plumosum.—This grand plant may be compared to an enlarged form of the first-named species (D. acrotrichum), the leaves being both longer and broader.

D. serratifolium — a distinct and bold plant, with a stout stem, bearing a dense head of broad leaves about three feet long, armed on the margins with distant, long, white teeth-like spines, colour on both surfaces bluish-green.

Davidsonia.—This is a genus of recent introduction, which is said to produce a large and delicious edible fruit. It is, however, as a stove ornament we introduce the only known species. *D. pruriens* is a handsome plant, with bold, spreading, hirsute leaves. These are alternate, unequally pinnate, but usually bearing five or six pairs of leaflets, and an odd one; these when young are of a vinous-red, changing with age to a deep green. It has neither produced flowers nor fruit in this country. Pot in loam, leaf-mould, and peat, in about equal parts, adding a fair proportion of sharp sand, drain well, and water freely.

Desmodium.—A genus of *Leguminosæ*, containing many species. We confine our remarks, however, to one only, which is perhaps the most extraordinary plant in cultivation. *D. gyrans*, the Moving Plant, or the Telegraph Plant, as it is popularly called, cannot boast of beauty either in foliage or flowers, but is entirely dependent upon its peculiar motion for the interest it excites. It is a slender, erect plant, sparingly branched, and attaining a height of about two feet. The flowers are arranged in short terminal racemes; these are small, and deep violet in colour. The leaves are trifoliate, the terminal leaflet being about two inches long, green and glaucous. The side leaflets, which give the interest to the plant, are very small; these, without any external influence, are nearly always in motion, first one leaflet moving up or down, then both, and frequently the whole of the leaflets on the plant, the greatest activity being displayed when the temperature is high, and the atmosphere well charged with moisture, and the sun's rays fall direct upon it. Pot in peat and sand. It enjoys strong heat and a moist atmosphere. It is a native of the East Indies.

Dichorisandra. — An interesting and showy family belonging to *Commelinaceæ.* and nearly allied to *Tradescantia.* The genus contains plants remarkable for the beauty of their flowers as well as the variegation of their leaves. Dichorisandras (sometimes written Dichorizandra) should be potted in peat and leaf-mould, in about equal parts, adding a little loam and sand. These plants enjoy a moderate supply of water and a high temperature in summer, but less of both are requisite in winter.

D. leucophthalmus is a species with panicles of rich blue flowers and a large white eye. Summer months. Brazil.

D. musaica — this species is remarkable for the beauty of its leaves, as well as for its panicles of rich azure-blue flowers. They are deep green, barred and pencilled transversely with zigzag lines of silvery-white, the under side of a uniform deep purple. Peru.

D. ovata — an erect-growing plant with lanceolate-ovate leaves, deep green above, reddish-purple beneath, and terminal erect racemes of deep blue flowers. Spring and early summer. Brazil.

Dieffenbachia.—A handsome genus of Arads, all natives of South America and the West Indies, where the first-known species is called the Dumb-cane. This name is derived from the naked stems, after the leaves have fallen, having a very cane-like appearance, and because the sap is so acrid that if placed on the tongue it causes that organ to swell rapidly, and renders its victim speechless.

Dieffenbachias rank amongst the finest of variegated-leaved plants, and are extremely easy to cultivate. Pot in equal parts of peat, loam, and rotten manure, adding a little sand. They enjoy abundance of water both to the roots and foliage, and luxuriate in a hot moist atmosphere. There are a great number of kinds.

D. amœna — this fine form is of compact growth, leaves oblong-acute, deep green with a light midrib, the blade profusely spotted and blotched with white and yellow.

D. Bausei — leaves about a foot long and broad, petioles white, blade yellowish green, marbled and bordered with dark green, and blotched and spotted with white.

D. Carderii — an extremely beautiful and bold-growing plant, leaves large and oblong, of an intense rich green, marbled with creamy-yellow and white.

D. illustris — an elegant plant with dark green leaves, mottled and spotted with yellowish-green and white.

D. imperator — leaves ovate-lanceolate, deep olive-green, blotched with yellow and white.

D. Leopoldii — leaves oblong-ovate, of a deep lustrous green; midrib pure ivory-white, feathered on each side with a band of greyish-white.

D. magnifica—leaves oblong ovate, of a shining dark green, richly variegated with white, the variegation following the direction of the nerves.

D. nobilis — a dwarf form, deep rich green, profusely spotted and blotched with white.

D. Regina — a splendid form with large broad oblong-acute leaves, of a greenish-white, marbled with pale green; the narrow margin rich deep green.

D. Rex — a close-growing handsome form, with oblong-lanceolate leaves, blades rich deep green passing to light green at the margin, mottled and flaked with white and greenish-white.

D. splendens — stem mottled with various shades of green, blade of leaf intense deep satiny-green, very lustrous, mottled with white: midrib broad, ivory-white.

Dion.—A Mexican Cycadaceous genus, containing two species only, the best known being *D. edule;* this is a bold and handsome plant, even in a young state; stem stout, clothed, like the petioles, with short woolly hair; the leaves are some six or more feet in length, pinnate, firm and hard, as if cut out of metal, pea-green in colour. The seed-bearing cone is very large, producing seeds as large as Walnuts, from which a kind of arrowroot is obtained, and hence the specific name *edule*. Mexico.

Dionæa.—A genus belonging to the Sundew family (*Droseraceæ*), and, from its habit of catching flies and other insects, from which it derives nourishment, it is called a Carnivorous plant.

Pot in peat and living sphagnum moss, drain well, and stand in a pan of water; this, however, should be frequently changed to prevent stagnation. Intermediate House.

D. muscipula (Venus' Fly-trap) is the only member of the genus, and is a very remarkable plant. It forms little rosette-like tufts, never exceeding a few inches in height. The leaves are all radical, and the foot-stalks are broadly winged; at the end of each of these are developed two fleshy, flattened, semicircular lobes, each of which is fringed at the edge with long stiff hairs. In addition, in the centre of each lobe there are three similar hairs, and these are extremely irritable, so that when touched by a fly or any other insect, the lobes suddenly collapse with a spring, the hairs of the margins interlacing each other. When the fly is dead, they open again spontaneously, but remain closed whilst there is any movement within. Swamps of North Carolina.

Dipladenia.—A genus belonging to the *Apocynaceæ* (or Dogbane) family, which are, for the most part, climbers, with opposite leaves, and large highly-coloured trumpet-shaped flowers. They rank among the most superb stove flowering plants, and produce a succession of their beautiful blooms for many weeks.

Dipladenias may be trained upon pillars or rafters, but when intended for exhibition purposes they are usually grown upon wire trellises of a balloon shape. Pot in rich loam, peat, and sharp sand, in about equal parts; drain well, and supply liberally with water. During the growing season these plants enjoy a strong heat and moist atmosphere, but after growth is finished, in the autumn, partially withhold the water, and remove into the Intermediate House.

DIEFFENBACHIA MAGNIFICA.

D. amabilis—flowers large and numerous, rich rosy-crimson. Summer months.

D. Brearleyana — flowers like a large trumpet with broad spreading limb, intense rich crimson. Summer months.

D. ornata — flowers large, rich crimsou shaded with purplish-violet. Summer months.

D. profusa—very free flowering, even when young; colour rich carmine. Spring and summer.

D. Regina — flowers a soft

flesh - colour, inside of tubs yellow. Spring and summer.

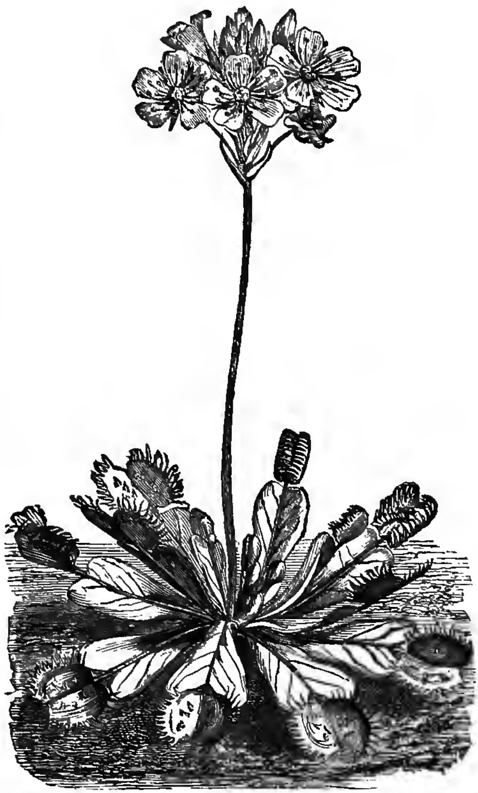
D. rosacea — flowers soft pink flushed with rose, inside of tubs yellow, with a deep rose-coloured ring at the mouth. Summer.

Dipteracanthus.—A genus now referred to *Ruellia;* it contains numerous weedy-looking plants; some few kinds, however, are extremely beautiful. They are all easily managed, and should be treated like other Acanthads, such as *Eranthemum.* Intermediate House.

D. affinis—a beautiful species, which is, however, a rather shy bloomer, and requires frequent stopping of the young shoots to produce a handsome specimen. Leaves ovate-acute, deep green; flowers large and funnel-shaped, having a long slender tube, and large broad five-lobed limb; stamens exserted, of a uniform rich scarlet. Spring and summer months. Brazil.

D. calvescens — leaves somewhat oblong, acuminate, deep green above, paler and tinged with reddish - purple below. Flowers funnel - shaped, with a spreading limb, the lobes prettily toothed on the edge, soft lilac. Winter months. Rio Janeiro, Brazil.

D. Herbstii—this is one of the grandest plants in the order of Acanthads. It is a much-branched shrub, attaining a height of three or four feet, but most handsome when smaller. Leaves six to seven inches long and two broad, oblong lanceolate, deep green above, the midrib ornamented with a narrow band of white on either side, the reverse is dull reddish-purple. Flowers produced in great profusion from the axils of the leaves, tubes very long and slender, suddenly enlarging, rosy-purple, limb spreading, the lobes deeply bifid, and pure white. All the autumn and winter. Brazil.



DIONÆA MUSCIPULA.

Dracæna (*Calodracon*).—The plants known as Dracænas were formerly a very large genus, including many species now known under separate names; and many plants now termed *Cordylines* are still popularly known as Dracænas; one genus has been somewhat recently separated from the crowd of species, and established under the name of *Calodracon.* But as it will be long before the horticultural public will give up the old names, *Dracæna* is still retained here. Calodracons, or Dracænas, have increased in numbers so much during the last quarter of a century as to be almost innumerable; this has come about through the thorough exploration of the South Sea Islands, and from cross-breeding at home, so that it is not possible to do justice to the family in the limited selection here adopted. Amongst the numerous forms, besides those here briefly described, may be enumerated—*ampliata, anerleyensis, bellula, mirabilis, Mrs. Bause, Mrs. Freake, Mrs. Wills, Renardiæ, rosacea, Scottiæ, Sydneyi, Thomsonii.* Those figured do not belong to the true *Calodracon* section, but to the larger genus of *Cordylines,* under the section of *Dracænopsis.*

The members of this genus are undoubtedly (next to Palms) the most useful we have for room decoration, whilst as ornaments for the stove, associated with Crotons, Dieffenbachias, and such-like plants, the effect produced is quite equal to that of a house of flowering plants; and to those who admit any other than green upon the dinner - table they are invaluable.

Pot in a compost consisting of about two parts loam, one of peat, and some sharp sand, drain well, and water freely. These plants do not require so much exposure to the sun as Crotons.

D. Bausei — a splendid form, leaves closely set, recurved, ground deep bronzy-green, and flaked with rosy-crimson.

D. Cooperii—leaves broad, pendent, when young wholly reddish - crimson, when aged deep metallic bronze, crimson streaks and flakes.

D. Diana—leaves recurved, when young creamy-rose, changing to deep green, flaked and streaked with crimson and pink.

D. elegantissima — leaves narrow, recurved, deep bronzy - green, margined with crimson.

D. amabilis—a bold form with bright green leaves, suffused with white and tinged with rosy-pink.

D. amboynensis — leaves deep metallic-green, margined with rosy - carmine.

D. Elizabethæ — habit dense, leaves broad, recurved, when young creamy white flushed with pink, changing to dark bronzy - green streaked with rosy-crimson.

D. Hendersonii — leaves large, light green, marbled, flaked, and freckled with white, rose, and pink.

D. Laingi—a superb variety, leaves, when young, white, suffused with rosy-pink, changing to bright green, flaked, bordered, and streaked with white, and suffused with carmine.

D. Macarthurii — a small.

growing plant, resembling a miniature D. terminalis, but much higher in colour.

D. Regina—leaves broad, recurved, bright green, flaked with pure white, the young leaves wholly white.

D. Rex—leaves large and broad, bronzy-green, suffused with rosy-purple, and striped with carmine.

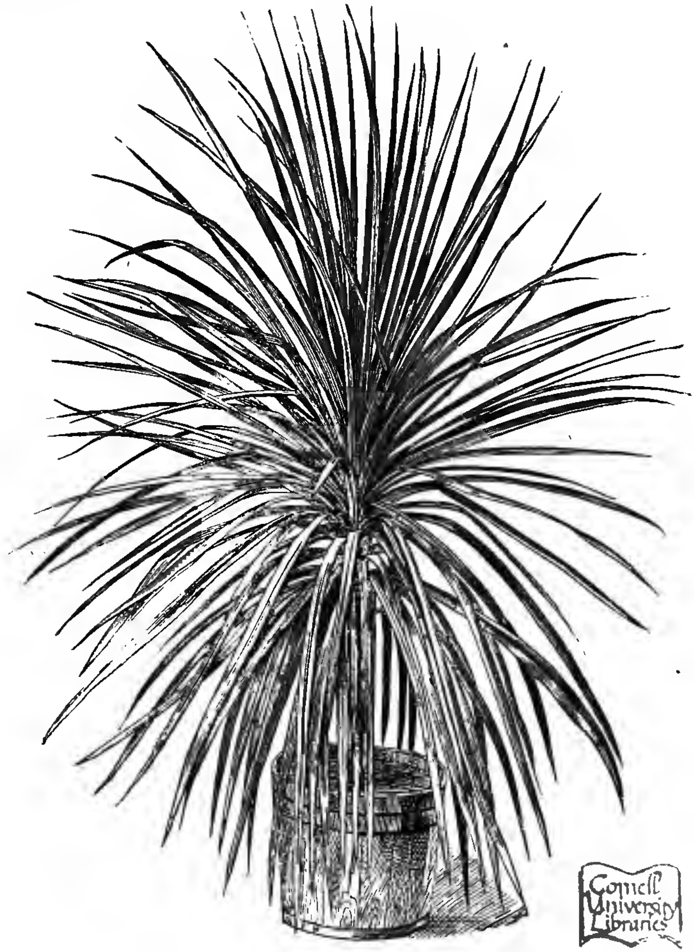
D. Robinsoniana — leaves large, dark green, striped and flaked with crimson and greenish-white, over which is spread a metallic hue.

D. salmonea—leaves when young deep flame-colour, changing to deep green, streaked and flaked with salmon-pink.

D. terminalis—the oldest of the coloured-leaved kinds, and still one of the most useful, leaves when young crimson, changing to a bronzy-green, flaked with deep crimson.

D. terminalis alba—an exact counterpart of the preceding in habit; leaves narrow, when young pure white, changing to bright green, broadly flaked with white.

Drosera.—This genus gives its name to the order (*Droseraceæ*); it comes from the Greek word *drosos*, "dew," in allusion to the viscid gum which exudes from the glandular hairs clothing the leaves, thus retaining any insects which alight upon them, and hence the popular name of Sundew.



DRACÆNA (CORDYLINE) INDIVISA.

These plants should be grown in peat and sphagnum moss, supplied liberally with water to the roots, and fully exposed to the sun. Intermediate House.

D. binata—usually attains a height of six to twelve inches, the narrow leaves are dichotomously divided, the narrow segments profusely clothed with the reddish glandular hairs. Scape erect, bearing numerous large white flowers. Summer months.

D. capensis—a bold-growing form, leaves simple, six or more inches long, arranged in a rosulate manner, densely covered with long viscid crimson hairs.

D. lunata—this is a most

elegant plant, with an ascending stem, the slender petioles support a small half-moon-shaped leaf, sparingly furnished with viscid hairs.

D. spathulata—this species forms dense rosettes, with spoon-shaped leaves which are covered with viscid, bright reddish-crimson hairs.

Leaves erect, narrow, six to nine inches long, bright green, the whole surface covered with purple, glandular, viscid hairs. Flowers large, produced in a terminal corymb, bright yellow. Spain, Portugal, &c.

DRACÆNA (CORDYLINE) STRICTA CONGESTA.

Drosophyllum (*D. lusitanicum*) is a strong-growing, almost shrubby, representative of the Sundew family. Sir Joseph Hooker says, the development of its leaves is circinate, and not revolute.

Echinocactus and Echinopsis. — These genera belong to the Indian Fig family, or *Cactaceæ*. They are very similar in appearance, yet have some slight differences, such as the position of their flowers, &c. &c. The name comes from *echinus*, "a hedgehog," and refers to their dense covering of spines. These plants are all erect, leafless, cylindrical, and fleshy, more or less ribbed, and fluted; and upon the edges of these ribs, the spines are arranged in little crowns or rosettes.

The Toothpick Cactus of the Mexicans (*Echinocactus Visnaga*) attains an enormous size. A specimen introduced to Kew Gardens some years ago stood nine feet high, measured as much round, was densely armed with very large spines, and weighed upwards of a ton; but it soon died, and must have been of a great age, as they are slow growers.

The species of these genera are all natives of Mexico, and various parts of South America, where they inhabit hot, dry, sandy, barren places, consequently they do not need much water even in the summer season, and in winter none should be given. They have mostly large and showy flowers, which are freely produced, the principal colours being rose, yellow, and white; but in some species these are rather short-lived. Pot in sandy loam, adding about equal parts of old mortar and brick rubbish, and fully expose to sun and light both winter and summer. The following will be a good selection:—

ECHINOCACTUS.	ECHINOPSIS.
Cummingi.	Bridgesi.
electracanthus.	Decaisneana.
hexædrophorus.	Eyriesi.
hystriacanthus.	Forbesi.
longitramatus.	formosa.
multiflorus.	Linki.
obvallatus.	multiplex.
Pfersdorfi.	ornatus.
platyceros.	pectiniferus.
scopa.	Pentlandii.
Simpsonii.	Schelhasi.
Stainesi.	texana.
Visnaga.	Zuccariniana.

Encholirion.—A small genus of Bromeliads, requiring the same treatment as *Æchmea*, which see.

E. corallinum—a somewhat small-growing plant; leaves arranged in a rosulate manner, recurved, dark green on the upper side, dull purple and glaucous beneath. Scape erect, flowers yellow and green, bracts crimson. Summer months.

E. Saundersii.—An elegant vase-like plant; leaves recurved, silvery-grey above, green beneath, profusely freckled, and spotted with reddish-crimson. Scape erect, flowers and bracts rich yellow. Summer months. Both are from Brazil.

Encephalartos.— A genus of *Cycadaceæ*, all natives of South Africa, mostly near the borders of Caffraria, one species being called Caffre Bread, from the natives scooping out the soft upper part of the stem, which they roast and eat, and from this custom the name is derived; thus, *enkephalos*, "edible," and *artos*, "bread." Some of the species form very tall and stout stems; under cultivation, the stems grow but slowly, taking fifteen or sixteen years to make one foot. Naturally these plants grow in stony, sterile ground, which is a sufficient indication that they require good drainage. Soil and treatment the same as for *Cycas*.

E. Altensteinii—stem stout, leaves some six feet long, petioles very thick at the base, leaflets thick and coriaceous in texture, oblong, tapering to a point, and armed all round with spines.

E. brachyphyllus — stem stout, leaves spreading, petioles clothed with leaflets nearly to the base, leaflets smooth, saving the terminal spine, the whole plant very glaucous.

E. caffra—stem very stout, attaining a height of ten to fifteen feet, or more, tesselated with the scars of fallen leaves; leaves pinnate, some four feet long, recurved at the points, leaflets very thick, nearly six inches long, and one broad, at times armed with spines on the edges, at other times smooth, deep green; seeds roasted and eaten as above; the soft interior of the stem is also cut out, buried in the earth for a month or two, taken out, made into cakes, and baked in the fire. Majestic. South Africa.

E. Ghellinckii—a very handsome species, sometimes named Gracilis; stems scarred with the bases of fallen leaves, and also furnished with a brown woolly tomentum, which likewise covers the erect spreading, pinnate leaves, leaflets, and petioles.

E. Hildebrandii — this fine species is of remarkably bold growth; leaves pinnate, the petioles clothed to the base with reduced leaflets, which take the form of spines; leaflets lanceolate, deep green, profusely armed at the apex and on the edges with spines.

E. horridus — stem stout, leaves pinnate, suddenly recurved at the top; leaflets a deep bluish-green, very thick and hard, some four inches long, armed at the point with a long, sharp spine.

E. horridus trispinus—similar to the preceding, but having two sharp spines on the lower edge of the leaflets, which are deep bluish-green.

E. lanuginosus—stem stout, the pinnate leaves about six feet long, recurved; leaflets lanceolate, with a somewhat rounded base, deep green, whole plant spineless.

E. pungens—a bold-growing plant with a stout stem, leaves pinnate, some six feet long; leaflets sessile, oblong-lanceolate, tapering to a sharp point, thick and hard, deep heavy green. South Africa.

E. villosus—this is a handsome and distinct plant; leaves pinnate, about four feet long; the petioles densely tomentose; leaflets upwards of six inches long and one broad, bright green, the apex and margins armed with numerous spines. South Africa.

Epiphyllum.—A small group of the order *Cactaceæ*, possessing great beauty, and as the majority flower during late autumn and the dull days of winter, they are doubly valuable. In a state of nature Epiphyllums are epiphytes, and thrive well in hanging baskets under cultivation. They also succeed as pot plants, struck from cuttings, but are seen to the greatest advantage when grafted to form pyramids or standards, or to creep up rafters and pillars. The best stock for this is the *Periskea aculeata*, but they form more handsome specimens when grafted upon *Cereus speciosissimus*. There are but two species in cultivation, but from these a great number of varieties have been obtained, the chief differences arising from the size and colours of the flowers. Pot in turfy loam and sand, drain well, and water carefully.

E. Russellianum — the flat branches are some two inches long, and grow out of each other, the flowers issuing from the ends of the terminal branches. These are large and showy, the petals rolled round and forming a tube, and the apices all expanded regularly. They vary from flesh-colour and white to pink and reddish scarlet. Winter and spring months.

E. truncatum — similar in habit to the preceding, but somewhat more robust, flowers large, bent down, and through the irregular expansion of the petals, one of the sides of the flower is larger than the others, thus forming a kind of lip. Colour varying from orange-red and white to pink and crimson. Winter months.

Eranthemum.—A large family of soft-wooded plants, remarkable for their beautiful flowers, which are freely produced, and continue in beauty a considerable time if carefully cultivated. They belong to the order *Acanthaceæ.* Eranthemums are widely distributed, and have usually simple, entire, or serrated leaves. The flowers have a long slender tube, unequally-lobed flat limb, spreading at right angles. Pot in two parts of loam, one of peat, and one of leaf-mould, with a little sand. The points of the young shoots must be frequently stopped, in order to produce handsome bushes. Intermediate House.

E. Andersonii — a half-shrubby plant, with narrow oblong-lanceolate, deep green leaves. Flowers fascicled, forming large heads, some eight or ten inches high. White, freckled with purplish-crimson. Winter months.

E. asperum — a slender, much-branched shrub, leaves somewhat ovate-oblong, slightly sinuate and dark green. Flowers in cymes, pure white in the upper part, with a few marginal dots of purple, lower lobe of limb rich deep purple. Winter months.

E. cinnabarinum—this species is a somewhat large grower, four to six feet high; leaves variable, usually oblong-lanceolate, slightly crenulate, deep green. Flowers fascicled, brilliant red, with a white eye, and a stain of crimson at the base of the large lobe. Winter months. British Burmah.

E. Cooperii — a much-branched shrub, with narrow-lanceolate leaves, which are lobed on the margins, and taken to a sharp point, and dark green. Flowers pure white, dotted with lines of purple. Spring and early summer.

E. crenulatum — this is a slightly-branched plant, leaves large, ovate-acuminate. Flowers on long terminal racemes, tubes white, limb rosy-pink. Winter months.

E. hypocrateriformis — a splendid species, of dwarf habit, with ovate-obtuse, dark green leaves. Flowers on terminal spikes, forming large, dense heads of bloom, flowers rich bright red, deep blood-red at the base, where it is also dotted with purplish-black, the reverse side of the corolla pale yellow. Spring months.

E. laxiflorum — this beautiful plant is dwarf, and branched. Flowers in cymes, from the axils of the leaves, rich purple, the reverse side paler. Winter months.

E. nigrescens — a bold grower, with large ovate-acuminate leaves, of a uniform purplish-black. The flowers are pure white, rosy-purple in the eye, the large lower lobe being dotted with purple. Winter months.

E. palatiferum — there are two forms of this plant, one having scarlet, the other lilac flowers. It is a dwarf grower, with oblong-lanceolate, dark green leaves, curiously blotched with white. Spring months.

E. pulchellum—leaves large, ovate, and deep green, flowers in terminal spikes, rich vivid blue. Winter months.

E. roseum—this species is remarkable for its ornamental foliage. Leaves large and broad, cordate at base, and acuminate, somewhat bullate or wrinkled above, deep shining green on the upper side, below reddish-crimson. Flowers on terminal spikes; rosy-purple.

F. tuberculatum—the stem and branches of this species are thickly covered with small tubercles; leaves small, and light green. Flowers numerous, with very long tubes, pure white. Spring and early summer.

Erythrina.—A genus of *Leguminosæ*, popularly known as Coral-trees. They mostly attain considerable dimensions, producing in abundance their splendid deep red or flame-coloured flowers, but are noticed in these pages only to introduce a somewhat small-growing handsome-leaved kind. Pot in a compost of two parts loam and one of peat, adding a little sharp sand.

E. Purcelli.—A handsome and effective plant; the leaves usually consist of a pair of leaflets, and a terminal one, somewhat triangular in form, ground-colour deep green, the midrib and principal veins broadly banded with yellow. Flowers pea-shaped, bright cinnabar. South Sea Islands.

BULBOUS PLANTS.

By William Goldring.

Acidanthera.—A small genus of the Iris family, allied to Gladiolus, and comprising some half a dozen species, all natives of Africa, the Cape of Good Hope being their chief locality. Two are found in Abyssinia, and one of these, *A. bicolor*, is the only species at present in gardens. It is a Gladiolus-like plant, having the same sword-like kind of leaves. The flowers, produced on a one-sided spike, from two to four together, are white, with lines of purple on each division. The slender tube of the flower is remarkable, being about six inches in length, and, in addition to the beauty of the blossoms, they have a delicious odour. It needs green-house or frame culture, either in pots or planted out; the soil which suits it best being a mixture of peat and sand, with a little turfy loam. Being deciduous, the bulbs should be rested during the winter by keeping them drier. It recommences growth early in the year, and flowers in summer. It is a free-growing plant, and may be propagated by the bulblets from the parent bulb. These bulblets flower after three or four years.

Acis.—These pretty little plants are so nearly related to the Snowflakes that botanists now unite Acis with Leucojum. The species of Acis are, however, so different in appearance from the Leucojuma proper that cultivators will probably always adhere to the former name. There are about half a dozen species and varieties of Acis known, and all of them are or have been in cultivation. They are slender little plants, having tiny bulbs, bearing few grassy leaves, and fragile flower-stems, a few inches high, carrying from one to three small bell-shaped flowers, either white or pink. The best-known and commonest species is *A. autumnalis.* It is the only autumn-flowering species, and bears, on reddish, slender stems, some three or four inches high, small, pale pink flowers, in clusters of from one to three on a stalk. It is a native of Spain, Portugal, Sicily, and Algeria, and is the strongest in constitution of all. The other species are *A. hyemalis*, which bears small white flowers in April (not winter, as its name would imply); *A. trichophylla*, and its variety *grandiflora*, both with white flowers; and *A. rosea*, a pretty Corsican plant, having rosy-pink flowers.

The best place to grow these delicate little bulbs is in a warm sheltered border, or better still, in a frame so that they could be protected well during winter. They are most successfully grown in a fine sandy soil, which must be well drained so as to be always dry. The chief consideration is to allow the bulbs to become thoroughly ripened in full sun after the foliage is decayed.

Allium (*Onion*).—Persons not much acquainted with plants would hardly suspect that there were any Onions worth growing for the sake of their flowers; yet there are about half a dozen species that are highly ornamental, though this is a small number indeed compared with the enormous number of species which constitutes the genus. All the desirable species, happily, are hardy, and easily grown.

The ornamental species that can be recommended include the following:—

A. pedemontanum, a most beautiful plant, from the European Alps, bearing dense drooping clusters of rose-pink blossoms, produced on slender stems, about a foot high.

A. Murrayanum, *A. acuminatum*, and *A. Macnabianum* are three species very similar to each other, each being characterised by broad, flat heads of small blossoms, varying in colour from a deep carmine to a pale rose.

A. neapolitanum, *A. Clusii*, *A. triquetrum*, all bear dense clusters of small, white blossoms, produced plentifully on stalks rising a foot high, and very desirable for cutting in early summer, as the characteristic garlic odour is scarcely perceptible in them.

A. neapolitanum is the kind whose flowers are so largely imported from the South of France to our flower markets in spring, and sold about Eastertide for floral decorations. Then there are two yellow-flowered kinds, both desirable. These are *A. Moly*, an old-fashioned garden plant, very showy on account of its large heads of bright yellow flowers, and *A. flavum*, an elegant as well as attractive plant.

The foregoing comprise a representative selection from this large genus, though, of course, those who seek for collections of hardy bulbous plants, would find among the others many that would prove attractive in a garden.

The ornamental Alliums succeed well in any ordinary soil, if not too stiff, and they are readily propagated by division or seeds. Some, such as *A. Moly*, become troublesome weeds in a garden, as they propagate so freely, both by seeds and bulblets. *A. pedemontanum* is worthy of the most attention, and the best position in a warm, sunny border should be given to it. All are perfectly hardy in light soils.

Albuca.—A small genus of Lilyworts, native of South Africa, but of not much importance as garden plants. They somewhat resemble the Ornithogalums in growth, having narrow deciduous leaves, erect, often tall and slender flower-stems, bearing numerous flowers, in loose racemes, borne on slender and generally pendulous stalks. The prevalent colour is white, yellow, pale and deep, and green. There are half a dozen species that are fairly good plants; the finest, *A. Nelsoni*, a rather recent introduction from Natal, being by far the handsomest plant in the genus. Its large bulbs bear numerous leaves, which grow from two to three feet in length, the flower-stems attain a height of from three to five feet, and carry in a loose raceme on the upper half numerous erect flowers, one and a half inches in length, pure white, striped with dull red. It is, therefore, well deserving of attention as a green-house plant, but is as yet very rare. The other species to be recommended are:—*A. aurea*, a dwarfer and smaller plant than the preceding, bearing racemes of flowers about an inch long, of a deep yellow, striped conspicuously with green. *A. fragrans* has yellowish flowers, deliciously fragrant. *A. caudata*, with white flowers, *A. juncifolia*, *A. major*, and *A. minor*, all with yellow flowers, are among the showiest in the genus. All of them need green-house culture, and require a decided rest. Those mentioned usually flower in early summer, and then make their annual growth.

Amaryllis.—Amaryllis has long been a familiar name in gardens. It has been applied to various bulbous plants which are now called by other names. For instance, the Jacobean Lily (*Sprekelia*), the Zephyr Flower (*Zephyranthes*), some of the *Crinums*, *Sternbergia*, and the Scarborough Lily (*Vallota*) have all been called Amaryllises. Even now some confusion exists in the application of the name, for the Amaryllis of the botanist does not agree with that of the gardener. What are now popularly called Amaryllises in gardens belong strictly to the genus *Hippeastrum*, a name, however, seldom used in gardens; and, according to botanists, there is but one Amaryllis, and that is the beautiful Belladonna Lily of the Cape. The most obvious difference between the true Amaryllis and the Hippeastrum exists in the seeds, for while those of Amaryllis are few in the pod, and large and fleshy, those of Hippeastrum are numerous, membranous, and black. The growth and flower characters are much the same in both genera; but their geographical distribution is quite distinct, for while the Belladonna Lily is exclusively a native of the Cape of Good Hope, all the Hippeastrums are natives of tropical and sub-tropical South America and the West Indies.

As the older and more familiar name, Amaryllis, will no doubt always be adhered to in gardens, we will, after the foregoing explanation, proceed to consider them as such.

The Amaryllises are surpassed by no other bulbs as regards their value as decorative plants, their flowers being among the largest in the whole range of bulbs, and for brilliancy of colour they are unrivalled. They are, therefore, highly important garden plants, and are particularly valuable on account of flowering most abundantly in early spring. They are all characterised as having tunicated or coated bulbs, deciduous foliage, except in one species (*A. reticulata*), and large showy flowers, produced in umbels before or with the foliage.

The garden history of the Amaryllis is peculiarly interesting. Some of the species were cultivated upwards of a century ago, and fifty years ago all or nearly all of the typical wild species were in gardens, but now the more beautiful modern hybrids have almost entirely supplanted them.

The Amaryllises, on account of their showy flowers, have always been favourites in gardens, and their strong tendency to hybridise was taken advantage of as soon as they were introduced, consequently hybrid varieties have always been common; but the material with which the hybridiser had to work was comparatively limited. There were only about a dozen species, and these did not possess much diversity of form or colour, consequently the old hybrid varieties resembled each other greatly. With the introduction about twenty years ago of two or three new species from South America, a fresh stimulus was given to Amaryllis hybridising. The most important of the new discoveries was *A. Leopoldii*, named in honour of the King of the Belgians. This species naturally possesses large and handsomely-formed flowers, with whitish sepals, tipped with crimson. In this species the hybridist possessed fine form and large size of the flower, and it only needed brilliant colours infused into it to make it a perfect Amaryllis. So, by intercrossing it with the finest of the older hybrids, quite a distinct race was produced, eclipsing all others produced previously.

A. pardina, introduced about the same time, possesses large flowers, copiously spotted with red. Before the introduction of these species, the hybrids, though brilliant in colour, lacked size and form. Even now the range of colour is somewhat limited, for among the hundreds of varieties that exist the colours only extend from white, through pinks, to deep crimson and vivid scarlets.

The criterion of a first-rate variety of Amaryllis nowadays is a stout, erect flower-stem, carrying two or more blooms. These should measure from six to nine inches across, with the sepals and petals of thick substance, so as to be firm enough to hold themselves out well, and slightly reflex at the tips. They must always be broad enough to quite overlap each other, and the nearer they approach a circular outline the more perfect the flower is considered to be. In the original species of Amaryllis the lowermost sepal of the flower is nearly always much narrower than the rest.

Among the large numbers of hybrids now existing several distinct races are discernible, according to the species from which they have originated. There are about twenty species from which the hybrids have been produced, the chief being the following:—*A. aulica*, *ambigua*, *barbatum*, *bulbulosum*, *breviflorum*, *equestris*, *Leopoldii*, *miniata*, *pardina*, *psittacina*, *Reginæ*, *reticulata*, *rutila*, *solandriflora*, *stylosa*, and *vittata*. The few groups under which the present hybrids may be classed are—*Aulica* section, in which the flowers are large, more or less funnel-shaped, and generally a deep crimson. *Acramannii* section, with smallish flowers characterised by an intensely deep crimson. *Leopoldii* section, in which the flowers partake more or less of the original species, and always with large open (not tubular) flowers. *Pardina* section, in which the flowers show indications of the original spotting of the flowers; and the *Vittata* section, which includes all those sorts having flowers rather small and usually funnel-shaped, and generally more than usually numerous in the umbels.

Lastly, there is a race distinct from all the foregoing, which has sprung from *A. reticulata*, the evergreen species, a native of Brazil. This species likewise differs from the rest in having flowers of a delicate pink, and beautifully netted with deeper-coloured veins, hence the name *reticulata*. In its original state, however, it is not an easy plant to grow and flower successfully, but by crossing it with sorts of a deciduous nature, this shy-flowering tendency has been overcome; indeed, all the varieties of the race are almost perpetual flowerers, and the fact that they flower in mid-winter, as well as at mid-summer, greatly increases their value. There are now about half a dozen hybrids having *A. reticulata* for one of their parents, and all possess the characteristic white stripe down the middle of each leaf, more or less conspicuous. Among the most beautiful of these hybrids are those named *Autumn Beauty*, which flowers chiefly during the autumn months, *Mrs. Garfield*, *Mrs. W. Lee*, *Defiance*, and *O'Brieni*. These all have flowers smaller than the ordinary hybrid Amaryllises, and vary in colour from a pale pink to a deep rose.

Culture and Propagation.—A good deal of attention is required to grow Amaryllises to perfection, although fair results may be obtained under the ordinary treatment of stove plants. In large nurseries where these bulbs are a speciality, houses are built expressly for their culture. The houses are spacious, light, well ventilated, and provision made for a good command of artificial heat if required; but Amaryllises do not require very much heat, certainly not so much as they are generally subjected to in private gardens. The rule in nursery culture is to have beds of tan in which to plunge the pots to the rims. These beds are placed above the hot-water pipes, which keep the plunging material at a growing temperature, and the roots are thereby kept in an equable condition, alike as regards moisture and heat. The mode of treatment is as follows:—In January the bulbs, which have been kept dry during the preceding three or four months, are re-potted. They are turned out of the pots, the soil shaken from them, and are divested of any offsets formed around the bases; these bulblets furnish the means of increasing the stock. The size of pot varies according to the strength of the bulb, a 7-inch pot being used for the largest. The soil consists of fibry loam, with a little sharp sand, crushed bones, or well-decayed cow-manure. The pots must be well drained, and the bulbs only placed about a third below the surface. After re-potting the stock of flowering bulbs they are plunged in the tan beds, but no water is given for some weeks, until the leaves and flower-spike begin to appear. Water is then gradually applied, not too much at first, but more and more as the spike develops. In the meantime the temperature of the house, and also that of the beds, is kept in a nice growing condition of about 55° as a minimum, rising with sun-heat during the day to 70° or so; slight ventilation must be given, according to the weather. The pots will now be full of roots, these having commenced to form almost immediately after the bulbs were re-potted in the moist soil, and when the bulbs show signs of vigorous growth an occasional dose of weak manure-water is given. In this stage of growth, onwards till growth is fully developed, the plants require a good supply of water. During March and April the plants are in bloom, flowering in succession, each continuing for two weeks or more in perfection. Some of the strongest bulbs develop three, the majority two spikes. As soon as the flowers are over the leaves quickly perfect their growth, and continue to add strength to the bulb throughout May and June. About August, when the leaves show signs of decay, care is needed, that the bulbs do not receive too much moisture, for as soon as the leaves begin to turn yellow, water should be withheld from the plant altogether. From September onwards, till re-potting time in January, the plants do not receive any water, but the house is well ventilated and unshaded, so as to admit all the sun-heat possible, in order to ripen the bulbs thoroughly. By the end of summer the bulbs will be literally baked, the soil being as dry as dust, but the plunging material will be sufficiently moist to preserve the roots in a healthy condition. In this condition they remain until the beginning of the next year.

The same principles and practice of culture apply to the culture of the Amaryllises in private gardens, where only a few plants are dealt with, although a special house and appliances may not be provided. Under whatever conditions Amaryllises are grown, it is always advisable to plunge the pots, especially when the bulbs are starting into growth, as this is one of the secrets of their successful culture. The heaps of fermenting material generally placed in early Vineries afford a capital substitute for a proper plunging-bed; and other equally suitable makeshifts will occur to a thoughtful cultivator.

Fortunately the Amaryllis is not subject to much disease or liable to insect attacks. A moist atmosphere will generally prevent the attacks of red spider while the plants are in growth, but it sometimes is troublesome during the warm and dry resting period, but it will succumb to the usual remedies for eradicating insect pests. The main point is thorough development of growth and ripening of the bulbs.

The foregoing remarks apply, however, only to flowering bulbs. The culture of the seedling and succession bulbs is somewhat different. When the offsets are detached from the parent bulbs at potting-time, they are re-potted in much the same way as the large bulbs and plunged in similar beds. In order to induce the formation of roots, a little sand is placed round each bulb on potting it, and this also tends to prevent decay. The young offshoots soon show signs of growth, and water is gradually given, as in the case of the flowering bulbs, and throughout the season they are induced to make as much growth as possible, and instead of the foliage decaying it often keeps green throughout autumn and winter. The plants, therefore, are not kept dry so long as the leaves are green, though less water is given after the warm weather is gone. This treatment is continued until the offsets arrive at a flowering stage, which is usually about the second or third season after separation.

Propagation is also effected by raising seedlings, and as the Amaryllis bears and ripens seed freely every season, this is an expeditious mode of increase. The flowers are, as a rule, artificially impregnated either with their own pollen or that of a finer variety. The seed-pod soon swells, and about midsummer it commences to ripen. In July and August the seeds are ripe, and the seed-pod bursts. The seeds are black and membranous when fully ripe. They should be sown as soon as gathered from the pod. The usual mode is to sow thinly on the surface of pans or pots of light soil, cover with a thin layer of soil, and place the pots in a gentle heat, say about 65°. In a few weeks the seeds will germinate, and by the autumn will have formed a leaf. Care is required during their infancy that they do not receive an excess of water, especially in cold, damp weather. In the spring the seedlings are large enough to pot separately in small pots, or three in a 4½-inch pot. Their treatment during the first year is much the same as that received by offsets, and during the second year some of the strongest bulbs will produce flower, though two-year-old flowering bulbs are the exception. During the third and fourth seasons all the seedlings will flower. The finest sorts should be increased by offsets, and particular attention paid to their culture, and producing seeds from them.

When all the stock of plants is treated in one house, under the same conditions, the bulbs will of course flower about the same period, which extends over several weeks during March and April, the beginning of April being the height of the season. Flowering plants may however be had earlier and later, by forcing in the one case and retarding in the other. By re-potting the bulbs earlier than January, and gradually inuring them to a warm temperature, flower-spikes may be had as early as February; and by retarding the bulbs in a cool place and allowing the growth to commence unaided by heat, flowering plants may be had as late as June and July, and thereby the Amaryllis season may be extended over a period of several months, and by the addition of the *reticulata* hybrids, the interval during autumn and winter may be filled by flowering plants.

When in full flower the plants may be removed for a short time to the conservatory or green-house, but as growth is very active about the flowering-time, and requires abundant moisture and more heat than a conservatory can give, it is not advisable to subject valuable varieties to a low temperature and dry atmosphere long together. It is better to cut the spikes and place them in water, and leave the plants in the stove. In the case of ordinary varieties or seedlings, however, no risk is run in taking them to embellish the green-house during their flowering. Some cultivators pot Amaryllises when in full growth, immediately after blooming, and prefer that condition to one of dormancy.

Some varieties of Amaryllis are much hardier than others—so hardy, indeed, that they may be grown successfully in the open borders. Among these hardier kinds are *A. Acramannii pulcherrima*, a beautiful variety, with intensely deep crimson flowers, and *A. vittata*, with smallish striped flowers. These, in the neighbourhood of London, have been grown in a warm sunny border of light soil, and only protected during winter by fern litter or some such material.

Selection of Varieties.—During the last few years a few of the nurserymen in this country have paid a great deal of attention to Amaryllis culture, and particularly to the raising of new varieties, and in one nursery alone seedlings are raised annually by the thousand, and as care is taken to hybridise only the finest sorts, the progeny, as may be expected, possess high merit; but only those sorts whose flowers conform to the standard of a first-rate Amaryllis are named. The remainder of the seedlings are sold unnamed, generally at a few shillings a bulb, whereas the finest of the named sorts are sold for as much as five guineas a bulb. The price of a first-rate variety, as a rule, varies according to its power of propagating itself. In the case of one that sends out offsets freely from the parent bulb, the plants become cheaper, for, in all cases, individual varieties are propagated solely by offsets. Some throw out these so sparingly that they maintain a high price for years.

The following is a selection from among those sorts that have been exhibited in London during the past five years; they include the finest varieties that have been raised, the majority having large and finely-formed flowers, with brilliant colours.

Acis—flower very large, of a brilliant crimson, tipped with white.
Ajax — deep maroon-crimson, blotched with yellowish-white.
Alexandra — flowers above medium size, bright rosy-carmine, striped with white.
Archimedes — deep violet-crimson, edged with white.
Autumn Beauty—one of the Reticulata section; colour pale rose, and netted with a deeper colour.
Baroness H. Schroeder — flowers very large, pure white, flaked and striped with red.
Baroness Rothschild—vivid scarlet; white centre.
Blushing Bride — delicate rose-pink, striped with white.
Brilliant — flowers below average size, but exceedingly brilliant in colour; crimson.
Byron—deep crimson; pale centre.
Charles Dickens—rich crimson-scarlet, and greenish-white centre.
Clio — brilliant scarlet, striped white; one of the finest.
Comte de Germiny — rich orange - scarlet, petals striped with white; one of the finest.
Constance — white, flaked and netted with red.
Countess of Rosebery — scarlet-rose; white stripes.
Cowper — crimson-carmine, mottled with white.
Diadem—deep colour, finely-formed flower.
Dido — reddish - crimson, flushed with a lighter hue.
Dr. Masters—flowers medium-sized, but of a brilliant scarlet, with no light centre, and of exquisite form.
Duchess of Connaught—

pure white, and finely-formed flower; among the choicest.
Duke of Cambridge—deep scarlet; white centre.
Duke of Portland—brilliant scarlet, banded with white.
Electra — vivid scarlet; white centre.
Empress of India—one of the finest sorts yet raised; the flowers of good size, perfect form, and of a brilliant scarlet, banded with white.
Ethelred—brilliant scarlet, flushed with crimson.
Fire King—remarkable for the intensity of its deep crimson flowers.
Grace Darling — white, veined and striped with crimson.
Gustave Doré—deep velvety crimson.
Hamlet—very deep crimson, striped with white.
Heroine — white, veined with red.
Homer — crimson, shaded scarlet; white centre.
Indian Chief—rich scarlet-crimson, broadly striped with white.
Iris—vermilion-red.
John Heal — one of the finest of the Leopoldii race; perfect in form, of a rich crimson, tipped with white.
King Arthur—finely-formed flower; crimson and white.
Lady of the Lake—a beautiful white flower.
Leonidas — crimson-scarlet, tipped with white.
Lord of the Isles—brilliant scarlet, shaded with maroon.
Meteor—deep rosy-crimson, broadly edged and striped with white.
Milton—scarlet, veined with white.
Miss Gair—brilliant scarlet; one of the finest.
Mrs. Baker—fine crimson-scarlet; white stripes.
Mrs. Freeman — finely-formed, white ground, rosy-white flushed.
Muriel—rich crimson-scarlet.
Olivette — deep crimson, tipped with white.
Othello—one of the deepest crimsons.
Prince Leopold — brilliant scarlet-crimson; pale centre.
Princess of Wales—white, mottled with rose; very fine.
Ptolemy — crimson-scarlet, white striped; a very fine sort.
R. Wagner—deep crimson, shaded with maroon.
Royal Standard—one of the best of the Leopoldii race; scarlet - crimson, tipped with white.
Salmones — pale salmon, distinct in tint.
Sir Beauchamp Seymour—very vivid orange-scarlet.
Sir Evelyn Wood—one of the finest and most brilliant of colours; vermilion-scarlet.
Southey — Scarlet, striped with white.
Tennyson — brilliant scarlet; large fine flower.
The Baron—a fine flower, lake - red, tipped with straw-yellow.
The Corsair — orange-scarlet, banded with white.
The Giant—remarkable for its vigorous growth and the unusually large umbels of flowers, which, however, are rather small and pale in colour.
The Siren—a late-flowering variety, bright scarlet, shaded with carmine, and edged with white.
The Sultan—deep maroon-crimson; a fine sort.
Vesuvius—remarkably brilliant orange-scarlet, banded with white.
Virgil—French white, spotted and veined with scarlet
Wordsworth — scarlet, shaded with rose.
Zephyr — carmine, banded with white.
Zelinda — crimson-carmine, tipped with white; finely formed.

Amaryllis Belladonna (*Belladonna Lily*).—A lovelier plant than this is not to be found in gardens; hence it is deservedly popular, and the fact that it thrives to perfection in the open air enhances its value. It is not, however, a perfectly hardy plant, and it requires to be placed under certain conditions in order to insure success in its culture. In the Southern counties it is, as a rule, grown out of doors in borders of light warm soil, at the foot of southerly exposed walls. If the wall, however, is damp, or the border wet and undrained, the Lily will not succeed. In no position does it thrive better than when planted outside stoves and green-houses, in which cases the walls are dry and warm, and thus conduce to the thorough ripening of the bulbs. In some such positions as these the Belladonna Lily is a perfect perennial, flowering regularly every August or September, and continuing in beauty for a fortnight. If planted in the open in positions other than that described above, the bulbs must either be protected during the winter or lifted. In all cases when planted out of doors the bulbs must be placed at a good depth, about nine or twelve inches, so as to be protected from frosts. It is of little use to attempt its culture in stiff soil, unless it be thoroughly drained. If the soil is poor, manure should be added, and at all times the plant is grateful for a mulching.

The bulbs begin to push their foliage in spring; it is then that a mulching of manure is most beneficial, for upon the vigour and strength of the foliage the abundance and quality of the flowers mainly depend. During dry weather, the bulbs should be freely watered occasionally, until the leaves show signs of decay. When the foliage has dropped, the flowers soon begin to show themselves. Pot culture is desirable in places where its open-air culture is not practicable. It may be simply managed in pots: the bulbs should be potted in early spring and kept dry until growth appears. During summer growth should be encouraged as much as possible, and after the foliage has decayed the plants should be kept drier. A good rich soil should be used. Grown thus the Belladonna Lily is most valuable for adorning the green-house or conservatory in late summer.

To those who do not know the Belladonna Lily, it may be described as having flowers similar in shape and size to the common White Lily. They are produced in umbels of from three to eight, on the tops of stout stems, ranging from one to three feet in height, and always unaccompanied by leaves. The colour ranges from a delicate blush-pink to a deep rosy-magenta, and they are sweetly scented. The variety *blanda* bears larger flowers of pale rose-colour, but unscented, and is larger in all its parts. Both the original and the variety are natives of the Cape of Good Hope.

Androstephium.—There are two little bulbous plants, sometimes met with in gardens, belonging to this genus, which is closely allied to the pretty Mexican bulb, *Bessera elegans*. Both Androstephiums belong to Western America—one, *A. brevifolium*, being a native of California, while the other, *violaceum*, is a Texan plant. They are, therefore, not very hardy, and to grow them well they must have frame protection.

A. violaceum grows about six inches high, and bears crowded spikes of pretty rosy-violet flowers. *A. brevifolium* is a stouter and taller plant, growing from six to twelve inches high. It also bears pretty rosy-violet flowers in early spring. Those who have grown them successfully have planted them in light sandy soil in frames.

Anomatheca cruenta. — A charming little South African plant, which no garden can afford to be without. It is of dwarf growth, with grassy foliage, and produces numerous slender flower-stems, carrying a profusion of cherry-red blossoms from June to September. Though not a thoroughly hardy plant, it thrives admirably in the open border, and as it seeds freely, seedlings spring up every year in light soil, so that the plant is no trouble in increasing. In cold localities, or on stiff, cold soils, the plant requires protection during winter. It should have a small sunny corner to itself, so that stray seedlings would not interfere with other plants. It is a capital plant for growing in pots for the conservatory, for which purpose the bulbs should be potted in early spring. It is best to defer planting the bulbs in the open border until spring. It is easily raised from seed, which should be sown as soon as ripe. The tiny bulblets produced from the parent bulbs flower the following season. It is the only plant worth growing in the genus, which is exclusively South African.

Antholyza. — These are comparatively unimportant plants for the garden. A few of the species, numbering about a dozen, are among the old-fashioned plants which have been ousted by showier kinds. They all resemble the Gladiolus in growth and foliage, but their flowers, instead of being open, are tubular, and generally of singular shape.

The names of the most attractive species are *A. ringens*, *A. æthiopica*, *A. bicolor*, and *A. Cunonia*. The flowers, generally bright red, are numerous, and produced in spikes, overtopping the foliage. Being natives of the Cape of Good Hope, the Antholyzas require similar treatment to most other bulbs from that region. None of these Antholyzas are absolutely hardy, though in light, warm, sandy soils in southern districts they take no harm during ordinary winters, especially if protected by a covering of ashes or leaves. As a general rule, however, it is advisable to lift the bulbs after the foliage is matured, usually about August, and to keep them in store until February or March. They may be increased by separating the bulblets from the parent bulbs, and by seed. Sometimes the Watsonias, a much showier genus of bulbs, are incorrectly called Antholyzas.

Anticlea glauca.—This little bulb, which inhabits the swamps of Canada, and the Northern United States, is not of much value as a garden plant, though it is to be found in nursery catalogues. It produces tufts of long, narrow, grassy foliage of a glaucous hue, and bears branching flower-spikes about a foot high, with small yellowish flowers. It thrives in a moist peat border. It is a Liliaceous plant, and is known also as *Zygadenus glaucus* and *Z. chloranthus.*

Babiana.— Like the Ixias, Tritonias, and Sparaxises, the Babianas come under the general head of Cape bulbs, which it is to be hoped will again become as popular as with our forefathers a century ago, when the bulk of these beautiful gems of the South African flora were first introduced to our gardens. There are about a score of species known to botanists, but the common Babianas of gardens have all sprung from one species, viz., *B. stricta,* a species distinct from the rest of the Babianas, and forming the type of the sub-genus *Acaste.* In this species the flower is of regular outline, with the petals arranged in a saucer-like form; the growth is dwarf and the foliage conspicuously ribbed. Under this species are classed all the Babianas which were introduced about a century ago under specific names. These are now found to differ in no way from the original *B. stricta,* except perhaps in the stature and colour of the flowers; and the whole of the varieties with fanciful names which have been raised, chiefly in the Dutch bulb gardens, have sprung from either the original *B. stricta* or its six wild varieties.

The other sub-genus, the true Babianas, comprises a very different class of plants, the species included in it being more like Gladioli than the ordinary Babianas. They are all characterised in having flowers more or less irregular in outline, with unequal-sized petals, and generally having a long slender tube. In some instances, as in *B. tubiflora,* this tube is as much as four inches in length, giving the flowers a strange appearance. The species in this section are rarely seen outside a botanical garden, although many of them possess such rare beauty as to well deserve the attention of the general cultivator. Mention will only be made of the most remarkable.

B. disticha.—A dwarf plant, with ribbed leaves, and showy flowers of a pale purplish-lilac. The tube is long and slender, and the spike crowded.

B. tubata and *tubiflora,* being so much alike, may be described together. They are both very singular plants, being remarkable for the great length of their slender flower-tubes, which are from three to four inches long. The petals are creamy-white, heavily blotched with red. The flowers are produced in clustered spikes, on short stems. *B. tubiflora* is the showier plant, and the more easily procured.

B. plicata has small Gladiolus-like flowers, of a pale lilac, spotted with yellow. The flower-tube is long and slender in this plant also.

B. ringens is another singular species in this section, but very rare, and the same remark applies to *B. sambucina*, *spathacea* (one of the dwarfest species in the genus), and *pygmæa*.

The sub-genus *Acaste* is by far the most important, from a garden point of view. As previously remarked, it includes all the numerous varieties of Babiana sold under popular names. Taking *B. stricta* as the original, it may be well to describe it. An illustration of it occurs in the *Botanical Magazine* (tab. 621). It is there represented as a dwarf-growing plant, having narrow, erect, and ribbed leaves, and short flower-spikes, bearing flowers as large as a florin, and of the richest blue imaginable. This same plant may still be found pure in Dutch gardens, after being a hundred years in cultivation. It has given rise to many beautiful seedling varieties, having a blue tint in their flowers. The wild varieties of *B. stricta*, which were introduced from the Cape as species at the close of the last century, are the following:—*angustifolia*, like the original, but with paler and less showy flowers, and narrower leaves; *purpurea*, with deep reddish-purple flowers; *obtusifolia; rubro-cyanea*, a most beautiful plant, the flowers having a strange mixture of deep blue and red, the latter tint forming the centre. This is still pure, and does not appear to have yielded any varieties in a similar way. It may still be obtained under its original botanical name, and if only one Babiana is grown this should be the selected one. *B. sulphurea* has pale yellow flowers, and *B. villosa* a deep rich crimson. The most desirable of the foregoing kinds are *B. rubro-cyanea*, *stricta*, and *villosa*. These may be found, in all probability, under popular names in collections of Cape bulbs, but without trustworthy illustrations of the originals for comparison, it is a difficult matter to identify them. The Dutch bulb growers now catalogue many varieties of Babiana more or less distinct from each other as regards colour. These are offered in this country in collections of named varieties and mixtures. In one of the chief catalogues, about twenty named sorts occur. A selection from the list would include the following:—*atro-cyanea*, purple-blue, marked white; *Attraction*, dark-blue (probably the true *B. stricta*); *Celia*, rose and white; *General Froome*, violet, spotted white; *General Scott*, lavender, suffused with white; *Hellas*, pale yellow (probably the original *sulphurea*); *Julia*, white and blue; *kermesina*, crimson-magenta (identical with *B. villosa*); *Lady Carey*, rose and white; *rosea grandis*, rose-purple and white; *speciosa*, mauve and blue. These range from 1s. 6d. to 5s. 6d. per dozen, the dearest being *B. rubro-cyanea*, which happens to be in most demand, as it is the finest.

Culture.—The true, or long-flowered Babianas, being rare, require special pot culture in a frame or green-house, following the same treatment recommended for Cape bulbs in general, always bearing in mind that the chief consideration is to obtain as fine growth as possible, so as to insure large bulbs, and also to thoroughly ripen the bulbs by exposing them to all the sun it is possible to give them in this country. This done, the bulbs will rest safely in a dry place until potting-time in early spring. The species flower in succession from spring to the end of summer. The common Babianas of the Dutch gardens, being more plentiful, do not need so much attention; they may be either grown in pots plunged in ashes under a frame, or placed on a green-house shelf, or planted out under a frame in a bed of suitable light and well-drained soil, treated in the same way as other Cape bulbs. Though not so free-flowering as Ixias and Tritonias, they make an attractive display if grown in quantity, and as the flowers open in succession they are beautiful for some weeks. All Babianas may be increased more or less freely by offsets, or by seed, which is produced during favourable seasons.

PROPAGATION.

By W. Watson.

CUTTINGS.

THE multiplication of a plant by means of portions of its stem or branches, commonly designated cuttings, is perhaps the most frequently used of artificial methods employed in their propagation. Although there are many instances of planta having hitherto proved incapable of being propagated in this way, it may be stated as a general rule that nearly all planta bearing buds upon their stems and branches may be propagated by means of cuttings. The exceptions to this rule may be due to our ignorance of the treatment that would prove successful, rather than to absolute incapacity on the part of the plants to be increased in this way. There are many instances of right treatment having revealed itself only after repeated experiments upon the plants and their cuttings; and hence the necessity of further experiment where success does not follow the first. Patience and perseverance are essential to the successful increase of the large number of new, unknown, and delicate plants which are being introduced yearly.

To render our instructions both complete and easy of reference, it may be well to divide this portion of our subject into sections, each one of which will be devoted to certain plants requiring a particular kind of treatment for their propagation; and although the limits of our space will not admit of the enumeration of all those plants to which such treatment is adapted, all those that will serve to illustrate our observations, as well as those of special interest and importance, will be mentioned under the respective methods that are considered best for their propagation.

Before dealing with these, however, it will be well to lay down a few general rules which apply more or less to the treatment of all cuttings. The portion of a plant most suitable to be selected as a cutting depends upon the condition of the plant as regards growth and health; upon its nature—whether hard-wooded, soft-wooded, herbaceous, or succulent; and upon the time of year when the cuttings are to be put in. With regard to the first, it is important that the plants intended to be propagated should be in perfect health, for although sickly cuttings may be induced to strike root, they frequently remain long in a weak and very precarious condition, and nearly always fail to grow into healthy, vigorous plants. The condition of growth varies according to the nature of the plant, but in the case of the majority of plants, in which the period of growth is succeeded by one of rest, the most favourable time for their propagation is directly after the growth is ripened, and before the fall of the leaves, if deciduous. Hard-wooded plants should always be dealt with on the completion of their growth, which is generally in the autumn, though there are many Australian plants which require treatment somewhat different from this, to which, however, we will refer under the heading Hard-wooded Plants.

Soft-wooded plants, such as Fuchsias, Pelargoniums, Bouvardias, &c., may be struck at almost any time, though the autumn is the most favourable season for many of them. The same may be said to apply to herbaceous and succulent plants. In the spring, when vegetable life is awaking from its winter's sleep, and bursting forth into vigorous new growth, the propagation of many plants may be successfully performed. The condition of the wood, together with the strong activity of the sap in the vernal season, is especially favourable for the propagation of quick-growing plants, and as all danger from the effects of winter is avoided by deferring this work until spring, it will be found a good plan to leave the whole of those plants that strike root readily and grow freely, to be dealt with after the winter is about over.

Hard-wooded Plants.—All those plants the young growth of which ripens quickly into hard wiry wood are understood by this term. The Heaths, Epacrises, Azaleas, Camellias, Coniferæ, and many Australian plants are examples of plants of this nature. The propagation by means of cuttings of the whole of these requires great skill and attention, owing to the necessity of selecting as cuttings only those portions of the plants which possess the power of striking root, and the length of time it takes for them to callus and produce roots.

Heaths.—The propagation of these popular plants, and especially of those kinds that require green-house treatment, is an art in itself. In large establishments, where Heaths are propagated by the thousand yearly, the success of the expert propagator is almost marvellous, when we consider how extremely difficult it is to increase many of the kinds.

The season most favourable for putting in the cuttings of these plants commences in August and continues until the February following. Autumn, however, is the most preferable time; cuttings put in then having sufficient time to root and become strong before damp and dark weather sets in. The portions of the plant to be selected as cuttings are the wiry little pieces about one and a half inches long, which are formed about the base of the plants and clothing the lower portions of the principal shoots. In gathering these, the operator must be careful *not to pinch the tips*, or the cuttings will surely perish when subjected to the close damp atmosphere beneath the bell-glass. If possible, these shootlets should be gently pulled rather than cut from the plant, as by pulling, a portion of the old wood remains attached to the base of the cutting, which is of great assistance to it in callusing and forming roots. When gathered, the lower half of each cutting should be stripped of its foliage by pulling away with the finger and thumb one or two leaves at a time. If done carefully, there is no danger of the bark coming away with the leaves. Scissors were once used for this purpose, but the operator will succeed better without them, and avoid all risk of injuring the cuttings by the awkward use of such tools. With a little practice, the stripping may be performed very successfully, and much more rapidly than is possible when scissors are used. A sharp knife should be used to make a clean cut at the base of the cuttings. It is a bad practice to put the cuttings of Heaths, and indeed of any plants, into water and leave them for any length of time, with a view to the prevention of flagging. A damp cloth is the most useful article in which to envelop cuttings that cannot be put into the pots at once. The size of the pots to be used for the reception of the cuttings may vary according to the number it is intended to hold, and the size of the bell-glasses to be used; for large batches, 6-inch or even 8-inch pots may be used, the most convenient small size being 5-inch. These should be filled to within two inches of the top with crocks, which should be covered with a layer of peat fibre, and the pot then filled to within half an inch of the top with an equal mixture of finely-sifted peat and sand. This should be pressed in very firmly for all the kinds of Heaths, and exceptionally firm for the hardest-wooded sorts. Clean silver sand will occupy the remaining portion of the space. A sprinkling with water is necessary to make the sand sufficiently adhesive to enable the operator to dibble the cuttings in firmly. Dry sand must be used to fill up the holes made by the dibber and to make the surface level. The cuttings should be dibbled in about half an inch apart from each other, leaving sufficient space round the margin of the pot to allow the bell-glass to rest upon the sand, so as to keep the cuttings perfectly air-tight. Water well on the completion of the dibbling, and after the water has drained off the cuttings, bell-glasses may be placed over them, and the pots placed in a house where the temperature ranges from 55° to 60°. A dry stage, or one covered with a layer of ashes, is better for the cutting-pots to stand upon than a heated bed or cocoa-nut fibre. The cuttings require to be shaded from sunlight, and to be protected from roof-drip as much as possible. Wipe the bell-glasses dry about every second or third morning. Water may be given whenever the sand approaches dryness, care being taken to allow the water to drain off the cuttings before the glasses are replaced. As soon as rooted, the cuttings will commence to grow, when the glasses should be gradually removed, and the young plants hardened by a little exposure, until finally the pots are transferred to a cool frame to await potting off. Before separating the plants give the whole a good soaking with water, which will cause the soil to adhere to the roots. Small pots and very sandy peat, which should be pressed in firmly—care being taken to keep the base of the stem close to the surface—complete the operations of the propagator. After this, proper attention to the watering, airing, and shading of the plantlets will be necessary for the production of a batch of sturdy, healthy little plants by the end of the year. A section of a cutting-pot prepared for and filled with Heath-cuttings is here shown, and will enable the reader to understand the instructions here given with respect to this important subject (Fig. 6).

Success in the propagation of Heaths is the keystone to success with by far the larger proportion of hard-wooded green-house plants. Epacrises may be treated as advised for Heaths, the only difference being that, instead of stripping off the lower leaves in the preparation of the cutting, it will be necessary to use a pair of small scissors, as the leaves of these plants cannot be pulled off without tearing away a portion of the bark. Many successful propagators prefer to put in the cuttings with the whole of the leaves upon them, and if carefully performed, this is a much safer practice than the use of scissors to remove the leaves, an operation requiring much practice and care to prevent injury to the cutting. Several of the species of Heath require to be grafted upon others of a similar habit and constitution, cuttings of them failing to produce roots. We shall refer to these when treating upon grafting.

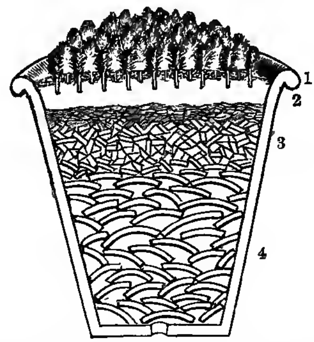


Fig. 6.—Section of Cutting-pot Prepared for and Filled with Heath-cuttings.
1, Silver sand; 2, soil; 3, rough material; 4, crocks.

The Boronias, Leschenaultias, Acacias, Correas, Croweas, Eriostemons, Genethyllis, and all those green-house plants with wood of a hard wiry nature, are not so satisfactorily propagated in the autumn as they are in the early spring. In the latter season the plants from which the cuttings are to be taken should be placed in an intermediate temperature and syringed once or twice a day. This treatment induces rapid growth in the tips of the shoots, and it is the short wiry pieces from the lower portions of the plants which are the most likely to strike freely, if put into pots prepared as advised for Heaths, and treated similarly to them. Instead of standing them upon a dry cool stage, however, it is best to plunge the pots containing cuttings of the above-mentioned plants in a gentle hot-bed, after they have stood for a fortnight upon the stage. The advantage of this treatment for these cuttings is that they callus when upon the stage, before the influence of bottom heat is brought to bear upon them. The heat then quickly excites the sap into activity, the result of which is the formation of roots and immediate growth. For all hard-wooded plants that require their cuttings to be placed under the influence of bottom heat, it is necessary to use this precaution, the effect of extra heat upon all cuttings being to excite them into growth almost immediately; and in the case of all those cuttings the callusing and rooting of which is slow, the early growth is made at the expense of that stored-up vitality which, under proper treatment, is expended in the formation of roots. The most successful method for the propagation of Boronias is that of grafting for most of the species, using as a stock the vigorous *B. elatior*, which strikes freely under treatment as described above, is a quick grower, and as a stock is an excellent nurse for the weaker-growing species. *B. megastigma* may be either struck or grafted. Correas are generally worked upon the free-striking *C. alba*, which is also a suitable stock for Eriostemons and Croweas. The latter are never so satisfactory when upon their own roots as they are when grafted upon *Correa alba* or *Eriostemon intermedia*. Cuttings of Aphelexis and Phænocoma strike best when placed in pots standing upon a cool ash bottom. Cytisuses, or Genistas, as they are generally called, require exceptional treatment for their propagation. A dung hot-bed, as hot as is used for Cucumbers, is required, in which the pots of cuttings should be placed under cover of a close frame, and without the bell-glasses over them. It is necessary to allow the cuttings to callus by treating them as advised above, before subjecting them to the heat and moisture of a hot-bed. The autumn and spring are both equally favourable for the increase of Genistas. *G. Everestiana* is generally grafted upon stocks of *G. fragrans*.

Turning now to another section of the hard-wooded plants, viz., the intermediate ones, the Azaleas, Camellias, Oranges, and Rhododendrons (green-house) are the most popular and best examples. In the propagation of these plants, grafting is had recourse to for the greater portion of them, some of the freer growers and easiest propagated being used as stocks. For Azaleas the common white one, *A. alba*, is most frequently used as a stock upon which the others may be grafted. Many of them, however, thrive well when grown from cuttings, which should be put in during August or September, selecting woody shoots with growing points, and dibbling them into pots filled two-thirds with drainage, and the remainder with sandy peat, surfaced with clean silver sand. A propagating-frame in which the atmosphere can be kept moist, and at a temperature of about 65°, will answer for the propagation of large numbers; bell-glasses, and a shaded position where the temperature can be maintained at 65°, being equally suitable for small quantities of cuttings. If after having been treated thus for three weeks the pots are plunged in a gentle hot-bed or heated cocoa-nut fibre, roots will be very speedily formed. The cuttings should be about three inches in length, and if possible have a portion of the old wood attached to their bases (see Figs. 7, 8, 9).

Fig. 7.—Araucaria excelsa.

Fig. 8.—Rhododendron, Princess Alice.

Fig. 9.—Azalea indica.

Fig. 10.—Camellia japonica.

Camellias are almost invariably grafted upon the common red kind, *C. japonica*, which is increased by means of cuttings. The preparation of these consists of selecting long ripened shoots, which may be cut into lengths of about six inches, the middle of the internode forming as suitable a base for the cutting as a bud and leaf-axil (see Fig. 10). The cuttings strike freely at almost any period of the year, September being perhaps the most favourable. A mixture of sifted loam, peat, and sand forms a suitable compost for the new roots to feed upon; sand, both on the surface of the soil and at the base of the cuttings, being essential for the support of the cutting, and the early formation of roots. Treatment similar to that advised for the Azaleas will answer for the cuttings of Camellias until rooted.

Oranges are generally increased by grafting, although cuttings of most of the commoner kinds root freely if treated as advised for Camellias. Seeds, however, are the most frequently used means of raising a batch of young plants to form stocks for the more delicate kinds.

Rhododendrons.—The popularity of the recently introduced Indian Rhododendrons has led to their being multiplied on a large scale by means of cuttings, grafts, and seeds.

It is too frequently the case that where a particular method has been in general use for the propagation of certain plants, new-comers of the same genus are operated upon in the same way, without being experimented upon by the application of other methods for their increase. This has been the case with the new green-house Rhododendrons, grafting being the only art employed to any extent in their multiplication. Most of them, in fact all of them most likely, thrive at least as well when grown from cuttings as they do when worked on another species; and if the right pieces are selected to form cuttings, large plants may be had in a comparatively short time. A cutting is shown at Fig. 8. When treated liberally, the Indian Rhododendrons make long and rather succulent growths, being sometimes almost a foot in length. If these are severed from the plant in the spring, with the thickly budded portion of the last-made growth attached to form a base sufficiently ripened to produce roots, and be then placed singly in small pots of sandy peat, and plunged in a bed of cocoa-nut fibre, heated to a temperature of 75°, covered with a hand-light or frame, and kept moist and shaded, they will produce a mass of roots in about six weeks, and commence to grow vigorously almost immediately. If grafting is preferred, the species most suitable to form a stock is R. Princess Royal or Countess of Haddington, both being free growers, and in every way adapted for grafting upon.

Araucarias.—With the exception of *A. excelsa*, the Araucarias are increased by means of seeds, which are often imported in large quantities: *A. excelsa*, however, is rarely propagated in this way, the seeds being seldom procurable. The cuttings are only to be had by removing the leader out of the plant, which causes it to produce several shoots near the top. These when about six inches long may be severed from the plant, cutting away a small portion of the wood of the parent stem to form a heel, and placed in a close frame of about 65°, planting them in very sandy peat. A prepared cutting is shown at Fig. 7. Under this treatment *A. excelsa* may be multiplied largely, as the old beheaded plant continues to produce lateral shoots until the whole of its latent buds are exhausted. The branches of these plants are useless as cuttings, as they never form a leader even if they root, but always retain the character they had when upon the plant. It is only the shoots that are produced under the above treatment which may be used for the propagation of this plant. *A. Cookii*, *A. Rulei*, and several other green-house species of Araucaria may be multiplied in the same way.

There are many in-door plants for the increase of which the above-described methods may be successfully employed. The operator can always allow himself to be guided in the choice of methods by a comparison of the character of the different plants treated upon above, with the character of those he desires to propagate.

Soft-wooded Plants.—Under this head we include all those plants that are most readily propagated by means of young shoots. Many of them are almost hard-wooded when mature, but as we have to deal with that portion of their growth which is best adapted for use as cuttings, it may be better to class them with the really soft-wooded plants. An enormous number of in-door garden plants have to be dealt with here; the majority of them being comparatively easy to manage, some of them rather difficult, and a few exceptionally obstinate in the propagator's hands. For the first of these a little extra warmth, a moist close atmosphere, and a suitable medium for the formation of roots, will be found sufficient to enable the cultivator to increase them abundantly. The most important particular is the moisture, for although many of these plants root quite freely when placed with their bases in water, yet the effect of an overdose of it when they are in soil is often fatal. It must be remembered that the gases contained in the soil are operated upon and released by water, with which they mix, and, being absorbed by the cutting in larger quantity than is conducive to its health, they cause decay and damp, and, if excessive, finally destroy the cutting. We know that a great many cuttings emit roots freely and comparatively quickly when placed with their bases in water, and this method is often resorted to for the increase of many plants. Dracænas, Crotons, Nepenthes, Yuccas, Verbenas, Lobelias, and a host of other plants may be propagated by this means; and yet, notwithstanding this, an excess of moisture in soil containing cuttings of these plants often proves fatal to them. From this it will be evident that if soil is employed for the propagation of cuttings, it must be well drained, and must be kept moist without being allowed to become stagnant. Sand is perhaps the best and safest medium for cuttings to form roots in, because it not only does not contain the gases which in soil are a source of danger to cuttings, but it prevents excessive moisture from accumulating about them, and maintains a sweet and moist condition. Hence it is that many of the most successful propagators use soil only in the lower portion of the cutting-pot, the upper being filled with clean sand. It is not known that soil is essential to the formation of roots on cuttings; moisture alone being required to maintain the cuttings in health, and supply the only food the cutting is capable of absorbing. Indeed, it might rather be said that the cuttings do not even absorb moisture until they have formed roots, if the surrounding atmosphere is sufficiently saturated to prevent the moisture contained in the cutting from evaporating through perspiration. This is to be seen in the fact of many cuttings forming roots even when the whole of them is exposed to the air, if the moisture of the atmosphere is sufficient to keep the cuttings from perspiring, the effect of which is what in garden phraseology is termed "flagging." The maintenance of the proper condition of the soil and atmosphere as regards moisture is an important point in the art of propagation; hence the use of bell-glasses, propagating-cases, and such-like appliances, whose special purpose is the prevention of perspiration in the cuttings. Saturation point for the atmosphere, and moistness without stagnation in the soil, are necessary for the successful propagation of most plants, the only exceptions perhaps being those of a succulent, tough-skinned nature.

Fig. 11.—Cutting of Pelargonium.

Fig. 12.—Cutting of Bouvardia.

Heat is an important factor in the multiplication of plants. It may be taken as an unvarying rule that all plants require for their propagation a higher temperature than they enjoy naturally. In many cases it is found that a very high temperature indeed may be used for cuttings of many plants, and if carefully applied this excessive heat may be productive of extraordinary success. For the propagation of many of our hardy plants a tropical heat is often resorted to, and as the effect of this is the formation of roots in a very short time, and an excitement into immediate growth, a great saving of time is thus secured. But as we are now dealing more especially with in-door plants, it may be stated that cuttings of the whole of these strike freely in a temperature about 10° higher than the plants themselves require. Bottom-heat may be employed for cuttings of soft-wooded plants from the first, as the process of callusing and forming roots is in their case much more rapid than in the case of hard-wooded plants. The temperature of the soil or sand in which the cuttings are planted should exceed by a few degrees that of the atmosphere surrounding them. A wide difference between these is almost sure to excite the cuttings into weak and premature growth, which, being unsupported by roots, soon rots, and the whole cutting perishes. Shade from bright sunlight is necessary for the safety of soft-wooded cuttings, but it is not advisable to shade more than prevents the sun's rays from reaching the cuttings, as excessive shade weakens the foliage, and renders the fresh growth so soft that the cutting is apt to damp off.

These general principles may be applied to the propagation of all soft-wooded plants. The limits of our space forbid us to do more than point out the principles of the methods practised for the multiplication of the thousands of plants which come under this heading. As has already been pointed out, spring is the most favourable time for operations with soft-wooded plants, although their nature is such as admits of their propagation at any time of the year. Dracænas, Crotons, Begonias, Hibiscus, and such-like strong and free-growing subjects, may be propagated by means of large pieces, which when rooted are good plants at once. Bouvardias may be taken as representative of that class of plants the wood of which is fairly hard when ripened, but young shoots of which are soft and sappy. Of these, the portions to select as cuttings are the young shoots produced on old ripened plants, when placed in a moist, warm house. If taken off with a heel and placed in pots of sand in a propagating-frame, these cuttings root much more freely than cuttings of stronger and riper growth. A prepared cutting is shown along with one of Pelargoniums at Figs. 11, 12. Finally, it may be said that the cuttings of soft-wooded plants strike root in a moist cutting-frame or beneath a bell-glass, the temperature in which is between 60° and 70°, and the atmosphere and medium in which the cuttings are planted sufficiently moist to prevent flagging, and to afford a proper supply of nourishment to the cutting so soon as roots are formed.

Nepenthes.—Cuttings of these plants are in most cases not difficult to strike, while a few of them require great care. Early in spring, plants which have become leggy must be cut down, and the tops cut into lengths of one or two eyes each, a leaf and an eye being sufficient to form a plant, should the cuttings be scarce, although a shoot a foot in length produces roots freely. Examples of both are shown at Fig. 13. A frame of cocoa-nut fibre, heated to a temperature of 80°, and kept very moist, may be used, the cuttings being planted in the fibre. In this they will produce roots in about six weeks' time. Should a frame be unobtainable, a flat pan filled with water and some 2½-inch pots may be used, the pots being inverted in the water, and the cutting placed with its base through the hole of the pot, but not allowed to touch the water. Over the whole place a large bell-glass, and thus circumstanced, if set in a high stove temperature, the cuttings will soon callus and form roots, when they may be potted into peat and sphagnum moss. For such species as *N. albo-marginata*, *N. rajah*, and *N. sanguinea*, it will be found safest to half sever the portion intended for a cutting from the parent stem, and tie a bunch of sphagnum mixed with sand about the incision; and if kept continually saturated, roots should form in the sphagnum. If severed from the plant at once, cuttings of the above-mentioned species rarely produce roots. Both cuttings and plants of Nepenthes require an abundance of moisture always.

Fig. 13.—Nepenthes, showing both top and inter-node cuttings.

ORCHIDS.

By William Hugh Gower.

Oncidium.—This genus is one of the very largest in the whole order; the name comes from *oykos*, "a tumour," and refers to the peculiar callosities which are found at the base of the labellum. *Oncidium* as a genus is very nearly allied to *Odontoglossum*; the chief difference is to be found in the column, which is much shorter, and broad at the base, and not narrow as in *Odontoglossum*. As a rule these plants grow at lower elevations than their near allies the *Odontoglots*, although some few species are found at great heights. The larger kinds thrive best under pot-culture, but the smaller ones succeed admirably on blocks of wood; equal parts of rough peat and sphagnum moss, with a little sharp sand, and some nodules of charcoal form a nice compost for them. Thoso species which are found at low elevations require the temperature of the Brazilian House, but those from cooler regions should be kept in the Peruvian House.

O. ampliatum majus.—A fine old species, with large roundish compressed pseudo-bulbs, which are apple-green freckled with streaks of red; leaves oblong-lanceolate, flat, and shining bright green; scape erect, about three feet high, much branched and many-flowered; the lip is large, bi-lobed in front, bright yellow, paler beneath. Spring and early summer. Panama and Guatemala.

O. aurarium.—This is a robust-growing plant, with large and pale green pseudo-bulbs; the panicle is much branched, bearing an immense number of flowers, which are rich yellow, the sepals and petals being transversely blotched with reddish-brown; lip clear yellow, stained on the crest with brown. Spring months. Bolivia.

O. bifolium majus.—This is a dwarf-growing plant which thrives best on a block of wood; the pseudo-bulbs are ovate, deep green, streaked and dotted with black; leaves in pairs, short and dark green; racemes about a foot long, many-flowered, but laxly set; lip large, bi-lobed in front, deep rich golden-yellow. Spring and early summer. Monte Video.

O. calanthum. — The pseudo-bulbs are roundish, ovate, smooth in the young state, but becoming furrowed with age; leaves lanceolate, erect, and deep green; raceme lax; sepals and petals bright rich yellow; the lip large, deeper coloured than the petals, stained at the base with reddish-crimson. It is an abundant bloomer. Winter and early spring. Cordilleras of Ecuador, at considerable elevations.

ONCIDIUM CRŒSUS.

O. cheirophorum.—A small-growing species, with orbicular compressed pseudo-bulbs, seldom exceeding an inch in height; the leaves are about six inches long, narrow, dark green; the scape is longer than the leaves, and very slender; the flowers are densely set and numerous; they are deliciously fragrant, wholly bright, sparkling yellow; the lip is much the larger part of the flower, and is three-lobed. Winter months. Volcano of Chiriqui, at 8,000 feet elevation.

O. chrysothyrsus.—Pseudo-bulbs oblong, smooth when young, becoming ribbed with age, bearing a pair of oblong-lanceolate leaves, which like the pseudo-bulbs are pale green; the spike is stout and erect, about three feet high, bearing a much-branched panicle of many flowers; sepals and petals small, greenish-yellow, transversely barred with red; the lip bifid, large, and spreading, rich golden-yellow, marked at the base with purplish-crimson. Summer months. Southern Brazil.

O. concolor.—A very pretty species, which succeeds best upon a block of wood, or in a hanging basket; pseudo-bulbs ovate, bearing a pair of small oblong-acute leaves; scape pendulous, bearing a dense raceme of flowers, which measure some two inches across; sepals and petals nearly equal; lip very large, bi-lobed in front, the whole flower rich golden-yellow, the base of the lip being ornamented with two lines of reddish-crimson. Spring and early summer. Brazil.

O. crispum. — This is a very bold and showy species; pseudo-bulbs oblong, slightly compressed, ribbed, some four inches high, and rough, dull pale brown, or brownish-green in colour; leaves in pairs, lanceolate, thick and leathery in texture, and dark green; scape sometimes simple, but more usually branched, bearing an immense quantity of its gorgeous flowers; sepals and petals beautifully crisp on the edges, all a rich copper-colour, or rich brown, according to the particular variety; petals much the broader; lip large, bi-lobed in front, and like the petals, crispate on the edge, rich coppery-brown, the base and column yellow. In the variety *marginatum* the sepals and petals are margined with a band of golden-yellow. Hanging baskets. Summer months. Organ Mountains, Brazil.

O. crœsus.—A small plant which must be grown upon a block of wood. The whole plant seldom exceeds six inches in height; pseudo-bulbs slender, conical, bearing a pair of linear, fleshy, pale green leaves; scape short, bearing a few large flowers; sepals and petals greenish-yellow, streaked with brown; lip large, flat, and spreading, rich deep gold colour, crest and base deep velvety-black. Summer months. Organ Mountains, Brazil.

O. cucullatum.—This is a small-growing species, which requires suspending upon a block or in a basket, and placed in the coolest end of the Peruvian House; pseudo-bulbs small, oblong, bearing a single linear-oblong leaf, the whole plant not above six inches high; spike erect, bearing three to six flowers, which last long in full beauty; sepals and petals small, dull deep brown; lip large and spreading, emarginate in front, considerably above an inch across, rosy-purple, spotted with deep purple, crests orange-yellow. This is the normal form of the plant, but it is so variable that scarcely two are exactly alike. Winter and spring months. Mountain forests of Ecuador, 6,000 to 13,000 feet elevation.

O. curtum.—In general appearance this plant resembles *O. crispum*, and it requires to be treated in the same manner; spike erect, bearing a large and many-flowered panicle of lovely blooms; sepals and petals yellow, transversely banded with reddish-brown spots; lip rich golden-yellow, with a band of brownish-purple spots near the margin. Spring and early summer. Brazil.

O. hæmatochilum.—This rare and beautiful plant belongs to the group of which *O. luridum* may be taken as a type; they are quite destitute of pseudo-bulbs, but have erect, thick, and fleshy leaves. In this species the leaves are oblong, thick, and fleshy, and taper to a point, dark green with dull brown spots; spike erect; raceme dense; sepals and petals spathulate, greenish-yellow, blotched with chestnut and speckled with purple; lip large, rich crimson, passing into bright rose towards the base. Autumn months. New Grenada.

O. incurvum.—An elegant plant with oblong compressed pseudo-bulbs, which are ribbed and pale green; leaves in pairs, narrow, and lanceolate; scape erect, branching, about three feet high, and many-flowered; sepals and petals long and narrow, white, transversely blotched with reddish-purple or brown; lip white, stained at the base and on the crest with reddish-purple. Autumn and winter months. Mexico.

O. Kramerianum.—This is one of the Butterfly Oncids, and thrives best upon a block of wood or in a basket; pseudo-bulbs short and cylindrical, corrugated, dark green, tinged with brown, bearing a solitary leathery leaf, which is deep heavy green, netted and spotted with reddish-crimson; spike erect, some two feet long, forming knotted joints at intervals of a few inches, and bearing on the apex a single butterfly-shaped flower; the sepals are narrow and stand erect, whilst the petals are broad and deflexed, the ground-colour rich golden-yellow, over which is spread a profusion of chestnut blotches and spots, the edges beautifully undulated; lip same colour as sepals, plain in the centre, with a marginal band of rich brown, where it is undulated and fringed. It is almost a perpetual bloomer, if the old spikes are not cut off. Central America, on Chimborazo, at 3,000 feet elevation. A variety of *O. Papilio.*

O. Lanceanum.—This grand species requires more heat than any other member of the genus. It is quite destitute of pseudo-bulbs; leaves large, erect, thick and coriaceous, carinate, bright green, profusely ornamented with reddish-brown spots; spike erect, one to two feet high, many-flowered; flowers powerfully scented like vanilla; sepals and petals large and of great substance, greenish-yellow, barred and blotched with reddish-crimson; lip large, thick, and fleshy; the lower portion deep rich violet, the basal half passing into rose. In one variety the lower portion of the lip is white. Summer months. Demerara and Surinam.

O. leucochilum.—An old but beautiful species, which seems to luxuriate naturally in a region where the temperature never exceeds 70°, and often falls to 36°; the pseudo-bulbs are stout, oblong, and ribbed; spike erect, several feet high, branched, and many-flowered; sepals and petals greenish-white, transversely streaked with brown or reddish-crimson; lip large and flat, pure white. Winter months. Guatemala.

O. macranthum.—Pseudo-bulbs large, flask-shaped, three to four inches high, becoming furrowed with age, bearing a pair of narrowly-lanceolate leaves a foot or more long; panicle climbing, several feet in length, and bearing numerous thick and fleshy flowers some four inches across; sepals and petals roundish, so as to form quite a full flower, golden-yellow, tinged with dull brown; lip small, hastate; side lobes purplish-brown, yellow in front, with a white crest. Spring and early summer, lasting a very long time in full beauty. Peru and New Grenada, at 7,000 to 14,000 feet elevation.

O. Marshallianum.—In appearance this much resembles *O. crispum*, previously described, and it should be treated in the same manner; when the flowers open it is thoroughly distinct from any other species; the scape is erect and much branched, bearing an immense number of its large rich golden-yellow flowers, which are blotched and spotted with bright brown. Summer months. Organ Mountains, Brazil.

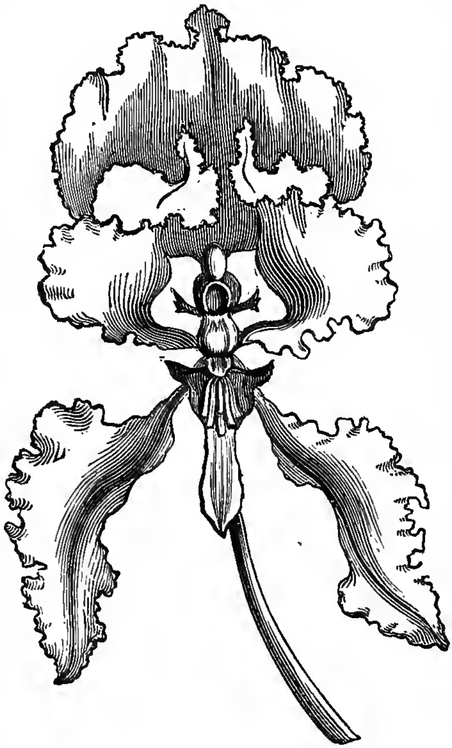
O. ornithorhynchum.—The pseudo-bulbs and leaves of this species are of a uniform pale green, and seldom exceed a foot in height; the spike is much branched, and bears a profusion of its rather small soft rose-coloured flowers, which have a perfume resembling Heliotrope. In the variety *albiflorum*, the soft rose-colour is changed to pure white. Winter months. Cool damp regions of Mexico.

O. Papilio (the Butterfly) thrives best upon a block of wood; pseudo-bulbs compressed, dark green, sometimes freckled with red, bearing a single broad obtuse leaf, leathery in texture, deep green, marbled with reddish-brown. Spike erect, some two feet or more high, bearing on the apex a single large flower, which is succeeded by others from lateral buds; sepals narrow, erect; petals spreading, slightly deflexed, broad at base, tapering to a point, the ground-colour golden-yellow, transversely barred with chestnut-brown, margin plain and entire; the lip large and flat, golden-yellow broadly margined with rich brown. Summer months. Caraccas, Venezuela.

O. Phalænopsis.—A dwarf species, resembling *O. cucullatum* in growth, and requiring the same treatment; pseudo-bulbs ovate, about three inches high, bearing in pairs upon the summit its dark green narrow leaves. Scape erect, three to six-flowered; sepals and petals cream-colour, blotched and barred transversely with violet and crimson; lip large, somewhat fiddle-shaped, bi-lobed in front, creamy-white, beautifully spotted towards the base with violet and crimson, crest deep yellow. Winter months. Peru, at great elevations.

O. phymatochilum.—Although not so showy as some species, this plant is always pleasing. Pseudo-bulbs fusiform, compressed, and dull purplish-brown in colour; leaves solitary, leathery in texture, and deep green; scape erect, slender, twelve to eighteen inches long, and bearing many flowers; sepals and petals nearly equal, linear and curled, bright green, spotted with reddish-brown; lip flat, pure white, the crest yellow, with a few purplish spots in front. Spring and early summer. Mexico.

O. sarcodes.—A comparatively dwarf-growing and very compact plant. The pseudo-bulbs tapering upwards, very deep green; leaves in pairs, oblong-obtuse, shining dark green; the scape erect, much branched, many-flowered; these vary considerably in the density of the markings; sepals and petals (in the example before us) deep crimson, tipped with deep orange-yellow, where they are more or less spotted with crimson; lip orange-yellow, crimson at base, and the front lobe ornamented with round crimson spots. Its very handsome flowers last long in beauty. Spring and early summer. Sao Paulo, Brazil.



ONCIDIUM SERRATUM.

O. serratum. — A strong grower, with large, oval pseudo-bulbs, and rigid, dark green leaves. Scape ten to fourteen feet long, much branched and twining; flowers large; sepals and petals usually deep, rich brown, bordered with yellow, and beautifully crisp or serrated on the edges; lip small, yellow, with a few brown markings. Winter and spring months. Peru, at considerable elevations.

O. sessile.—This species is compact in growth, and very free-flowering. Pseudo-bulbs oblong, slightly compressed and furrowed, bearing a pair of somewhat short, obtuse, ligulate leaves, thin in texture, and pale green. Scape erect, much branched; sepals and petals about equal, sessile (hence the name), yellow, spotted near the base with rich brown; lip broad and flat, the same colour. Spring and early summer. Caraccas.

O. tigrinum, var. *splendidum.*—As its name implies, this is a splendid variety, and unfortunately still very rare. Pseudo-bulbs nearly round, stout, compressed, about three inches high, deep green, bearing a single, thick and hard, oblong-obtuse, dark green leaf. Scape erect, upwards of two feet high, much branched, ten to twenty-flowered; sepals and petals nearly equal, turned back, and slightly waved on the edges; ground-colour yellow, transversely banded with rich brown; lip very large, spreading, slightly bi-lobed in front, clear brilliant yellow. Spring and early summer. Irapœan Mountains, Mexico.

O. varicosum.—Pseudo-bulbs ovate, deep green, marked towards the top with black, bearing a pair of short, dark green leaves. Panicle much branched, twenty to forty-flowered, or more; sepals and petals small, greenish-yellow, faintly barred with brown; lip large and flat, bright golden-yellow. Autumn and winter months. Sao Paulo, Brazil.

O. varicosum, var. *Rogersii.*—This truly grand variety is very similar in growth to the preceding, but differs much in size and quantity of blooms, the large branching panicles supporting from 100 to 170 flowers upwards of two inches across; brilliant yellow. Autumn months. Sao Paulo, Brazil.

Orchis.—This is the genus which has given its name to the order; in it are included many of the English and European Orchids, all being terrestrial. There are, however, some few species which must find a place in this enumeration, although they have been much neglected. For soil use a mixture of peat, leaf-mould, and sand; drain well, and although the plants are deciduous, do not dry them up in the winter; also bear in mind that terrestrial plants, having their roots and bulbs in the ground, do not require elevating above the rim of the pot in the manner recommended for *epiphytes.* For general treatment see *Disa.*

O. foliosa.—A remarkably handsome species, which, as its name implies, is amply furnished with leaves. It attains a height of about eighteen inches, and bears on the apex a dense pyramidal head of rich purple flowers. The leaves are broad, oblong-lanceolate, and deep green; the sepals and petals about equal, ovate; the lip three-lobed, broader than long. Summer months. Canary Islands.

Pachystoma.—This plant is of recent introduction, and has much the appearance of a Bolbophyllum, it is of dwarf habit, very free-growing, and an abundant bloomer. It should be grown in a pot, with peat and sphagnum. East Indian House.

P. Thomsonianum.—This elegant plant is thus described by Professor Reichenbach: "The bulbs may be likened to certain small Figs, and which are alternately marked by numerous small grooves. The leaf is membranous, a span high. The long peduncle is velvety, with one sheath in the middle, and bears two large flowers, and it may be surmised the flowers by-and-by will increase in number. Sepals and petals white, beautifully shining as if varnished; lip of the brightest purple, side laceniæ and column light green, striped and blotched with brown." Autumn months. West coast of Africa.

Palumbina.—This genus contains but a single species. It is a small plant, originally named by Lindl, *Oncidium candidum.* The appearance of the flowers suggested "flying pigeons," and hence the name Palumbina. The botanical differences are, however, insufficient to separate this as a genus, and so Lindley's name is now accepted by best authorities. It thrives best under the same treatment recommended for *Odontoglossum Alexandræ.* Peruvian House.

P. candida.—This plant somewhat resembles a small *Odontoglossum pulchellum* in habit and style of growth, but the practised eye would easily detect the difference. Pseudo-bulbs narrow, compressed, smooth, and dark green, bearing a solitary linear acuminate leaf, six to nine inches long, dark green above, paler below. Scape erect, coming up with the young growths, and bearing five or six flowers, upwards of an inch across, which are pure waxy-white, and have somewhat the appearance of flying pigeons. Sepals and petals oblong, subacute; lip much longer, caudate, with a few reddish dots at the base. Summer months, lasting a long time in perfection. Mexico.

Paphinia.—The species was originally named *Maxillaria;* it is distinguished from that genus, however, in the different arrangement of its four pollen-masses. The name is derived from *Venus*, and does not refer to any part of the plant. Pot or basket culture suits it, but we prefer the latter. It thrives well in a mixture of peat, sphagnum, and nodules of charcoal, and should be watered freely when growing, but much less during the resting season. Brazilian House. (*Paphinia* is now included under *Lycaste.*)

P. cristata.—This handsome species is a dwarf and compact plant, seldom exceeding ten inches in height, and of very curious structure. It produces oblong, or ovate, compressed pseudo-bulbs, which are slightly ribbed, and shining dark green; leaves, two or three, about six inches long, plaited and dark green. The flower-stem springs from the base of the mature growth, bearing one or two flowers. Sepals and petals nearly equal, the latter rather smaller, the ground-colour creamy-white, profusely striped, spotted, and barred with chocolate. Lip smaller, reddish-purple, with a fringe of slender white hairs on the tip. The colours vary, however, in different plants. Summer and autumn months. Trinidad.

Peristeria.—This is known in its own country as the Holy Ghost or Dove Plant, and is there called El Spirito Santo, from the supposed resemblance of the column inside the flower to a small white dove with expanded wings, and *Peristeria* comes from the Greek for dove. The genus originally contained several species, but most of them have now been removed to *Acineta.*

The plant here described is a strong grower, and enjoys plenty of root-room. The pots should be well drained, and the plants potted in a mixture of equal parts of loam, leaf-mould, and peat, to which add a little sharp sand to keep it porous. Peristerias enjoy strong heat, and a bountiful supply of water during the period of growth, but if the plants are strong it should be entirely withheld during the cool or resting season. Brazilian House.

P. elata.—A bold-growing plant, with pseudo-bulbs as large as a Spanish Onion when well grown, bearing several large plicate leaves, some three feet high, upwards of six inches broad, and deep green. The peduncle is erect, springing from the base of the pseudo-bulbs, and rises to a height of three or four feet, or more, bearing towards the upper part numerous globose waxy flowers of great substance, each measuring one to two inches across, and deliciously fragrant. Summer months. Panama.

PACHYSTOMA THOMSONIANUM.

Pescatoria.—This genus was founded to keep alive the memory of that zealous Orchidologist, M. Pescatore, of St. Cloud; it is, however, now more correctly included under *Zygopetalum*. In general appearance they very much resemble *Huntleya*, and they require the same treatment.

P. Dayana.—A variable plant; leaves arranged in a two-ranked fashion, eight or ten inches long, about two in breadth. Flowers solitary, on short, stout peduncles, and measuring about two inches and a half across. Sepals larger than the petals, waxy-white, tipped with violet. Lip deep crimson, white in front; at the base is a plaited callosity of a deep violet. Summer and autumn. New Grenada.

P. Klabochorum.—These plants resemble each other very much in growth. Flowers solitary, very large, thick, and waxy in texture. Sepals and petals creamy-white, heavily tipped with rosy-violet. Lip small and, together with the column, deep purplish-violet. Autumn months. New Grenada.

P. lamellosa.—Flowers about two inches and a half across; sepals and petals greenish-yellow, the lateral sepals much the larger; lip same colour, with a raised crest, which is orange and brown. Autumn months. New Grenada.

P. Wallisii.—Flowers solitary, large, ground-colour of sepals and petals soft creamy-white, tipped with violet, back part of the column deep violet, lip purplish-violet. Spring and early summer months. New Grenada.

PERISTERIA ELATA.

Phajus.—The name comes from *Phaius*, in reference to the polished appearance of the flowers; it is a genus of robust-growing terrestrial plants, with corm-like pseudo-bulbs, and large, erect, plaited, dark green leaves. They make large roots, and consequently require plenty of pot-room. The soil should be a mixture of peat, loam, and leaf-mould, and some well-decomposed cow-manure. Pot firmly, and do not elevate the pseudo-bulbs above the rim of the pot. Water them freely during the season of growth, but when at rest very little should be given, and the plants may be placed in a lower temperature. East Indian House when growing, Peruvian House when at rest.

P. Bernaysii.—Leaves broadly lanceolate, plicate, and deep green. Peduncle erect, longer than the leaves, naked below, bearing towards the top a large raceme of ten to twenty flowers. Sepals and petals about equal, spreading, china-white outside, pale yellow within; lip three-lobed, side-lobes rolled over the column, white, stained with pale yellow in front. Winter and spring months. Queensland.

P. grandifolius.—Habit same as the preceding. Sepals and petals white, lip brown. Autumn and winter into spring. A cultivated Chinese plant.

P. grandifolius, var. *striata.*—In this form the leaves are prettily striped with golden-yellow. Flowers the same as the species. China.

P. irroratus.—Pseudo-bulbs conical, growth resembling *P. grandifolius.* Sepals and petals creamy-white, tinged with rose, with several prominent veins running through their entire length; lip nearly circular, flat, creamy-white, light yellow at the base, with three obscure ridges on the disc. This plant is a garden hybrid, between *Calanthe vestita* and *Phajus grandifolius.* Winter months.

P. maculatus.—This species takes its name from the numerous yellow spots with which the leaves are ornamented. Flowers very showy; sepals and petals rich yellow; lip same colour, bearing numerous streaks of light brown; edge of the lip crimped and frilled, rich cinnamon-brown in colour. Winter months. Nepaul.

P. Wallichii.—The strongest-growing species, producing racemes of large flowers. Sepals and petals orange, yellow, and white; lip buff, suffused with purple. Winter and spring. Northern India.

END OF VOL. III.