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THE
GARDENER'S
MONTHLY VOLUME.

v. 7
THE PINE APPLE;
ITS CULTURE, USES, AND HISTORY.

BY GEORGE W. JOHNSON,
Author of "The Dictionary of Modern Gardening," "Gardener's
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JULY—VOL.

LONDON:
R. BALDWIN, PATERNOSTER ROW.
WINCHESTER:
H. WOOLDRIDGE, HIGH-STREET.
DUBLIN:
W. AND G. ROBERTSON.

1847.
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WINCHESTER:
PRINTED BY H. WOOLDRIDGE, HIGH-STREET.

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THE PINE APPLE.

CULTURE—(*Continued*).

Temperature of Air.—There is no well-grounded doubt that the pine apple is a much hardier plant than is usually supposed, and we have ample evidence demonstrating that it will not only endure very high, but very low temperatures, and that it will flourish and be fruitful when growing permanently in temperatures much below those usually assigned for it. Our conviction upon this point cannot be shewn more decisively than by our having commenced, without any previous communication, experiments to test whether this fruit cannot be grown out of doors in Devonshire, and in a greenhouse in Hampshire. Mr. Knight found that a young pine apple plant endured without injury a temperature as low as the freezing point of water; whilst to try its endurance of the other extreme, Mr. M'Phail found it could be plunged in water heated to 130 degs. without being prejudiced.

To ascertain this point decisively, he filled four vessels with hot water. The water in the first vessel was 130 degrees hot, that in the second 140, that in the third 150, and that in the fourth 160. Into each these vessels he put a few pine plants, divested of their fibrous roots, and suffered them to remain in the water about an hour. The plants which had been immersed in the water heated to 140 and 150 degrees, were a little hurt at the extremities of their leaves, but after being dried in the hothouse, they were planted, and grew as vigorous as if they had not been put into hot water; the plants put into water 130 degrees warm were not in the least injured; but those put into water heated to 160 degrees were entirely destroyed. (*M'Phail.*)

Another excellent authority, one very conversant with the capabilities and habits of the pine apple, Mr. Mills, gardener to Baroness Rothschild, at Gunnersbury Park, quite agrees with us on these points, observing that the pine apple is by no means the tender plant that it is by many supposed to be. It will live, if kept moderately dry, in the low temperature of 34 degs.; still it is not advisable to keep it so cold any length of time, and it requires from 45 to 50 degs. during the months of November, December, and January, in which temperature young plants will progress that are not intended to fruit the following summer; and even for these, the temperature may

be increased in summer 10 or 20 degs. with benefit. All larger plants should be kept at a higher temperature, say from 55 to 60 degs., and during the short intervals of sunshine an increase of 20 degs. will be highly advantageous, particularly when the young fruit is in blossom, and even 80 degs. in winter, from sun heat, if only for a very short period. It is by no means necessary to keep them in a uniform regular temperature, but to let it vary according to the external air; it is good to let them have comparative rest in very dark, dull, cold weather.* It gives them vigour, and they then feel the turn of the season to greater advantage; whereas, if forced into growth in winter, it is at the expense of the strength and health of the plants; the leaves elongate without firmness, and they become yellow for want of light. Plants so treated can never be made good afterwards;

* Although it is by no means necessary to keep pine apple plants in one uniform temperature, yet we cannot agree with the stand-still system, during any period of their growth. In the short days of winter we continue our plants' progress, though not with midsummer rapidity, yet steadily and strongly, with a robust fleshy foliage and strong roots. This is fully maintained at Bicton, by applying the heat by linings from the top part of the back and front walls of the pine pit, and less humidity from the bottom; by the application of abundance of air daily, but mostly at night. We are in no fear of dampness injuring the plants, or of their becoming weak, drawn, or yellow.

as their constitution or organization has been deranged, and the plants have become quite debilitated. Young plants will do well in high temperature, say from 80 to 85 degs. sunheat, with plenty of air and moisture. The pine plant, when in a fruiting state, and also when swelling its fruit, is not benefited in the summer by a heat exceeding 90 degs. with sun; 80 degs. is the best heat for swelling the fruit, and although it will swell much faster in a heat of from 100 to 120 degs., it will not come to so great a weight when grown in high temperature, as it would do if kept in one not exceeding 80 degs. (*Mills on Pine Apple*, 9.)

This leads us to the inquiry, what is the best temperature for the pine apple? We are always best answered if the reply to our queries can be obtained from nature; and the reply, therefore, to the above query shall be from observations made at Calcutta. In the vicinity of that city, the yellow-fleshed pine apples are high-flavoured, and commonly weigh between 5lbs. and 6lbs.; and M. Speede, in his "Indian Hand-book of Gardening," says (p. 183), that by a system of very ordinary cultivation, his brother grew them weighing $7\frac{1}{2}$ lbs. This was, of course, when the plants were exposed to a climate of which the following table shews the monthly averages of temperature, taken at the hottest and coldest periods of the 24 hours. Now, although pine apples may be

obtained nearly all the year at Calcutta, yet their period of greatest perfection is from April to September. This may be termed their ripening or stove period ; and it will be found, upon referring to this table, that the average maximum temperature of that period is above 91 degrees, and the average minimum more than 79.

TEMPERATURE.

	Maximum.	Minimum.
January ..	84·5	60
February ..	90	65
March ..	90·5	71
April ..	97	77·5
May ..	95	78·5
June ..	91·5	81
July ..	88	80
August ..	87	80
September ..	90	80
October ..	91	75
November ..	85·5	64
December ..	81·5	57

We may just observe that the above are average temperatures, and that the pine apple in Bengal often has to endure such widely differing temperatures as 129 and 53 degs. From these facts, we conclude that if in England the temperatures each month never ranged higher in the pinery than the minimums in the above table, they would not be too high in proportion to the diminished light of our latitude.

The following are the night temperatures aimed at

by Mr. Glendinning, and we are of opinion that they are full 5 degs. too high, not only from our own experience, but because the day temperature should differ full 10 degs. above that of the night. We are confirmed rather than shaken in this opinion by Mr. Glendinning's observation that—

Allowance must be made for sudden transitions of the external atmosphere, or any such cause which may influence the air of the internal apartments; a few degrees up or down; this variation, unless to a great and unnatural degree, will in no way affect the general health of the plants.

MONTHLY TABLE OF NIGHT TEMPERATURE.

			Pit.	Stove.
January	..	..	54	65
February	..	..	56	68
March	..	..	57	71
April ..	..	..	59	73
May ..	..	..	60	75
June ..	..	..	61	76
July ..	..	..	62	78
August	..	..	62	78
September	..	..	60	76
October	..	..	58	73
November	..	..	56	69
December	..	..	54	65

(*Glendinning on Pine Apple*, 52.)

We quite assent to the reasonableness of growing the succession plants in a temperature uniformly

about 12 or 14 degs. lower than that employed for the fruiting plants; and Dr. Lindley scarcely expresses his opinion upon this point too strongly.

We do not agree, however, without some qualification, to the opinion that plants which grow fast when young never carry good fruit. That they are subject to debility if allowed to make rapid growth, under some systems of management, is certainly true; but there are exceptions to this rule, under certain circumstances, or how are we to produce a robust plant by the growth only of a few months, and produce fruit from it, of surpassing excellence, within the year? To perfect a fruit alone, after its first appearance, in first rate condition as to colour, flavour, and extreme weightiness, according to its size, would take, or should be allowed to take, the time of from 16 to 18 weeks. We are in no fear of debility in its constitution, or of its organization being deranged under a correct system of applying heat, air, water, and humidity of atmosphere, at any season of the year; and we cannot countenance the stand-still system. Slow, but still continued, growth is quite another thing, and must be adopted at some seasons of the year. Thus, no one now would think of applying the same amount of heat and moisture to any plant in short dark days as they would in the bright, hot, and dry days of summer.

With this qualification we agree with Dr. Lindley,

that the first, and we apprehend the most essential, circumstance, is the growing plants slowly at first, and rapidly afterwards. It is a certain law in vegetable physiology, that plants which grow fast when young never carry good fruit. It is, indeed, impossible that they should: for how can we expect vigour in old age from debility in youth? and rapid growth when young is inevitably attended by debility. Plants grow fast, but acquire no solidity. They are like children who shoot up at once into the stature of manhood, and immediately afterwards perish of consumption; or they may be likened to those fungi which are formed in a day, and rot in an hour. This truth is just as applicable to melons, strawberries, peaches, and vines, as to pine apples.

If, says Mr. Glendinning, the pine-apple in its younger state is supplied with the same amount of heat and moisture as are required in ripening the fruit, the foliage will become drawn and slender, and the whole plant so constitutionally weak, that nothing but puny fruit could be produced. In fact, this agrees with the natural habit of the pine. For in the tropics it grows in the cool season and fruits in the hot season, and there is scarcely less than 16 deg. of difference between these two periods. For instance, at Nassau, where the Providence pines are found, the difference is from 14 to 15 degs.; and in some parts of India, it amounts to as much as 30 degs. It is

true that these variations of season are not applicable when pines are several seasons before they fruit ; but then very fine pines are always produced on young plants, for the whole of whose growth two seasons—the cool and the hot one—are sufficient.

Mr. Hamilton, gardener to F. A. Philips, Esq., of Thornfield, near Stockport, and one of the best of modern pine cultivators, is equally decisive in his opinions as to the variations of the temperatures, during the different periods of the plant's growth. He says that the heat required for succession plants ought to vary according to the season. In the winter, when they are not growing much, 55 to 60 degs. will be sufficient ; but from March to November, 70 to 80 degs. during the day, and 65 to 70 degs. at night. (*Hamilton on Pine Apple*, 67.)

In the fruiting stove he recommends the maximum heat of the house in November, December, and January, by artificial means, not to exceed 60 degs., the minimum 55 degs. In spring and autumn, if fruit are to be swelled, maximum by sunshine 80, minimum 68, medium by artificial heat 70 degs. In the summer, the maximum, under the effect of strong sunshine, may rise to 90 degrees, and may be allowed to drop as low as 70 degrees in the morning. In very bright, sunny weather, Mr. Hamilton says, the plants in fruit had better be shaded, than have admitted to them too much air at any time of the day. From

this recommendation of shading we entirely dissent, considering it to be one of the most incorrect practices in modern pine culture. In this country, where we have so much gloomy weather, and consequent deficiency of light, there is never such an excess for any plant that is a native of the tropics as to render necessary shade when it is established, or its fruit swelling. It is a recommendation not in accordance with the dictates of nature, though such a recommendation was very necessary in those by-gone days, when pine plants were cultivated almost without roots. We condemn the shading system altogether, for plants of any age which are established with roots. Applied to fruit, or fruiting plants, it must certainly occasion a considerable sacrifice of their best qualities. A far more correct principle is, instead of shading, to secure in fervid weather a genial humidity to the interior atmosphere. We are fully aware that shading was in full practice among cultivators of the pine years ago, but considering the poor rootless system then adopted, and the parching, unkind interior atmosphere, and the fine, soured compost employed, undoubtedly shading was then necessary, to keep upon the plants even a slight degree of green colour; otherwise they would have had a more seared, lean, narrow-leaved appearance than they then had. Instead of shading, let the pine-grower secure a regular and constant circulation of moist air in the interior

of the structure, as previously directed. By this method the plants will always maintain a dark healthy green ; have stems, stout and well rooted, with leaves short in proportion, wide and fleshy, and well able to shew, and swell off fruit of the first quality. In order to swell this fruit to a large size, no air ought to be given until the thermometer reaches 80 or 85 degs., which will generally reach that point in the morning, by nine or half-past. To keep it down to this, give it the benefit of air, until half-past ten, then close the house, and water them over their leaves ; thus let them remain until half-past two or three in the afternoon ; letting them have all the benefit of light and sun. At half-past four, close the house, syringing again over the leaves of the plants, which will keep them moist during the whole of the night. (*Hamilton on Pine Apple*, 90.)

Newly potted plants will be benefitted by a heat of about 90 degs. for two or three weeks ; after which time it may fall to 85 maximum, and 80 minimum, but in the winter, 75 degs. will be sufficient. The bottom heat required for those plants which are to produce several fruit from the same plant, ought to be as equable as possible, at a medium of about 80 degs., and not to fluctuate more than 3 degs. above or below ; however, a plant will swell well in the summer, in a bottom heat of 70, but in the winter, when the superincumbent atmosphere is kept cooler, the

plants that are swelling their fruit will make little progress, except the bottom heat be about 75 degs. (*Hamilton on Pine Apple*, 92.)

In a more northern latitude, and consequently diminished duration of light, slightly lower temperatures ought to be employed than in those we have mentioned, and in accordance with this we find that Mr. A. Smith, gardener to Col. Paterson, of Cunnahie, N.B., states that about February the temperature is raised by him to 70 degs. during night, and about 65 degs. in the morning. In May, or when the flowering is over, the steam is frequently admitted to the atmosphere of the pit through the whole night. This seems to destroy insects, and to keep the foliage of the plant in a state of fresh and healthy verdure. The temperature is now about 75 or 80 degs., and steam is applied when artificial heat is necessary to maintain that degree of heat, which, in very warm weather, is only about once or twice a week. (*Cal. Hort. Mem.* iv. 573.)

Shading—Necessary as it is to expose the pine apple to a duly regulated amount of heat, and a free exposure to light, yet they both may be admitted in excess. Night naturally brings a refreshing period of rest, but it is also beneficial to relieve those plants from the effulgence of the mid-day sun which are not fully rooted, and more slightly during their blooming, for there is not a plant when in blos-

som that is not prolonged in vigour by being shaded from the sun at noon. Impregnation is thus better secured. Nor should shading be attended to merely with regard to the blooming plants. Every plant transpires at a rate great in proportion to the elevation of the temperature and brightness of the light to which it is exposed ; the greater the transpiration the more abundant is the absorption of moisture ; and the moment the roots fail in affording a supply equivalent for the transpiration, the leaves flag, or become exhausted of moisture, and if this be repeated often, they decay altogether. Shades properly managed, prevent this injurious exhaustion.

It is but fair to state that Mr. Barnes dissents from the recommendation of shading the pine apple even whilst in bloom. He says, "shading pine plants, although necessary under former systems of culture, in my opinion, is now loss of time, and injurious to the plants rather than beneficial. Maintain a kindly humidity, correspondent with the admission of air, and then no shading will be required to a pine plant after it has made roots. Shading, then, when in bloom is entirely opposite to my own ideas. Above all other times, I delight in seeing plenty of sun light upon a pine when it is in blossom. This will not only induce it to open its blossom vigorously, but to attain a dark beautiful blue borage colour; fructification will be vigorous, and there need not be the least fear of

deformity or debility. If showing fruit, and blossoming in short days or in gloomy dark weather, the blossom is naturally weaker, of a lighter colour, fructification is not so vigorous, and the formation of the fruit is more liable to malformation. These are practical facts, and must be well known to every observing gardener. Be assured that if a pine plant of any age or size, well established, with healthy roots, and placed so that the roots may be maintained fully in a vigorous condition by the application of the other requisites methodically, there is no more need of shading it than there is for shading an old forest *oak*. Shading moderately certainly is requisite for fresh potted suckers, or occasionally, a short time, for newly potted, or planted out plants; but, generally speaking, for the latter even I do not practise shading, but apply a little extra humidity. The quick progress the plants will make managed methodically upon this system is astonishing; there is no stand-still about it."

Mr. Hamilton is more friendly to shading, and states that, various experiments have led him to believe that partially intercepting the rays of the sun for a few hours in the middle of very bright days, and occasionally dewing the plants in fruit in the early stages of their growth, does not injuriously affect the flavour of the fruit, provided that water is entirely withheld three weeks previously to the time

that the fruit changes colour. The Providence, Enville, and Antigua, he never waters nor shades six weeks after they have bloomed; and such as the Montserrat, Jamaica, &c., he does not water after seven or eight weeks, as these sorts are longer in ripening. So rapid has been the growth of the three former varieties, that the fruit frequently measured from 18 to 21 inches round in that time, and increased in weight from 16 to 20 ounces per week. Very justly he endeavours by artificial means to surpass a tropical climate, by imitating a moist and dry atmosphere in the same house, and at the same season. This he accomplishes by so arranging the plants that he can sprinkle and shade those that are growing, whilst those that are maturing their fruit have the benefit of all the light and sun; and thus he effects one of the most important objects of pine culture, namely, encouraging rapid growth in one set of plants, whilst others are ripening their fruit. By thus deviating from a natural climate, he manages to cut at least eleven months out of the twelve; whereas, if he was to imitate entirely a tropical climate, the fruit would be all produced at one particular season. In his opinion, wherein we fully coincide, the flavour does not so much depend on a scorching sun as on the health and vigour of the plant. (*Gard. Chron.* 1844, 372.)

Mr. Glendinning entertains a similar opinion, en-

tirely concurring with us in thinking excessive light injurious to the pine apple. He says, some shade, of a partial kind, is necessary, in clear and scorching sunshine, which prevents that brown ferruginous hue, by some so highly lauded, and certainly preferable to a yellowish green; both extremes are alike objectionable; shade, therefore, given and removed at the proper periods, will be of the utmost service in preventing extraordinary evaporation, and thereby promoting the rapid and luxuriant growth of the plants, and securing to them that dark green colour, which is the aim of all first rate cultivators of this exotic. Upon this recommendation, Mr. Barnes observes, "I entertain a decided opinion that the light we receive in this country is never to that excess, that well rooted, healthy pine plants, or those in blossom, or swelling their fruit, ever require any shading at any part of the season. Have the structure for their cultivation so arranged that the front of the lights can be tilted with ease, to any required height, if found necessary, in very clear scorching weather; thus altering the angle of the structure, applying the requisite humidity throughout the most fervid parts of the day, or all day, if found requisite; making use of the engine or syringe freely in good time of an afternoon, to apply abundance of clear tepid water, mixed with a quart or two of clarified manure water, and occasionally clear soot water, all over the plants,

surface of the soil, or plunging materials, and walls of the structure ; all this will maintain a favourable and kindly humidity both night and day, and no shading will be required under such circumstances. Thus treated, a growth vigorous and rapid will be quickly established and maintained. As to 'a ferruginous hue,' no such objectionable appearance will ever be observed if the system I have recommended is faithfully carried out. There need be no fear whatever of any depredation from insects, as such treatment will quickly scourge them, let them be ever so numerous. Respecting grape vines being introduced into a pine structure, I condemn it altogether. No man, under such a combination, can do entire justice to either one or the other. The shade from the vine I am perfectly convinced is injurious to the pines. What is gained by one is loss in the other, and neither very often will be of first-rate quality. I am for separate structures, to do justice to each."

Being an advocate for shade to a limited extent, even to the fruiting plants, Mr. Glendinning does not object to grape vines being trained up, and confined to the rafters of the fruiting-house, but, on the contrary, would prefer them as a useful, ornamental, and economical screen. One great evident advantage arising from shading the young plants, when the day proves clear, and the foliage has been moistened in the morning, will be the prolongation of a damp

growing atmosphere ; and the heat, likewise, moderated by a plentiful admission of air, will prove in fact the desideratum during the influence of powerful atmospheric heat ; for without some sort of shade, the withering effects of a summer's sun would soon become but too apparent, by deteriorating the colour, and collapsing the foliage. The young plants must not be matted up as in protection from frost ; the direct rays of the sun should be intercepted ; but only some very thin mats laid lengthways, or otherwise ; some slight bunting, or nets very close in the mesh, would answer the purpose exceedingly well. (*Glen-dinning on Pine Apple*, 42.)

Every stove should be furnished with outside roller blinds to its roof, and these, if made of wide-meshed canvass, will modify the light when necessary, will check radiation and consequent cooling at night, as well as be an efficient guard to the glass in case of hail storms.

Moisture in the Air.—A chief atmospheric characteristic of the tropics, is its extreme moisture. By day, the air, owing to the intense evaporation, is saturated with watery vapour, and this bathes again every plant at night, when the air by cooling cannot combine with so much vapour, and this is, consequently, deposited in the form of heavy dews. To keep pine apple plants healthy, and, consequently, free from insects also, this moistness of atmosphere must be secured to them.

At Bicton, the paths of the pine stoves are deluged with water, many times daily, in clear fervid weather. They have perforated pipes, so constructed all round the fruiting pine structure, that they can turn the water on the whole or part, at back or front of the structure, and both ends, at any desired time. It is so constructed that they can turn on a very strong power of water, and entirely deluge the whole structure in a few minutes, or they can ease it down to the softest dribble, or in single and very slow drops ; and this is at all times in full command. Copper pipes are employed, placed in union joints, by which means, with a single turn, the water can be made to spray over the whole surface of the walls of the structure, or the paths or the heating apparatus, either in part or over the whole.

If tan or other fermenting mass is within the stove, this yields much moisture, but nothing nearly sufficient ; and to increase the amount, the paths should be deluged with water at least twice daily ; viz., about the middle of the day, and at night when about to shut up. At this latter time, also, the plants may be syringed.

If the tank system of heating the stove be adopted, another aid to keeping the atmosphere moist may be adopted, as suggested by Mr. R. Errington, the very able gardener of Sir P. Egerton, Bart., at Oulton Park. He observes upon this point, that in applying

the tank system to pine growing, it must be remembered that no plan can be regarded as complete which does not provide a perfect command of atmospheric moisture. It must be borne in mind that the moisture arising from a fermenting body is very considerable, and that, at least, an equivalent should be provided. For this purpose it would suffice to have a cemented gutter in the front of the house or pit, on the bottom of which the lower or return pipe should rest. By having a permanent supply of water ready to turn on by a tap at one end, the bottom pipe could be immersed in water at any time in the course of a quarter of an hour. A discharge plug should also be provided at one end, to run off the water into a drain when necessary. The admission of air at front is a consideration ; if the point of ingress could be so arranged as to be immediately over the piping, the air would be charged with moisture as it entered, and instead of ascending immediately to the roof, to descend in drip, might be made to pass through the plants. (*Gard. Chron.* 1846, 580.)

Ventilation, and, what is equally necessary, and not identical, free circulation of air, is of great importance for securing the health of pine apples. They should have a little air every day, it being far better to keep them in a temperature sufficiently high to allow of air being given them, than to keep them shut up in a damp atmosphere, at a low temperature.

Air will prevent the plants from being drawn up weak, and causes them to have a fine green colour, with thick, firm, robust leaves. (*Mills on Pine Apple*, 31.)

In the winter months, advantage ought to be taken of all bright days, even should the frost be intense in the night, by opening the sashes or ventilators a little; one sash or ventilator in every three should be tilted or let down, at top or back of the house or pit; and as the season advances, a proportionately greater quantity of external air must be admitted. In summer, when the minimum temperature of the external atmosphere is never greater than 52 degs., the sashes of the pits may be left a little raised in the night. This will be found to strengthen the young plants astonishingly; and when the sun is bright, every sash should be elevated six inches, front and back alternately; which will prevent the plants from becoming long and narrow-leaved, and give them a robust and stocky character. (*Glendinning on Pine Apple*, 45.)

Mr. Mills' observations upon this point are excellent, and his directions most practically correct, with the exception of keeping his temperatures rather too high. He says—

There is no doubt but, like the cucumber, pine plants do best when kept moist all night by steam or otherwise, and also by being dried during the day;

and if that is not possible, it will be well to reduce the steam or other moisture, and to give a little additional heat by the means before stated ; so that if the plants cannot be dried in 24 hours, they may in 48 hours. Plants, swelling their fruit, will require less air than young plants, as they cannot be drawn up weak from want of it. In the morning, air is admitted, when the mercury indicates 75 to 80 degs., in such quantity as not to reduce the temperature below that point ; it is injurious to lower the temperature by admitting air, and better to prevent its rise by giving air early, and allowing it to increase gradually to 90 degs., when more air may be given, but not so much as will reduce the temperature below that point. The plants with this heat will have become quite dry by 10 or 11 o'clock A.M., when they should be sprinkled with water warmed to 80 degs., so as to fill the base of their leaves. Mr. Mills then recommends them to be shaded, and the quantity of air reduced so as to retain in the structure 90 degs. of heat. But we cannot agree with this practice of sprinkling pine plants in the fore part of the day, after the sun has shone on them for some hours, and then to shade them. Indeed this appears very much departing from nature's laws, instead of assisting to enforce them. Circulate or disperse a kindly vapour throughout the interior atmosphere, but do not shade. Admit air freely, and shut up in pretty good time in the

afternoon, and generally wholly close the lights for a short period, after a good application of water has been given over the plants and whole structure ; but then apply air again at sunset, to remain all night, and increase it the following morning previous to the sun shining on the structure. This practice is in no way regulated by what the internal heat may be, though, of course, if the external atmosphere is very low in temperature the admission of air is to be regulated accordingly. In this state they should be allowed to remain till three o'clock P.M., when the shade should be removed, and the air gradually increased, so as to prevent a greater accumulation of sun heat than will keep the mercury indicating 90 degs. At five o'clock P.M., if the plants are quite dry, give them a little sprinkling of water, and take off the air or not, as the temperature may require, thus having them dry, and the reverse, twice in 24 hours. In very hot weather, give the young plants the same treatment as to shade and water, with a little lower temperature in excessive sun heat. (*Mills on Pine Apple*, 56.)

Watering.—During the consideration of the previous practices for keeping the air of the stove moist and ventilated, many suggestions as to watering, necessarily, have been incorporated. The water to be preferred is that afforded by rain, or, in its absence, that from ponds.

The pine-houses should be provided with the means of obtaining milk-warm water for syringing and watering. This, which is so often neglected, is a capital point in the cultivation of all tropical plants, which are unacquainted with the low temperature of northern countries in any shape, and unprovided with the means of resisting its effects. It is of little use to maintain a steady bottom heat, or a steady air heat, if the warmth of the soil or of the leaves is to be suddenly lowered six or seven degrees by a deluge of cold water. Tender plants do not like cold shower-baths. (*Gard. Chron.* 1843, 837.) To secure this desideratum, an iron tank, with a portion of hot water pipe passing through it, is very convenient and effective.

At Bicton they have many simple contrivances to get a quick supply of this necessary thing. They have, in the first place, draw-cocks to every boiler, and several boilers are furnished with expansion boxes, from which is obtained a supply of hot water in the interior of the structure; in others they have reservoirs; and, again, a hole is drilled in the flow-pipe, and a cock put in in convenient places. When a large supply of hot water is required, by turning cocks they shut off the whole circulation from the pipes to boiler—have nothing but the boiler to heat—and set the cock from the expansion box, which is placed upon the summit of the boiler running of hot

water, while the cold is still running in at bottom from a cistern placed aloft, with ball-cock. They have also, close at hand, cocks in every structure to supply abundance of cold water; so convenient, in some cases, that both hot and cold may be introduced in the same water-pot, or interior cistern, at one and the same time.

There is not the least danger in watering the plants plentifully all over their leaves in winter, or in any time of the year, provided there be a sufficient heat kept up in the tan bed and in the air of the house. But watering the pine apple plants all over their leaves in winter is not to be adopted as a general rule, but only when it is necessary for cleansing the plants, and when done the heat in the house among the plants must be kept not lower than 70 in the morning, and raised to 85 or 90 degs. in the course of the day. (*M'Phail.*) Indeed so far should the gardener be from withholding water from the pine apple in winter, that it is absolutely very necessary in severe weather, at all times when strong fires are required, to give small quantities of water, once in two or three days, according as the plants may appear dry, in which state they should not be allowed to remain; care being taken not to give a great quantity of water at any one time, particularly in winter. (*Mills on Pine Apple*, 19.)

Indiscriminate watering, or an application of it at

similar times and in uniform quantities, would be a most mischievous and ill-judged practice. The application of water should be regulated by many considerations. Prominently among these are the state of the atmosphere and the season of the year ; during the summer months, when evaporation and transpiration are at the maximum, a corresponding degree of moisture must, by artificial means, be created to secure a growing atmosphere for the plants. Solar heat and light moisture must be relatively and equally supplied ; —the one without its due proportion of the others will soon produce disease, and ultimately death. The pine plant ought never to be soaked with water. It would be an important improvement in watering, if it could be calculated in its administration, to give no more than just enough to moisten the soil in the pot, without any escaping at the bottom. (*Glendinning on Pine Apple*, 34.)

When the fruit is in bloom, do not water over the top ; for moisture will be liable to prevent the generative parts of the flowers from performing their necessary functions. When the blossoms are past, and the fruit begins to advance in magnitude, then the plants may be watered all over without danger ; with this caution, however, not to do it in the middle of the day. In the spring and autumn seasons, the morning is the best time for watering the pine plants ; but in summer the evening is preferable.

Ripeness.—The first sign of perfection in most sorts is their assuming a golden yellow colour, though some discover different tints peculiar to themselves; but the most certain sign of full growth and ripeness is their fragrance. Let the fruit be gathered before it becomes soft; for if left until then, it would be greatly diminished in its perfume and flavour. Cut the fruit from the plant with four or five inches of the stalk, preserving also its crown of leaves at the top. To have it served up in the highest flavour, it should be cut in a morning, and laid in a cool dry place till wanted; but its juice is always more poignant when eaten the same or the next day; though it may be kept 6 or 8 days if required. It is generally served to table with its crown of leaves on. (*Griffin on Pine Apple*, 73.)

Culture in Pots.—After the preceding directions and observations applicable to both modes of planting, viz., in pots and in the beds of the stove, we will now gather together separately the information applicable to each mode.

Growing and fruiting in pots has been the longest practised, and there is no doubt that fruit in every respect equal to that grown in the beds can be produced in this mode. It is also quite certain that, where bark pits are used as a chief source of heat, pot culture is to be preferred, for it enables the bark to be renewed, stirred and mixed with a facility

that cannot be attained when the plants are growing in soil resting upon it. But, on the side of bed culture, it must be admitted that much less care and labour are required for its practice, and that if the hot water system of heating be adopted, the chief difficulty in the way of its adoption is removed. Without a combination of pot culture with that in the bed, it is almost impossible to keep up a regular succession of fruit.

It is but due to Mr. Barnes to state that he inclines to pot culture of the pine apple, observing that, "the advantages derived from the turning out pine plants into prepared beds over those cultivated in pots, have hitherto been but small, under our usual methods of applying bottom heat ; indeed I have not ascertained that any one has produced superior fruit, or in quicker succession, from plants turned out of their pots than we have, cultivated entirely in pots. I am an advocate for any improvement, and shall adopt the turning out system so soon as its advantages are brought to bear. Turning out plants into a bed of soil placed on fermenting materials, must for a time confine the bottom heat to that extent that it would cause a large portion of the soil resting on it to become stagnant. Through watering the plants and its confinement the heat is liable to subside suddenly ; by applying heat as we have recommended in a former section, in the 1st volume, those difficulties would be got over. Where

it is necessary to keep up a succession of fruit, we would recommend the structure to be in small compartments, in order to have at full command the application, or withholding, any of the requisites from those in various stages of fruit swelling or growth. If fruit can be produced equally good from plants in pots as those turned out, those in pots have the additional advantage, that they may be treated individually with stimulants, or these may be wholly withheld at pleasure, and when the fruit has finished its growth a potted plant with its fruit may be lifted out, and placed in a light airy situation to ripen gradually, which is decidedly a great advantage in producing beauty of colour and superiority of flavour. The rich flavour of a large portion of pines cultivated in this country is entirely sacrificed through close confinement, being ripened too quickly, being allowed to stand too long on the plant previously to cutting, and being kept too long after being cut before being made use of. To obtain a pine apple of first-rate excellence, the application of water should be moderated for a time previously to its finishing swelling, and when its swelling is concluding, water, and moisture of air, should be withheld altogether, and the fruit should have the benefit of a light, airy, dry atmosphere. This cannot be accomplished so well in a structure which has fruit in various stages of growth upon plants turned out as it could with plants in pots,

for these can be readily lifted out and placed in a light by themselves, or in another structure, and a fresh plant put into its place. A pine apple should never be allowed to remain on the plant after being ripe, as this is very detrimental to its flavour. It is best to cut any variety of pine apple a little previously to its being ripe, rather than to allow it to remain one day on the plant after being ripe. When cut in due season it will improve both in colour and flavour, which should be taken advantage of by not keeping it too long before making use of it.

Size of Pots.—For full-sized suckers the pot should be six inches diameter at the top and six inches deep ; for succession plants most gardeners employ another pot, 9 inches by 7 inches ; and for fruiting, 12 inches in diameter by 15 inches deep. But only the first and third sizes named are really desirable. We have no particular time or season for shifting, potting, or repotting ; we do all these at any season of the year, whenever we fancy the plants seem to require it. Never shift a plant, or repot, but twice at the most. If it is a strong spring sucker, give it but one potting from the sucker pot to the fruiting pot.

At Bicton, Mr. Barnes employs, for fruiting pines, pots from 12 to 17 inches in diameter and depth, but usually employs those which are 15 inches diameter and a like depth ; and this size he finds best at all

seasons. For luxuriant plants he employs 17 inch pots.

Previously to commencing potting, the soil and drainage must be properly arranged on the potting bench; the lumps of turfy loam on one side, and that which is a little finer on the other. If the plants are large, the work will be better accomplished by two persons than one. First place two large sherds, side by side, over the bottom hole, then add at least an inch of drainage, and upon this place from two to three inches of the selected pieces of loam, then let the plant down upon this; when the assistant will take both his hands and gently grasp the foliage, (for Mr. Glendinning considers it a bad practice to tie up the plants,) in order that the other may regularly fill up all round the ball with the finer soil, which he will be the better able to do, by using a flat and rather sharp pointed stick: when this is done, gently strike the pot two or three times upon the bench, and this will consolidate the whole properly. (*Glendinning on Pine Apple*, 25)

We find it a very great advantage in pot culture—and of course the same advantage also holds good for the turning-out system—not to make use of any fine soil whatever, or any kind of soil which would be likely to consolidate. With the potting-bench batten, as described in the section “Soil,” every sod which is the least close or adhesive gets a few sharp raps,

and then a quick shake, to rid it partially of the fine particles, making use of the remainder in an open, fibrous, friable condition, with rubbly charcoal applied with it as the operation proceeds. Thus the whole soil is an open porous mass of material, readily admitting a free circulation of air and water. The fine part of the soil, so much sought after formerly by some cultivators, we entirely discard, making use of nothing but open rubble, as above described; indeed it is a mass of healthy open drainage. We should act upon the same principle precisely in preparing for turning-out plants, in a proper structure. As to tying up the plants, on removal for potting, turning out, or any other purpose, if they are of any size we always tie, and make use also of a stake or two for the purpose of keeping the plants steady, which is regulated according to their size and weight. We find it a considerable advantage, for expedition in their removal, besides its securing them from the danger of being broken, which it would be an impossibility to prevent to some extent with such large-sized, weighty, crisp-foliaged plants as we cultivate, and which crack and break with almost the least touch; besides the great advantage the tying system has for removal through door-places at the potting-bench, and the replacing them again, over the loose system, is very considerable, and pretty generally acted upon by cultivators.

Instead of using, as in former days, a sharp-pointed stick, in order to thrust down, and regularly to fill up with the finer soil, we make use of a blunt square piece of wood, at least, for potting pines, two inches square ; the soil, instead of being rammed down, as formerly recommended, and in too many cases practised, we quietly push down. Thus a porous kindly mass is secured, and fully maintained.

Mr. Mills and all good pine growers, agree as to the importance of good drainage to the pine apple. Use, he says, a good quantity of drainage. Broken garden pots are good for this purpose, a few large pieces at the bottom, and the upper ones very small ; and oyster-shells or charcoal would be equally good. Be the material what it may, an effectual drainage must be secured, on which is placed about one inch of the rough compost ; and the bottom of the ball of earth, containing the roots of the plant, is placed thereon. If from one inch to one and a half inch of fresh soil is given at top, bottom, and sides, it will be a good remove or shift. In March, the plants, if well grown, will require to be looked to and shifted ; again about the middle or latter end of May ; and again in August usually for the last time ; but every thing will depend on the time the fruit is required. A plant will seldom show fruit until it has filled its pot with roots ; therefore, if large plants are not required to show fruit, they must be kept growing by

giving them fresh food and larger pots, with plenty of air. The largest pots Mr. Mills uses are those of eight to the cast; next size is 12, and the smallest 16 to the cast. (*Mills on Pine Apple*, 29.)

Mr. Glendinning agrees with us in thinking that the time when the pine plant requires a larger pot must always be determined by the progress the roots have made: let this on every occasion be the criterion, and on no account shift a plant into a larger pot, merely because it may be a general shifting, unless the roots have made sufficient progress to justify the act. Although we shift usually only twice, yet we agree in thinking it impossible to state how often the plants ought to be repotted, under all circumstances, or finally determine the capacity of the pot in which the plants will mature their fruit. They must be shifted as often as they require it; which operation should be resolved by the progress the roots make from time to time, until they attain a size to justify their removal to the fruiting-house: when there, should they continue growing, they must still have larger pots, until they show indications of fruiting, and even then, if the roots have extended through and completely enveloped the ball, a larger pot must be substituted. (*Glendinning on Pine Apple*, 23.)

Arrangement of Plants.—The same good practical authority gives the following directions on this point. The seasons of completely renovating the bark bed

are March and October. At each of the periods the plants are to be entirely removed from the pit; at one end a trench opened three or four feet wide, and the tan removed to the other. The new bark is to be placed about a foot deep over the bottom of each trench, and particularly against the sides of the pit, as the new will ferment stronger, and the centre of the bed is sure to be hot enough; besides it will decay much faster around the edges of the bed than in the middle. A corresponding quantity of the old decayed bark must be removed as you proceed to make room for the new. Select the largest for the back row, and so also for each consecutive row. The largest for each row again ought to be placed in the centre. This arrangement, on the whole, will give the plants a better appearance than if promiscuously plunged, and will also afford more room to the plants individually, more particularly if placed in the quincuncial manner. The pots ought not to be inserted more than half-way into the tan, until the heat, which in a few days will become too powerful, has subsided. Daily examine the temperature of the bark bed; for the least oversight at this critical juncture will entail positive ruin to the fruiting plants; especially as, should the roots now get scorched, the chance is, that every plant in the pit will be prematurely forced into fruit, in a weakly, exhausted condition, from the unnatural loss of those abundant strong roots which they are now supposed

to have acquired. The manner adopted by practical men to ascertain the heat of the tan bed, and which will be found sufficiently accurate, is to insert a few sharp-pointed sticks in front and back of the bed, and a very little acquaintance with these will constitute them an unerring index. Should the temperature of the bed be ascertained with an instrument, 90 degs. will be a good medium heat; but it ought never to exceed 100 degs. When the fermentation becomes too powerful, water should be poured around the outside of the pots, and all over the bed, which will immediately subdue the extreme excitement; but should extraordinary fermentation require a repetition of watering, so as to endanger drenching the bed, the tan ought to be partially removed from the sides of the pots, and again replaced when the heat declines. (*Glendinning on Pine Apple*, 30.)

We entirely and unreservedly condemn the system of applying bottom heat by tan or other fermenting materials, or upon any other system, so as to endanger its becoming dangerously hot, and requiring so much watchfulness and daily examination; as plunging the pots not at all, or only half way, to be removed when danger occurs, or pouring water about; all of which act as injurious checks to thrifty, healthy plants, besides the danger of being too late in the precautionary applications. Surely the time has arrived for men to have their mind's eye open to secure

a more simple, uniform, genial bottom heat, applicable at all times and seasons just to the required extent, without all the above former-days' complicated methods of watchfulness. Surely in these times no cultivator needs advice or caution regarding the application of bottom heat, for no well-instructed gardener of our days would now think of preparing a dangerous, expensive, laborious bottom heat, and then practise a remedy also equally dangerous, to avoid its evil consequences! These are not times, we should hope, that such things are to be found in practice, but are only matters of record.

Disrooting.—The old system of pine culture used to adopt as a principle that which is now justly condemned as the worst of all practice—the frequent disturbance and even destruction of the roots. So far from this being desirable, let the gardener ever keep in mind, both for this and all other crops, that the less the root is disturbed the finer will be the produce. Upon this point of pine-culture we will quote Mr. Hamilton's very judicious remarks. He says, neither shaking out, nor transplanting healthy plants into larger pots after the fruit is cut, can be adopted as a general rule, without deteriorating the quality of the succeeding fruit. Therefore merely dress off the bottom leaves, as high as where the roots appear; which is generally two or three inches above the level

of the pot. Then earthing up with the prepared compost, pressing it a little round the trunk of the plant, and allowing it to slope down to the edge of the pot. The plants, after earthing up, will commence growing immediately, and new roots will be thrown out from the bared trunk into the fresh soil. If water has been withheld for a time, on account of improving the flavour of the fruit, they ought to have a good watering at their roots; but if in the winter, it must be applied more sparingly; and a growing bottom heat of about 80 degs. be kept at the time. This watering do not repeat until the next fruit is cut, but endeavour to keep the soil continually moist (not wet,) by frequently syringing over the leaves with lukewarm water. By attention to watering, moist atmosphere, &c. the suckers will grow rapidly, and perfect their second fruit, generally speaking, in from eight to twelve months from the time the first was cut. If the plants have met with no accident at their roots, they must remain in the same pot, which will have to be placed inside a pot much larger and deeper. The process is as follows:—First dress off all the leaves, until the bottom of the sucker is bared which produced the last fruit, which will be found to have made a great number of roots at its base, in the axil of the adjoining leaf, and which must be covered during the process of earthing up. Then remove all the old soil down to the roots, and sink the pot, with the

plant, to the bottom of the large pot, first placing three or four broken pieces of pots at the bottom, to prevent the communication of heat between their bottoms. A cavity is thus formed all round, between the two pots, which will prevent the roots from being scalded. Although buried deep in the tan, the outer pot ought to be several inches deeper than the inner one, and in earthing up, observe to put nothing but broken bricks above the cavity, so that the heat may freely escape to the surface, without injuring the bottom roots; and at every process of earthing up, nothing but the sods, or the lumpy part of the compost, ought to be used; and fresher the better, provided the vegetable fibre is dead. All the varieties of the pine, except the White Providence, have one sucker or more in progression, whilst the plant is swelling its fruit: in such cases one only ought to remain, the others should be destroyed as they appear, except the cultivator prefers quantity to quality. At every process of earthing up, none of the leaves must be shortened nor taken off, except a few at the bottom, to allow the emission of new roots into the fresh compost; and whenever water is used, either to the roots, or by sprinkling the foliage, it ought to be several degrees warmer than the atmosphere in the house. After the fourth fruit has been perfected, cut off the sucker which produced the last fruit, with from six to eight inches of the old trunk attached to its bottom.

The leaves are all dressed off that portion of the detached trunk, and from the bottom of the sucker, which will have made a quantity of roots in the axil of the leaf of the detached trunk, and is then planted into a pot, nine or ten inches diameter at the top, placing the detached trunk at the bottom of the pot, before the drainage is put in, in order that the sucker may be sufficiently deep to be covered with the soil. When plants are cut down in the winter, they ought to be planted in very small pots, or they may be planted in fresh tan, and taken up, and potted in the spring into a pot ten inches diameter at the top; and thus it is intended to perpetuate a successive progeny of suckers and fruit. (*Hamilton on Pine Apple*, 70.)

Root Scorching.—To avoid this, the best plan is to sink a pot into the tan large enough to contain that in which the pine apple is growing, and leaving a vacant space, half an inch wide, all round. Some gardeners merely lift the pot out from the bark, and obtain a similar vacancy by placing a brick or two at the bottom of the hole, and then returning the pot. Other gardeners use inverted pots in the stead of bricks.

The gardener at Mowley Hall Gardens recommends—Instead of inverted pots, or two bricks placed sideways, use two iron rods $1\frac{1}{2}$ inch wide, and $\frac{3}{8}$ of an inch thick; these rods are exactly the width of

the pit, and the flat sides are rivetted in three places, at equal distances, and six inches apart, for the pots to stand on. An iron bar extends the whole length of the pit, with hooks fastened to it at the distance the rows of plants are to be apart; and this is made fast to the back wall of the pit with flat-headed iron pins, which go through the wall and the bar, and are screwed tight in the inside of the pit with burrs; on the front wall of the pit double brackets are suspended at the proper distances, and fastened inside of the pit with nails made on purpose, so that they cannot move either one way or the other. These and the iron bars are fixtures, but the rails are made to take out and in, so as to be out of the way in emptying and filling the pit. In plunging, the leaves are taken out at one end of the pit, as deep as the bottom of the brackets, and carried to the other to fill up with; the rails are then dropped into their places, and the pots placed upon them, the shortest plants in front and the tallest at back; the leaves are then filled in even with the top of the pots; another row is then placed the same as the first, and so on till the whole is finished. As the leaves sink down more are added, so as to keep them up to the top of the pot. The advantages of this plan are these:—The plants are always at the same distance from the glass; there is little trouble in plunging them, it being only necessary to place them upon the rails, and push them along to

their proper places ; there is no danger of burning their roots, from the facility with which the fermenting material can be stirred and changed, the top of the pots being always a little higher than the pit ; and, finally, one plant can be substituted for another as soon as it has ripened its fruit. Pines never grow or swell their fruit well without there is a genial moisture in the pit. If the leaves become dry, have them pulled into the walk with a hoe, where one man turns them over, while another sprinkles them with water, warmed to a temperature of 90 or 100 degrees, the heat of the leaves ranging from 85 to 95 degrees ; they are then returned among the pots, and the house is kept close for a day or two to encourage fermentation. (*Gard. Journ.* 1847, 194.)

Planting in Bed.—This is by no means a novel suggestion, nor practised for the first time in the present century ; but Mr. Hamilton, the very excellent gardener at Thornfield, has the merit of enforcing its practice more extensively than had ever been previously done. This he has done not only by example, and growing very superior pines by this mode, but also by publishing an able little volume upon the subject, and from which, in several instances, this volume will be found enriched.

The earliest adopter of this system, we think, was Mr. Justice, who, writing in 1754, says, he (Mr.

Justice) tried some plants turned out of their pots with their balls, and planted in the bark for the last nine months before the fruit ripened, and found the fruit larger and earlier, but not better flavoured, than that of the plants in the pots.

The later and better experience of Mr. Mills sustains the same opinion; for he observes, that plants, when growing without pots, acquire naturally a dwarf growth, more particularly when not crowded. It is quite remarkable to see the different habit the plants assume when planted in the open soil; and, should they have been growing in pots for some time previously, the alteration will be the more perceptible, as they seem to change their habits all at once, by expanding their foliage, and also by a rapid swelling of their bases or stems, caused, no doubt, by the increase of food to their roots, combined with regularity of heat and moisture. (*Mills on Pine Apple*, 62.)

Next to Mr. Justice in pursuing this plan was Mr. Giles, who, writing in 1767, says more explicitly, when the bed is a little settled, lay on a border of the same kind of earth as before mentioned, at about one foot six inches wide on the surface of the tan, entirely round the bark bed, which may be kept up within side by planks, &c. The intention of this border is, to turn part of the succession plants out of their pots into it, which, when they are brought into the stove, are then called fruiting plants. This border should

be just so thick with earth as to contain completely the balls of the plants after they are turned out, allowing a reasonable distance, which in a pit that is capable of receiving a hundred plants, the border round will contain 46 of them. One end of the border should be left unplanted till last, for the convenience of filling the middle of the bed. When the border is done, bring in so much tan as will fill up the middle part of the pit ; then the remaining plants should be shifted into pots a size larger, as may be necessary, and plunged in the tan at a reasonable distance. (*Giles on Ananas.*)

The system does not appear to have been even partially adopted, until attention was again roused to it by the late President of the Horticultural Society. Upon this, Mr. Loudon observes—

The present practice is exactly the same that Mr. Knight commenced with, and it has years ago been recorded in the Transactions of the Horticultural Society. As soon as the plants shew fruit, the strongest sucker is preserved ; all the others being taken off as they appear. When the fruit is cut, the plant is taken out of the pot with as many roots as can be removed with it ; all the leaves, except four or five on the top of the stool, are scaled off ; the leaves are also scaled off the base of the sucker in the usual manner. The sucker, however, remains growing on the stool until, in its turn, it becomes the parent

plant, producing fruit and suckers, and undergoing the same operation as its progenitor, whose place it is to occupy. The few leaves left on the top of the stool are, as they become matured in the course of the season, plucked off; so that the whole stool, being entirely covered with earth, produces abundance of young roots, which continue to supply the rising plant with additional nourishment, independently of that obtained by its own immediate roots, until it has performed its office. The pines were never moved out of the pots in which they were first planted; and at all seasons, excepting in the depth of winter, the house was kept in a state of humidity. (*Gard. Mag.* ii. 368.)

Upon the details of Mr. Hamilton's practice, we shall only further add some remarks made by himself and by Dr. Lindley, adding the modes adopted by Mr. Gray and Mr. Dale for carrying out the same system. Dr. Lindley observes that—

Mr. Hamilton has but two moderate-sized houses for the whole of his processes, as far as pine-growing is concerned: in one of these, the principal fruiting-house, he grows winter and spring cucumbers; the only crop which can (according to Mr. H.) be grown with propriety in a house, the primary object of which is to produce abundance of first-rate pine apples. Mr. H. entirely repudiates the idea of growing grapes or pines, more especially late grapes; as, if such be

the case, it must be done at considerable sacrifice. The amount of atmospheric humidity necessary to carry out the Hamiltonian system would be extremely prejudicial, if not ruinous, to both the general health as well as the productions of the vine. The first and most peculiar feature in Mr. H.'s system, is fruiting the sucker on the old stool, which is nature's own way of doing the business. The second feature is the preservation of the old roots for a much longer period than is commonly practised—say for nearly seven years. The third, although much at variance with preconceived opinions, appears to answer, and is the maintenance of a high and moist atmosphere all the winter. The fourth consists in a much more moderate use of bottom heat than is customary. Mr. H. considers about 82 degs. to be the most wholesome maximum. Now, alluding to the preservation of the old stool, it seems strange that, seeing this was so long since recommended by the late Mr. Knight, it has not crept more fully into practice. If it can be proved that the old stump is a storehouse, or ready provided fund of organizable matter, which it has taken some expense of both time and material, as well as vital energy in the system of the plant, to provide, why not retain it? Who would think of cutting away all the green pseudo-bulbs of a new and choice orchid? The second feature, viz., the preservation of all the old roots for an almost indefinite pe-

riod stands boldly opposed at once to all disrooting systems. According to Mr. H., two serious evils are involved in the attempt to get abundance of new white fibres up the stems, viz., the necessity of stripping a considerable amount of valuable foliage; and, secondly, that these white surface roots, if procured, will in all probability produce premature constriction, if not decay, in the original roots, thereby losing the valuable assistance of thousands of mouths, adhering fast to various media, capable of supplying all the wants of the plant. The third feature, viz., a high and moist atmosphere through the depth of winter, appears to be the most disputable ground in the whole. Fourthly, in regard to bottom heat, although Mr. H. may be very right in so moderate a use of bottom heat (when coupled with the rest of his system), yet, such a moderate degree, if the best for plants thus circumstanced, is by no means binding on those who cultivate them by the old or any other system. Mr. Hamilton has a heated chamber under his fruiting bed, and this circumstance enables him to preserve his roots undisturbed as long as he pleases. Mr. H.'s pines are rooted over the top and through the bottoms of the pots, drawing quite as much nourishment, in all probability, as though they were planted out in the bed. (*Gard. Chron.* 1845, 595.)

Mr. Hamilton is now endeavouring to increase still

further the amount of fruit from a given number of stools, by ripening more than one upon each. To use his own words—

His attention has been directed to the producing two fruit on one plant at the same time, and he is getting entirely into this practice as fast as he can. Hitherto he has experienced little difference in size between each of the two fruit so produced and the single ones. Moreover, those plants that produced a brace last year, have produced a brace this year also. With regard to the size of the fruit produced by the old stools, in most instances they have surpassed those from the maiden plants. Mr. Jennings, of Worsley, has cut a brace from the Montserrat (Black Jamaica of some,) which weighed 10lbs.; other varieties have been produced, of equal weight, by other persons. (*Gard. Journ.* 1845, 716.)

Mr. Hamilton also gives the following directions. After all the plants are taken out of the bed, let the old tan be levelled, well trodden down, and smoothed with the rake; the whole bed then covered with fresh tan to the depth of ten inches; the plants immediately taken out of their pots, with their balls as entire as possible, and plunged into the bed, beaten tightly about the ball, and covered to the depth of one inch only. If the ball, with the roots, be covered too deeply, they will be in danger of being burned. The tan used for this mode of culture must be made from British bark,

as it undergoes a slower putrid fermentation than foreign tan ; and is rendered less fit for supplying the plants with food. In old, decayed tan, the plants make very little progress ; the fruit also is of inferior size. Foreign tan is objectionable, as it soon decays. When pine plants are turned out into the tan in the winter season, their growth is so rapid, that, except they have plenty of air and light, the young leaves are apt to blanch. For several weeks after planting, the surface of the tan ought to be frequently stirred with a rake or long stick, to prevent any fungous breeding, to effect the escape of the superabundant bottom heat, to allow the atmosphere to have free access to the roots, and to keep the tan in a clean, pure state. (*Hamilton on Pine Apple*, 62.)

Mr. J. Gray, of Esher, for fruiting the same plant for several successive years, instead of raising a fresh stock annually, says, the pit in which they are grown should not be less than 10 feet wide, and should be built in divisions of five lights each ; the frame-work being also so constructed that the part belonging to each division could be raised separately when required. The thickness of the wall at back and front should be 4 inches, with only a pigeon-hole occasionally along the bottom, to allow the water to drain from the interior of the pit. Within the outer wall, and at about 4 inches from it, another wall, a foot less in height, should be raised ; the cavity between being intended

for the reception of a hot water pipe, which must be fixed before the inner wall is completed, and should be about 2 feet above the level of the floor of the pit. The depth of the pit should be about 6 feet; the front being a little higher than the ground level, and the angle of the roof left to the builder's taste. He also recommends a cavity, 2 feet wide at the bottom, and 6 inches wide at top, to be formed round the pit, about six inches deeper than the level of the interior, to hold a lining, so that the hot water apparatus might only be called into use during severe weather. The bottom of the pit should be covered several inches deep with rough stones, over which any common slabs, or, in their absence, pieces of turf, may be spread. This will prevent the tan, which is next to be brought in to the depth of 18 inches, from falling down amongst the stones. The compost in which the plants are to be plunged should be about one foot deep. The latter, when planted, should be just upon the point of throwing up their fruit. The pit will be sufficiently capacious to admit of four rows being planted out in angles two feet apart. After the first fruit has been cut, one or two of the best suckers should be left, as low down as possible, on each stool; the old leaves should be trimmed off, and a few inches of fresh compost should be added, so as to raise the mould up to the base of the suckers. This treatment might be continued annually; and as soon as the

plants reached the glass, pieces of wood about four inches thick and a foot in height, made secure at the corners by means of small bolts, might be raised upon the wall beneath the frame-work. Upon the top of each piece of wood there should be a groove, in which the bottom of each succeeding tier would fit. Each division of the pit being separate, the frame-work might be taken off whenever it was necessary to add another tier; and the top of the pit being built but little above the level of the ground, these tiers of wood might be continued to the height of two or three feet. It would not be necessary to raise the lining higher than the top of the brick wall, as there would no doubt be sufficient heat in the bed from the lining and the hot water; which latter, being in the cavity, would warm the soil sufficiently. Boards made to fit above this cavity would be beneficial in keeping the dirt from falling down between the pipe and the walls when mould was required in the pit. The boiler and fire-place might be situated at one end of the pit. (*Gard. Chron.* 1843, 100.)

Mr. Dale, gardener at Brancepeth Hall, near Durham, gives some further directions for this mode of culture. He says that the treatment, supposing the first fruit to be cut, and the suckers and old plant growing away in a vigorous state, should be as follows:—The suckers to be reduced to one or two, according to the health of the plant, and when the roots become much

matted, a few of the bottom leaves pulled off to allow the plant to make fresh roots in a top-dressing of rich compost; the plant to have a moderately moist heat in the bed, and a moist atmosphere kept up, and the plants situated as near the glass as possible. In pursuing this mode of culture, give the plants, if free rooters, a fair portion of water, and if the soil should become much exhausted, give liquid manure occasionally, allowing the plant and sucker or suckers to grow on until they are strong enough to produce a good fruit; then the plant being tied up, turn it carefully out of the pot, and with a sharp-ended prong reduce the ball as much as possible, without injuring the fresh roots; then place the plant having part of the ball attached as low in the pot as you can, placing a small portion of compost in the bottom of the pot, and leaving a little room at top for top-dressing afterwards; by this means the plant will receive a partial check, and in making fresh growth will generally show fruit. The success during the following years will depend upon the health and treatment of the mother-plant. If the suckers break off from the plant near the pot, endeavour to give strength by putting a circular case round the rim of the pot, and by this means you can add compost to the roots of the suckers, previously pulling off a few of the bottom leaves. (*Ibid.* 1845, 70.)

Mr. Errington, gardener at Oulton Park, whose

able remarks have been already quoted, adds these warnings upon this mode of pine culture :—

The young suckers on the old stool ought to be always growing, but in very dark weather 65 degs. during the day will suffice, and answer a better purpose than a higher atmosphere, supported by enormous fires. With a humid atmosphere, they will make much progress even during the winter ; at least his plants do. Dormancy and dry air are both positively injurious, particularly a dry air ; the leaves will become debilitated, and their energies so impaired that they will be very unfit to meet the exigencies of the plant when the growing season arrives. The pine-leaf should be so brittle that it can scarcely be touched without breaking ; and when such leaves are cut with the knife the sap will directly ooze out from the inner tissue of the leaf. In this state they are prepared to meet a July sun. (*Ibid.* 1846, 252.)

The following observations by Mr. Errington apply to all modes of culture :—

When you cut your fruit avoid as much as possible any damage to the leaves. Preserve by all possible means your old roots. Young or stem roots are all very good adjuncts, if honestly obtained ; let them not, however, be petted at the expense of the original roots. If two suckers are left equally in a perpendicular position, and the agencies pointed out by the Hamiltonian method applied to promote rapid growth,

they may each be expected to produce a fruit as large as the one preceding. Neither can they fail to do so in a very few months, if the proper means be properly applied. (*Gard. Chron.* 1846, 252.)

Number a Bed will contain.—If a pine pit is constructed 8 feet wide in the clear, and in compartments of 32 feet in length, each compartment will hold 38 or 40 strong fruiting plants, either in pots or turned out. Eight feet is a very convenient width for getting at the whole of the plants to water, and to attend to their general wants. The pit may easily be constructed in shorter compartments, and it is certain that pines cultivated in any stage of their growth in small compartments may be most readily supplied appropriately with heat, air, and water.

CALENDAR OF PINE CULTURE.

THIS department of our subject is beset with difficulties, for even some of the most successful cultivators of the pine apple vary when they assign the temperatures, degrees of moisture, &c., appropriate to particular periods of its growth. Moreover there is no doubt that those circumstances should be varied according to the brightness or cloudiness of the season, and according, also, to the vigour of the plants.

Mr. Barnes, therefore, is quite right in observing that success in pine culture does not depend upon the expense bestowed in erecting the pit, nor in applying to it a heating apparatus of great efficiency; neither is it secured by obtaining vigorous plants of the best varieties; nor by procuring the soil, without regard to expence, from the locality from whence it is well known some celebrated cultivator procured his soil. Neither is success dependent upon a precise quantity of any kind of manure, either in a solid or liquid state; nor upon drainage, nor upon repotting, nor on the size of the pot, nor on a certain season of shifting. So neither is it obtained by the application of just one certified degree of heat, either at bottom or top; nor one stated method of applying air and humidity. None of these circumstances alone, nor even a major part of them, will secure excellence in the growth of this fruit; all are requisite, but, above all, foresight and attention; applying the whole of the requisites in combination and uniformity with each other.

Coinciding fully with this opinion, we rejoice in being able to place before our readers the results of the experience of two such men as Mr. Barnes and Mr. Errington. The latter has obliged us with the following Calendar of operations, and we have placed within brackets the directions furnished to us by Mr. Barnes upon the same periods of the pine apple's growth.

The monthly division of business which has generally been adopted by those who have attempted to lay down rules for the inexperienced—for whom alone we intend these remarks—appearing to us to be inefficient to the end in view, we have deemed it expedient to take a somewhat wider footing, and to endeavour so to group the main features of the subject, as that a mere tyro, although confined as to principles, may be totally unfettered by mere rules; and may, consequently, as a matter of convenience, greatly modify his mode of culture, so as readily to meet any contingency. We may also here state, that we have thought it necessary to confine ourselves to the pot culture of pines, on the old bark bed system; for those who can cultivate pines well by that mode may safely be entrusted with the tank. We have no prepossession for either the Meudon or Hamiltonian system; but believe that they are both good in their way. We have, therefore, occasionally adverted to them when considered necessary.

Before proceeding further, we would offer a few remarks on the following important processes as connected with pine culture in all its stages, which will be useful preliminaries, as tending to prevent repetition in what follows :—

1. General principles of potting.
2. General principles of watering.

3. General principles of syringing.
4. General principles of ventilation.

1.—GENERAL PRINCIPLES OF POTTING.

The question of soils having been discussed at p. 65 of Vol. I., we need say little here on that head, but merely observe that they must by all means be in a mellow state. Quite agreeing with Mr. Barnes in repudiating the use of wet turf or other composts, we will append a few remarks at the conclusion as to good modes of harvesting soils.

A continual succession of fruit being the aim with which we must set out, it follows, as a matter of course, that any general shifting, in the old acceptance of that term, must have a tendency to defeat the end in view. We, therefore, say, that the more progressive the shiftings are the better. As a general rule, however, we would say shifting might be entirely dispensed with from the end of October until Christmas. We consider that the root during this period should be allowed a comparative quiet, for an over active root would but weaken the general fabric of the plant, which it is the business of the clever cultivator to solidify by the last remains of autumn sunlight.

With regard to shifting, we would in the first place protest against shifting without a sufficient reason,—

that is to say, a pot full or nearly full of healthy roots. Another point we would urge, is to give liberal shifts. We would in nearly all cases, excepting in mere sucker treatment, have the fresh pot nearly four inches in diameter more than the pot whence the plant is removed. One favourite plan of ours is to continue pressing in gently lumps of porous turf round the sides of the pot during the process, merely casing with a general mixture at the close of the operation.

In the present state of pine culture we would advise that porous turfy loam, of a somewhat adhesive character, should constitute by far the largest half of the mixture. Indeed, if from rich lowlands, which have been employed for a score of years, we have no doubt that, coupled with a proper system of liquid manure, it would be found complete in itself without any admixture. For general purposes, however, we would say, mix some stimulating manures and a little half-decayed leaf-soil or peat with the mass, adding plenty of coarse charcoal poundings, with some coarse sand.

Pots with concave bottoms are the first essential, with a very large hole or holes for drainage. If such are not large enough, or the bottom looks suspicious, knock a hole larger with a hammer. The crocking is another and most important matter, for if the drainage hole becomes choked, it matters little how

much pounded material is placed over it—all becomes nullified. Therefore, so to arrange the first crocks over the hole in the pot as to preclude the possibility of its choking up, and to guard these again by another course and order of drainage, constitutes the chief part of the philosophy of potting. We generally place one huge hollow crock half overlapping the hole, a second half overlapping that, and a third overlapping both; by which means we have at least three main outlets for water; and it is very improbable that all should be choked at once. This accomplished, we cover to the depth of one-fifth of the pot, be its size what it may, with a mixture of pounded crocks, charcoal, and bone, in about equal quantities. A little turfy matter, with nearly all the soil battered out, is then thrown over the crocks, and on this the ball is placed, taking care so to calculate as to the depth of the pot that the surface of the ball will bear a coating of an inch or two of the prepared mixture, which, as we before observed, we consider necessary as a sort of regulator of moisture; for, without this the moisture of the soil or turf would be liable in extreme dryness of the atmosphere to evaporate too speedily. The ball being placed in the above preparations, lumpy mellow turf, shook in a coarse riddle in a dry state, to dispossess it of much of the mere earthy particles, is crammed in around the ball to wedge it in its position. Over this, a layer of the

prepared mixture is strewed, then another lot of turfy matter, and so on alternately, taking care to finish with an inch or two of the compost.

One remark, generally applicable, should here be made, viz., that in all cases of shifting with sound balls and healthy roots, that such balls should, if dry, have a liberal watering a couple of days previously to the shifting: this supersedes the necessity of watering close on the heels of potting, which is a practice to be avoided.

2.—GENERAL PRINCIPLES OF WATERING.

This is a difficult part of the subject to deal with, and the remarks we may make will be given, and we hope received, with much caution. No plant enjoys water more than the pine judiciously applied, whilst it is equally certain that no plant sooner suffers from an injudicious application of this needful liquid. Varieties also differ in the quantity they require; for, whilst the Black Jamaica (Montserrat of some,) would do with a watering once in a fortnight or once even in a month in the height of summer, the Queen, under a similarly very high temperature, and in full vigour, would grow, in what might be termed, by way of illustration, a hot ditch. Plants of robust habit and under high temperatures will of course require much more water than those not so strong; but if any doubt

arise in the minds of the inexperienced, we would say withhold water, and endeavour to compensate for its absence by an increased amount of atmospheric moisture.

With regard to suckers rooting, and young stocks recently potted, especially in the winter or spring seasons, we say give no water if possible until the pot is half filled with roots. Indeed, as before observed, some time should elapse in all cases of recently shifted plants before water is applied: we would rather depend on an increased amount of atmospheric moisture.

3.—GENERAL PRINCIPLES OF SYRINGING.

As sufficient humidity of atmosphere cannot, in the present state of gardening affairs, be supplied in the form of steam, or rather of vapour, syringing is had recourse to, and a very useful adjunct it is in pine cultivation. One of the first maxims with our best pine cultivators as to the regulation of this power, is to take care at all times that the lodgment of water in the axils of the leaves (consequent on the previous syringing,) has evaporated before more is supplied: at least, this is a very safe maxim with beginners. When much syringing is indulged in, a very great amount of heat must also be allowed, especially solar heat. We are of opinion that syringings could scarcely be too

frequent in the hot season, providing the above rule were observed, viz., to first suffer the water in the axils to evaporate. However, as the accumulation of solar heat must be limited, and at least bear a proper ratio to the intensity of light, moderation must be observed in this as in other matters.

4.—GENERAL PRINCIPLES OF VENTILATION.

We here find ourselves on somewhat disputable ground, for practical men differ, perhaps, more on this particular than any other. Some are for having their houses, as it were, hermetically sealed ; others talk about the wind blowing through them.

The horticultural public, we are glad to see, are at last becoming alive to the importance of settling this branch of cultivation on a more permanent basis than the mere opinion of any particular individual. For ourselves, we are great advocates for a motion or circulation in the atmosphere ; and we are happy to say that we find Mr. Barnes, as well as several more first-rate and truly practical gardeners, agreeing with us on this point.

To lay down anything like general rules is very difficult, especially in the present position of such matters. We would merely observe that we ourselves give air night and day at all times, were it in ever so trifling a quantity, providing, we feel certain of se-

curing the requisite amount of heat, and, what is more, of atmospheric moisture. This last, in the majority of hothouses, is the great difficulty; and how to get a fresh circulating air, without loss of atmospheric moisture, is indeed the great gardening problem that awaits solution.

Air with motion (yet without what is termed draught) is truly beneficial to most plants; and, as a concluding piece of advice, we would say, endeavour as much as possible to make front air suffice; there is more change of atmosphere when the front sashes alone are raised than people commonly imagine.

We now proceed to say a few words on the subject of general cultivation, and we think we cannot do better than commence with the

GENERAL ARRANGEMENT OF STOCK IN THE WINTER AND SPRING.

[JANUARY.—*Fruiting Plants and Fruit Swelling*.—Night temperature not to exceed 60 degrees, and have no objection of a cold or dark, foggy morning at day break, to observe the temperature down to 55 or a degree or two less. Humidity in very dark, foggy, rainy, snowy, or severe blowing weather, is to be applied with some caution and moderately; but always damp the paths well, morning and evening, with tepid water—never employ cold water. Take

advantage of light mornings, and then apply light syringings of tepid water about the axils of the leaves, and over the whole of the surface of the plunging materials with generally a quart or two of clear soot water or liquid manure, applied to a 4-gallon water-pot of clear soft water. Never allow the plunging materials to become dry and parched, and never think of putting it out from amongst the pots into the walks to moisten it, as frequent sprinklings will continue about it a kindly moisture. The bottom heat, of course, at this season should not be excitable, but genial and moderate, from 72 to 80 degrees or thereabouts. It will a little fluctuate by the influence of changeable weather. If a little additional heat at this season is required, as it probably will, if no additional fermenting material has been applied since autumn, apply it now on the surface with a fork and rake. The outside of the plunging bed is to be pushed and circulated about, and amongst the pots all over the surface as lightly as possible, and then the fresh material is to be applied to fill up the vacuum thus made.

This is very quickly and conveniently performed; but on no account remove the fruiting plants, to renew the bottom heat with fresh fermenting material, which would not only be likely to check them at this season, besides the extra attention required in watchfulness of the renovations, in order to be safe from

over-heating, which would probably occur; and a very little excess would do the roots an irreparable mischief. As to setting the plants on the surface of the bed for a time, as is recommended by some gardeners, the question is, whether such a remedy would not be almost as bad as the expected evil sought thus to be avoided.

Succession Plants in structures heated by dung, or other fermenting materials, will do very well and grow quite fast enough if the interior atmosphere is maintained from 50 to 60 degs. with air admitted, provided the heat is applied upon a good principle from the top of the outsides of the structure, to allow of air to be given to pass off any superfluity of vapour, the escape of which is most essential at this season. Plants grown in a strong humidity at this period of the year would be likely to suffer from debility, instead of acquiring a healthy sturdiness and a moderate progressive growth, and dark green colour, which will always be maintained with a moderate heat properly applied, with sufficient air, to preserve the foliage of the plants from a wet or damp appearance, which at this season is dangerous to their well-doing. To prevent excessive dampness the bottom materials should be in the most genial condition, and the linings be applied at top of the sides of the structure instead of at the bottom. This heating from above, to a considerable extent, would act similarly to the sun shining in drying and

modifying a humid atmosphere. Water at no time should be withheld if at all needful. Apply it little and often at this season rather than by large portions, and only occasionally.

FEBRUARY.—In this month, says Mr. Barnes, we advance the temperature a few degrees, as the month progresses and the light increases. Also we apply a more liberal humidity amongst the fruiting plants and fruit swellers, syringing a little more about their foliage, and giving them an occasional liberal syringing of good manure water about and amongst the lumps of charcoal, which lie on the surface of the plunging material ; damping the paths, walks, and the whole of the interior of the structure pretty often on bright days, and occasionally turning on moderately, for a short time, the perforated water pipe ; all of which combine to afford a general humidity to the interior atmosphere, which the pine plant in every stage of growth truly delights in. By the end of the month our night atmosphere is increased to about 60 or 65 degs., but rarely the latter, and not without we have had bright light days, for a strong fire heat, we are perfectly satisfied, retards the fruit from swelling kindly, and weakens their first showing fruit. We entirely regulate the interior night heat by the daily light we receive, and very seldom do we advance beyond 63 degs. in the month of February : from 60 to 63 degs. is our general maximum.

The Succession House, too, we advance a few degrees, and like to see it opened of a morning in light weather with a temperature from 57 to 60 degs. with covering, but lightly, with air, and a genial humidity, but not steam, so that a leaf looks wet.]

TOWARDS THE END OF FEBRUARY, says Mr. Errington, with regard to fruiterers, if a proper structure exists, these will all have been fixed in the autumn to remain without disturbance, and little will require to be done except stripping away any decayed leaves and adding some top dressing of porous turf. After this is done the tan bed should be well stirred up in the way Mr. Barnes recommends, and a little new well-wrought tan added, slightly to increase the warmth, which for the fruiterers at this period may be permitted to rise to 80 degs. A greater heat may be indulged in, but this we consider a safe proceeding.

For successions, from the sucker or crown upwards, a scheme of summer cultivation must at once be decided on, and the plants classified accordingly. If any are to be continued in pits or houses, in which the tan pit was made anew in the autumn, little disturbance will be necessary. If, however, new beds have to be prepared, some little extra labour will be required. Tree leaves, especially of the oak, are by far the best, and these should be fermented with a trifling mixture of dung before using. In taking out the decaying

matter from the pit, a considerable portion may in general be reserved to mix with the new materials. About four feet in depth must be provided, if leaves are to be had, beneath the plunging medium: if, however, the structures are mere frames, they must be kept somewhat higher in order to carry sufficient linings. Whilst carrying through these operations, the plants, of course, must be made secure from sudden depressions of temperature. A coating of fresh tan of about six inches will suffice to plunge them in, and they may be plunged nearly half their depth at first. All those which are robust, and possess a pot full of roots, should, if rather dry, (which they ought to be at this period,) receive a watering with weak liquid manure, and shortly after receive a shift, and it will be well if several compartments are at hand to keep the fresh-shifted ones by themselves, for the sake of system.

A temperature of 60 degrees minimum should now be secured to the succession stock, whilst in this, as in most other cases, the fruiterers rising, or swelling off, will need 10 degs. more. Syringing may be applied in a very slight degree on sunny afternoons, twice or thrice a week, to the successions, providing an advance of 5 degs. of solar heat can be shut up for an hour or two. The fruiterers, except those in flower, will require it a little oftener; taking care, however, to observe a rule laid down in the preceding

parts of this work, viz., to let the former syringing evaporate from the axils of the leaves before supplying more. The fruiters should be allowed a great advance of solar heat in the afternoon: the temperature may be safely carried to 80 degs., or even 85, from three o'clock until five, if by solar heat.

The only course henceforward is to continue to increase the heat in a justly corresponding ratio to the increase of light; for this, after all, is the only true standard. Those who can thoroughly understand this great principle will need few other rules to guide them.

With increase of temperature, atmospheric moisture must also increase, and be made to bear the same relation to heat that heat does to light. These matters being established, the next thing is to watch daily the bottom heat: this has always been an ill-defined matter; and, instead of laying down any given number of degrees for any period, we would say, to generalize the matter, let the bottom heat be always about 10 degs. in advance of the average atmospheric temperature; which latter, as we before observed, will have in the main to be ruled by the amount of light.* Thus, in January—

* See p. 115 of vol. I. for some observations on this point.

ATMOSP. TEMP.

DAY. NIGHT.

Fruiters.. 70 — 63=133 degs.

Or mean about 66

To which add 10

Gives for bottom heat 76

Successions 60 — 56=116 degs.

Or mean..... 58

To which add 10

Gives for bottom heat 68

We cannot but think that this mode of computation will exceed all dry rules, especially for the amateur, or those who have all to learn on the subject of pine-culture; and by taking the intensity of light as the basis of all the operations, little harm can ensue, and the whole matter will possess more interest.

Mr. Hamilton is very averse to what is called a lively bottom heat; and, indeed, so are most of our best gardeners. Mr. Hamilton seldom allows the bottom heat to rise to more than 84 degs., which is about his maximum even in the height of summer: he depends more on the continuous action of a great volume of undisturbed fibres, together with a great amount of unmutilated foliage, for he seldom removes a leaf for the sake of top-dressing, unless quite decayed.

[MARCH—Still further increase the temperature and

humidity in the fruiting house, giving also more liberal supplies of water and liquid manure. The perforated water pipes are to be taken advantage of pretty freely on bright days, and all the arrangements assume a forcing appearance. At Bicton, the night maximum rarely reaches 68 degs. in this month, but ranges about 65 degs., a degree or two under or over, according to the light received by day ; if two or three bright fervid days succeed each other, Mr. Barnes occasionally advances by night the heat to 68 degs. or thereabouts.

In the Succession Pit, too, they attempt to advance a little by turning the linings lower, maintaining, if possible, by night a heat of about 60 or 62 degrees, admitting at the time air, and a light covering with a single mat, which is left off altogether by the middle or last week in the month, and the linings continued well topped up with the previous year's dried short grass and kindly worked leaves, &c.

APRIL.—In the fruiting structure the degree of heat is still advanced a little. About the end of the month its usual night temperature standard is 68 degs., if there occurs a succession of light days, but if dark and stormy, ranging a degree or two less. Humidity and liquid manure, too, are now applied pretty liberally over the whole surface of the fruiting structure, plunging materials, as well as to the base of the trunk and roots of the plants ; always, of course, in a diluted, clari-

fied condition. A soft humid atmosphere is now fully maintained both night and day, but the hot water pipes, or heating apparatus, are never watered to raise a steam when hot; this being thought to be entirely opposed to nature, as she never applies soaking or hasty showers or storms while the sun is fervent and scorching, but the sky or atmosphere is generally modified by clouds or vapour to shade the earth.

Succession Plants.—To these the heat of course naturally increases at this season, as that of the external atmosphere also increases; therefore the plants in this structure should now be making rapid growth, and, consequently, have liberal supplies of water and syringings in suitable weather. Apply it over the whole structure, plants, surface of the plunging materials, &c. The more heat applied by lining, the more liberally can air be given to maintain the plants sturdy and healthy. If the night atmosphere in this structure can be maintained at about 65 degrees with air, so much the more in the plants' favour.

MAY.—In the fruiting structure this is a favourable progressive month. Heat may be increased to 70 degrees by night, with abundance of humidity, and liquid manure be given in greater abundance and stronger. The surface of the plunging materials and the whole structure should be continued moist, but not flooded with wet. Admit air liberally, and

apply with moderation the perforated water pipes at night, after scorching clear days have prevailed. Shut up early, and apply air early of a morning, but never syringe about the plants in a morning or in the day time while the sun is shining powerfully. This has a very different effect when the house is shut up early of an afternoon, and abundance of humidity at once applied to all parts of the structure.

Succession plants, also, this month should have a liberal heat, from 67 to 70 degs. at night, with air, and abundance of kindly humidity, of syringing, and application of good bottom waterings.

JUNE.—*Fruiting Structure*.—We are now come to the summer months, when the heat at night may reach 75 degs., with liberal applications of kindly humidity, of bottom and surface waterings, and abundance of air methodically admitted, night and day.

These directions hold good also for JULY and AUGUST, with an increase of air as the season advances. At Bicton they admit air very liberally indeed, both night and day, particularly in the latter month, often having the lights half off.

Succession plants also now should have abundance of heat, air, and humidity : if properly applied, their progress will be astonishing. The day heat, of course, is always, to a great extent, to be regulated by external circumstances. Shading is an injury un-

doubtedly to well-rooted healthy plants, and is in no way required if our directions are carried out ; and should in these times only be heard of as a thing once in practice, but now only to be found in the corner of curiosities.]

The summer management is very simple. The bottom heats must be closely watched, and if they advance too high, refer to Mr. Barnes' directions in the preceding pages. Nothing can be better than the directions there laid down ; therefore repetition is needless. As the young plants get full of roots, let them be shifted, not minding what period it is ; and, above all things, give abundance of air to growing stock, about which so much has already been said.

In the course of June, July, and August, the growing stock will, when full of roots, require abundance of water ; and liquid manure may be given at each watering, provided it is perfectly clear and not too strong. We will offer a few words of advice at the conclusion about this treatment.

Through the hottest part of the summer the fruiters will enjoy a vast amount of solar heat, providing the amount of moisture in the atmosphere and a due circulation of air can be made to keep pace with it. These, too, will benefit by the application of liquid manure, which may be used in a similar way as that for the successioners. Some good gardeners use

shading in intense sunshine, and some equally good do not ;—we are of opinion that where much shading must be had recourse to, it is an argument of either a bad state of root or of insufficient structures—in-sufficient as to a proper supply of atmospheric moisture.

We may here be permitted to offer a few remarks on the ripening process. Every one admits that the roots should be in a drier state at this than at any other period : we would, however, direct attention to another and equally important principle, long since recognised by the late celebrated Mr. T. A. Knight, The principle we allude to is that of slow ripening, or, at least, not a hurried one. We have always found melons, peaches, &c., much higher flavoured when ripened slowly ; and any one who has turned his strawberry-pots out of his houses rather prematurely in the month of February, into cold pits or frames, must have been struck with the vast increase of flavour under the latter circumstances. When we consider, however, that the secretions which give flavour to the fruit must, under all circumstances, require a given time to be complete in, it is no marvel ; and it becomes evident that all hurry in forcing beyond this point is at least supererogatory as far as flavour is concerned.

AUTUMN ARRANGEMENTS PREPARATORY TO THE
COMING WINTER.

So various are the means at hand to grow pines, as well as the chosen routine of management in various places, that it is somewhat difficult to say how pines must be wintered.

It becomes necessary, however, in the end of October, to lay down a scheme for their winter's management. One thing is really necessary in all cases; and that is, as observed in the early part of this Calendar, to endeavour to get the fabric of quick-grown plants solidified by the last remains of autumn sunlight. This must be, in the main, accomplished by a most free circulation of air, and by suffering both bottom and top heat to come quietly downwards in the scale, without any unnatural attempts to accomplish any thing beyond the well-being and sure preservation of the plants.

Where the young stock must be preserved in ordinary pits or frames by means of fermented material alone, some previous care is necessary. In such cases the bed should be renewed by fresh fermenting matter, and the early fallen autumn leaves blended with a very small amount of hot manure, and fermented once before use, may be resorted to for this purpose. However, all this is not for the production of unnatural bottom heat, but to produce a durable bed, which,

with due protection from linings, will never be very hot or very cold. And here we would say, do not force the body of the bed through the winter, but rather endeavour to heat the walls or boards, and thus to produce an atmospheric heat independent of the proper amount of bottom heat : this we would do in order to be enabled to give all the air possible during the winter ; thus keeping a solid texture in the leaf. Young stock wintered thus should not be watered late in the autumn, especially the black kinds. If the pots are pretty well filled with roots, one good general watering with clean water (for no excitement now may be permitted in dung pits,) properly administered, in the end of October, will for the most part carry them through until January. Some few, very full of roots, especially of the Queen kind, will perhaps require a little water once or twice during the winter.

As young stock in houses or pits, where there is piping or flues, will enjoy less atmospheric moisture of a permanent character, means must be taken to supply it, or to water rather more frequently. In such cases there is not, at all times, an absolute necessity for removing the bark bed in the autumn, as suggested for the dung pits ; a little more tan forced amongst the pots will frequently carry them safely through where the only object is to get them wintered safely.

Fruiters up and swelling will require both a livelier

bottom heat and rather more water. More atmospheric heat will also have to be applied, in proportion to the end in view, as described previously ; taking care to let it at all times, both night and day, bear a just proportion to the light. Above all things, however, with these, avoid aridity of atmosphere : a most liberal supply of atmospheric moisture must be provided even in winter, not by syringing—although this may sometimes be practised—but by watering the tan surface, floors, walls, &c., rather frequently.

[SEPTEMBER.—The autumn fruiterers and fruiting plants for early fruiting, the former placed at one end of the structure, must have the humidity somewhat modified, with applications of tepid water, with a little liquid manure added, to be still pretty liberally supplied both at bottom and by syringing all over. Air is now to be given, and during the two first weeks in OCTOBER still more liberally both night and day. The temperature of the structure we but little regard at this season, but allow it to modify with the season, by the application of a gentle fire only for a few hours of an evening to dry up the damp. The interior atmosphere of a morning in the stove at Bicton is often pretty nearly of the same temperature as the external, and the strength of the plants is thus very much increased ; the fleshiness of the foliage and stoutness of their trunks augments very fast, and the fruit weighs

astonishingly, according to their diameter. At the end of October we modify the application of heat and air—but continue air to some extent both night and day; the night heat at the end of this month, is reduced to rather below 65 degs.

Succession Plants must receive a similar treatment to the above, from September to the middle of October, as regards the modifying the humidity, with abundance of air night and day, but in neither must the surface of the plunging materials be allowed to become dry, or the plants to be in want of water at their roots.

NOVEMBER.—In the *Fruiting Structure* still continue the modification of humidity, airing, and bottom watering. We reduce the temperature of the atmosphere down to pretty nearly 60 degs., still admitting air night and day until December. Except during gales and extraordinary rough weather, we do not shut up at night until about the middle of this month, when the heat and humidity is modified down to what has been directed for January.

Succession Plants.—The atmospheric temperature for these is still modified, also the humidity of the air is reduced at this season, as the light declines to the degree already given for January. The heat in the Bickton pits is now applied at top to the greatest extent, by topping up the linings, and not turning them lower than the surface of the plunging materials, but always, if possible, maintaining a liberal supply of air,

at night. We commence covering with a single mat at the beginning of December, and in severe weather add a little refuse straw or hay, so as to admit of giving the structure air, to allow the escape of any superfluous vapour, and to maintain a healthy sturdiness of growth.]

We fear we have been rather too copious in our observations ; so various, however, are the structures employed to grow pines, that it is a difficult matter so to write as not to mislead.

We will conclude this section with a few remarks on the *harvesting of soils*, as it is aptly termed by Mr. Barnes, and which might have been inserted on the same page with his remarks. We consider a dry March the most eligible period : a winter's frost will be found a good preparation for this process. Next to March, we would choose September ; but, whatever time be chosen, dry weather for this operation is indispensable. The turf should be piled up in sharp ridges, so as to exclude the rain ; and if a slight coating of thatch could be placed over it, so much the better. Materials thus harvested—grass and weeds the more the better—will be in a fine mellow state in about six to nine months ; if it lays longer it begins to loose texture.

We use only one kind of *liquid manure* for this and all other purposes ; not because we think nothing

can excel it, but because it is very easily obtained. Urine is collected and allowed to become stale ; soot water is made in a tank adjoining the former ; when skimmed and quite clear, the two are mixed equally together, and guano is added after the rate of about four ounces to a gallon of the above mixture. In using it we have the whole as clear as wine : this we hold of paramount importance ; and we merely colour the tepid water with it, putting about a pint of the prepared mixture to a large water-pot full of clean water.

In conclusion, let it be borne in mind that the true basis of a continual succession of fruit is to be sought in a frequent succession of suckers and frequent shifts.

Mr. Errington subjoins a monthly table of temperatures for the successioners and the fruiterers ; which, he says, may in some degree serve to guide those who are totally inexperienced in pine culture. It must, however, be borne in mind that much liberty may be taken with the temperatures here given according to the state of the weather ; and we beg to request that our view of the most desirable temperatures may be referred to at p. 5 of this volume.

MR. ERRINGTON'S MONTHLY TABLE OF TEMPERATURES.

FOR FRUITERS.

			DAY MAX.	DAY MIN.	NIGHT MAX.	NIGHT MIN.
January	..	..	70	60	62	55
February	..	..	73	64	65	58
March	..	..	80	70	70	60
April	..	..	84	70	70	62
May	..	..	86	70	72	65
June	..	..	88	70	73	66
July	..	..	90	73	74	67
August	..	..	88	70	73	66
September	..	..	80	68	70	63
October	..	..	75	65	67	62
November	..	..	70	62	65	60
December	..	..	66	60	60	54

FOR SUCCESSIONERS.

			DAY MAX.	DAY MIN.	NIGHT MAX.	NIGHT MIN.
January	..	..	60	50	55	50
February	..	..	63	53	57	53
March	..	..	66	60	62	56
April	..	..	70	62	65	59
May	..	..	75	65	68	63
June	..	..	80	68	70	65
July	..	..	85	70	70	65
August	..	..	83	68	70	63
September	..	..	75	60	66	59
October	..	..	68	58	60	57
November	..	..	62	56	57	54
December	..	..	56	50	55	50

Mr. Dodemeade has also communicated a calendar of pine culture to one of the gardener's associations for mutual instruction established in the vicinity of London. It chiefly agrees with those of Mr. Errington and Mr. Barnes; but as it contains some useful hints, we print it almost entire. Where his temperatures differ from those already given, we would forewarn our readers that we abide by the latter.

In *January* it is necessary to ascertain the condition of the plants that were potted in their fruiting pots in August; if they have progressed favourably, the pots will be full of healthy roots: the bark bed, or other fermenting material, if employed for bottom heat, must be examined, and renewed with fresh fermenting material; it will be necessary to pay particular attention to the renovation of such bed at this time, that no accident may occur to the plants from too high a temperature to their roots, which would be fatal at this stage of growth. The roots of the plants being close round the sides of the pots, they are in a situation very much exposed to danger. Be particular that the plants do not suffer by want of water, or anything necessary to their well-doing, as the plants are shortly to realise the expectations of the operator or prostrate his hopes. The temperature of the house this month should be maximum, day, 70 degs.: minimum, night, 60 degs. It will be necessary to use a little judgment in watering, for if this element is sup-

plied too liberally at this early season, in connection with a brisk bottom heat, the plants may start into growth, and their fruiting be lost for the present.

In *February* the temperature may be advanced to 75 degs. by day and 65 degs. by night. The principal part of the plants should shew their fruit this month, and strict attention must be paid to give them every encouragement: they should be looked over daily; and when the centre leaves are perceived to be spreading outwards, it is an indication of the embryo fruit emerging from the heart of the plant. The soil in each pot is to be examined as the fruit appears. If the soil is dry, give a copious watering, sufficient to thoroughly moisten it; this greatly assists the plant and the swelling of the young fruit, as will be apparent at the time of flowering; it will then have a stiff, stocky appearance, setting close in the centre of the plant. The plants that are tardy in showing fruit should have a less copious supply of water towards the end of the month; but Mr. Dodemeade justly condemns the starving system, as practised by some growers, who withhold water altogether, and lower the temperature of the house; by these means forcing the plants into fruit at the expense of size and quality, for it comes small and puny, with a large disproportioned crown, mounted a foot above the plant, and requiring that support in infancy which

should be only admissable when the fruit approaches maturity.

In *March* keep the temperature of the house as in February.

In *April* the heat is to be advanced to 80 degs. by day, and 65 degs. by night, still allowing a rise of 10 or 15 degs. with sun heat, with plenty of air: the humidity of the house by day is regulated by the weather; and if it is a fine and sunny morning, as soon as the pipes are hot enough, Mr. Dodemeade sprinkles them with water to raise plenty of steam, syringing also the walls and paths of the house; and if the plants are safely out of flower, he gives a slight syringing over head with tepid water, which is highly beneficial to their growth, and soon will be perceptible in their rapid progress towards maturity. Mr. Dode-meade observes, that he had seen serious consequences ensue from inattention to giving air early in the morning, before the sun shone powerfully upon the plants; the leaves and fruit became blistered and unsightly, and no after attention could remove this defect. After fine sunny mornings, if the remaining part of the day continues fine, close the house early, say at three o'clock, to retain a good degree of sun heat, raising the temperature to 100 degs., as no artificial heat, however well regulated, has such beneficial effect upon plants as heat derived direct from the sun. Syringe the pathways and bed between the plants, also the

foliage of the plants with warm water: stir up the fires early to maintain a good heat until the close of the evening, when, if the night is fine and mild, the fire is to be damped up in order that the house may cool down towards morning to the minimum temperature.

In *May*, being generally a warm sunny month and vegetation in full activity, the most forward fruit swells rapidly. Pay strict attention to administer to the wants of the plants, as this is one of the best months for growing pine plants and swelling off the fruit; those that are swelling still water liberally with manure water in a tepid state, looking them over often that none may get dry, as the soil in the pots from this month till October should be kept in a regular moist condition, so as to hold in a state of solution the soluble matter contained in the soil, ready to be absorbed by the roots of the plants. From a want of due attention to this most important point of their culture, especially at an advanced stage of the swelling of the fruit, may be attributed the many disappointments experienced by pine growers, and the inferior fruit produced; attend to giving air, avoiding cold currents, shutting up early as before, and still having recourse to fires to guard against changes of weather.

In *June* many of the early fruit that were set in February become ripe. To insure good flavoured

fruit, it is necessary to admit a plentiful supply of air early in the morning, say when the thermometer reaches 80 degs., but taking care to avoid cold currents. The paths of the house are to be well watered to saturate the air with moisture; a point in culture not sufficiently attended to, and which is often apparent in the flaccid state of the foliage after a hot day; continue watering, till the fruit changes colour, when it must be withheld from the plant, until it is cut. The plants must be freed from all suckers, except one or two at most, to be retained for stock. When it is desirable to keep a ripe fruit back for a few days, the plant may be set upon the kerb of the pit, or removed to a vinery; after the fruit is cut the soil in the pot must be stirred up to the depth of an inch, and the stool well supplied with water, and every encouragement given to strengthen the suckers.

The successional crops of fruiterers have the same routine of management, but as many of them that ripen their fruit in autumn require a difference in the amount of air and water, these are regulated by the weather; if it is fine and sunny, it will be nearly the same as for the first; but if dull, cold, or wet, a diminution of each is necessary; and to swell the fruit to perfection, a little fire will be necessary on dull cold days or nights until the whole are cut. (*Gard. Journ.* 1845, 247.)

OUT-DOOR CULTURE.

IF Speechley and other cultivators of the pine at the commencement of the present century could awaken and read the title of this section, they would conclude that it applied to tropical horticulture. But it is not so, for the time has arrived when the gardener can be instructed how to ripen pine apples in the open air, in Devonshire, if not in other southern counties of England. We have already stated that the Editor and Mr. Barnes, without any interchange of opinions, commenced experiments, the one in a greenhouse without artificial heat, and the other in the open air, to ascertain if the pine apple could be successfully grown and ripened at lower temperatures than it is usually believed to require. Since that statement went to press Mr. Barnes writes as follows :—

The fruiting pines turned out into the kitchen garden at Bicton, without any glass or covering whatever, are going on well at this date, June 11th, and with every appearance of having some good fruit. I entertain no doubt, should the weather prove at all favourable, we shall get them of a most excellent colour and flavour in the autumn months. We have turned out several varieties, but the greater part of them are Queens, with a plant or two of Black Jamaica, Montserrat, Enville, Moscow Queen, Anson's

Queen, and Black Antigua. By the progress they have hitherto made and their present appearance, I can venture to state, without any doubt, that we shall cut a score of Queen pines from the open kitchen garden, between this date and the 29th of September, that will weigh in the aggregate 60lbs. This will be a novelty, and a case unparalleled, we believe, in this country. If this is discredited, parties are invited by Mr. Barnes to visit Bicton and examine for themselves. The mode of treatment is as follows :—We cut a trench, forming a bank on each side of it ; and then, at the end of May, place the plants in the bottom on three bricks, filling up round the pots with some well-wrought leaves. We then cover the surface of the leaves, and the banks on each side, with charred hay, Mr. Barnes considering this does best for absorbing the heat, retaining it, and giving it off in a gradual, wholesome manner. We can see no reason why pines should not do turned out as well as cucumbers, melons, and many other exotic plants, perennials as well as annuals. Mr. Barnes adds, that he is in no fear of the West Indian cultivators surpassing us for a time, by what he can already observe.

DISEASES.

WE have been very desirous of stating our opinions generally upon vegetable diseases, but until now have never had a few pages to devote to the subject. The desire arose from the conviction that a knowledge of principles applicable to plants generally affords light and guidance, without possessing which the gardener must be a mere empiric. In none is he usually more so than as regards the diseases to which his crops are liable. Numerous as are these, and destructive as they are to his interests, yet no subject connected with his art has obtained so little attention, and never was even trivial attention followed by benefit less important. The reason of the deficiency of benefit is not difficult to explain.

Common experience teaches us that diligence and perseverance, directed by judgment, are the essential preliminaries to success. In examining—in searching for the causes of the diseases and decay of vegetables—we have fewer guides, less assistance from the individuals affected, than we have from a diseased animal; fewer symptoms marking the commencement, or seat of the evil; yet where is the cultivator who ever took a fraction of the care exercised or a decimal of the attention to discover the cause, the progress, or the cure of one disease that sometimes brings ruin

by the destruction of his hoped for harvests, as he does to detect the disorder of, and the panacea for, some miserable pig? Diligence, perseverance, and judgment, then, have never for any length of time been directed to ~~the~~ diseases of plants; they are yet without their Æsculapius. The subject is one of difficulty, but it is commensurately important; difficulty is very far distinct from impossibility; and the importance of the research is a stimulus to exertion. Human knowledge is acquired by observation and experience; that is, by conversing with the things about us, by noticing them attentively, and subsequent reflection. Every cultivator is capable of doing this; and if, when he found his crops diseased, he would reflect and record from what soil he attained his seed, how and in what weather it was committed to the ground; its subsequent culture; the crops that preceded; the treatment of the soil; the seasons, whether wet or dry, or severe, through which it has vegetated; with any miscellaneous observations that his own common sense might dictate, vegetable medicine would soon advance more in one year towards that state of reasoned knowledge that deserves the name of science, than it has done during the last century. As observations multiply, the adjutant sciences, Chemistry and Botany, will contribute and apply their improved stores of information; and if few specifics for the diseases of plants are discovered, we are quite sure the

causes of disease will be better ascertained, and every one is aware that to know the cause of an evil is the most important step towards its prevention.

It is a very important preliminary to the study for which we would gain the attention of practical men, that they understand the nature of plants; of those organic creatures whose diseases they would obviate; for an ignorance of, or an inattention to this, is one of the causes that so little progress has been made in this branch of natural philosophy. It is absolutely necessary and important for them to understand fully that this part of the creation, the very grass they trample upon, is so highly organized, so exhibiting intimations of the functions more highly developed in the superior animals, that it is not possible to point out where animal life terminates, and where vegetable life begins: the zoophyte connects the two kingdoms. It is absolutely necessary, we think, for this to be understood and felt by those who enter upon the investigation of vegetable diseases, because we have a strong opinion that these in many, very many instances, are caused by the plants which they infect being treated as if they were totally insensible, inorganic matters, scarcely more susceptible of injury at some periods of their growth than the soil from whence they partly derive their sustenance.

To determine the question whether plants possess a degree of sensation is not so easy as many persons

may believe. "It is as difficult," says Mr. Tupper, who has written ably upon the subject, "to ascertain the nature of vegetable existence as to determine what constitutes the living principle in animals." Darwin, by the aid of imaginary beings similar to the Dryads and Harmadryads of the classic mythology, has raised plants to a position in the order of nature superior to that to which animals are entitled. Other philosophers, taking a totally antagonist opinion, estimate vegetables as bodies, only somewhat more organised than crystals, but, like these, entirely and exclusively subject to chemical and mechanical changes.

The above opinions are equally erroneous, as will appear from the facts arranged in the following pages. It might easily be made to appear that the gradation from reason to instinct, from instinct inanimation, is as gradual as the transitions of light from the noon-tide to the midnight of a summer's day; but these few remarks must be confined to that section of creation that commences from the close of the animal classes in the zoophyte, and terminates where inorganic matter commences in the crystal; and the details must be specially directed to demonstrate how closely it approaches, how distinctly it is divided from, the former.

Let us first consider the comparative composition of animals and plants demonstrated by the researches of chemists. Their constituents are identical:—

carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, acids, alkalies, earths, and metals are the common components of both. Nitrogen has been considered by some chemists as the constituent, marking by its presence animal from vegetable matters ; but the distinction fails, inasmuch as that from some animal matters it is absent ; whilst in the gluten of plants—a chief constituent of wheat—in all seeds, and in the whole frame of the tobacco, it is present.

If we follow the above chemical bodies through their combinations, we shall find that these in animals and plants are closely similar, and in both are equally numerous and intricate.

Of acids there are contained in

ANIMALS.	VEGETABLES.
1. Sulphuric	1. Sulphuric
2. Phosphoric	2. Phosphoric
3. Muriatic	3. Muriatic
4. Carbonic	4. Carbonic
5. Benzoic	5. Benzoic
6. Oxalic	6. Oxalic
7. Acetic	7. Acetic
8. Malic	8. Malic

and others equally numerous in each, but not common to both. Of the earths and alkalis, lime, magnesia, silica, soda, and potass, are found in each class. Of the metals, iron and manganese are their conjoint constituents.

If we follow the two classes through their more compound constituents, we shall find the analogy still

holds : they contain, in common, sugar, mucus, jelly, colouring, and other principles, gluten, fibrin, oils, resins, and extractives. The functions of animals and plants are similarly closely analogous.

Animals take in their food by the agency of the mouth, and prepare it for digestion by various degrees of mastication or attrition, as in the gizzard of birds. In this they differ from plants, but these have this compensation, they imbibe their food in a fluid form, and consequently in a state of the finest possible division. Animal and vegetable remains are their common food, plants having this superiority over animals, that, as they only absorb the soluble and finer parts, they are not obliged to throw off the grosser constituents which appear in the excrement of animals, though there are excretions given off from the roots of plants differing probably in every genus. In the animal stomach the food undergoes an extensive change, being reduced to a pulp of greater specific gravity, and being altered entirely both in taste and smell. In the lymphatics of plants, which may be considered their primary organ of digestion, their food or lymph undergoes a change precisely similar ; its colour and flavour are altered, and its specific gravity increased.

From the stomach the animal's food passes into the intestines, is there subjected to the action of the bile, and converted into chyle, the nutritive part, and

excrementitious matter. In their passage through the intestines the chyle is absorbed by the lacteal vessels, and is conveyed into the blood; by the heart, the mingled fluids are propelled into the lungs, to be there exposed to the action of the air. The vital fluid there changes its purple hue for a florid red, loses a portion of its watery particles and carbon; the latter combining with the oxygen of the atmospheric air in the lungs, and being breathed forth in the form of carbonic acid gas.

As plants in their food take in no gross, unnecessary ingredients, it is obvious that no process like the biliary operation is required. The lymph or sap, proceeding at once along the branches, is poured into the leaves, the very lungs of plants. There, as in the blood, its colour is changed, oxygen is emitted from it during the light hours of the day; but carbonic acid gas is thrown off during the night, and at all periods a considerable quantity of water.

From the lungs, by the agency of the heart, the blood is propelled through the arteries over the whole animal system, supplying nourishment and warmth to all the parts, and where, by these abstractions, it is again converted into purple or venous blood, it is returned by the veins to undergo the changes that were described as being effected by the lungs.

The sap, after exposure to the action of the air in the leaves, is returned by another set of vessels situate

in the bark, ministering to the growth and support of the whole plant.

Such is the close assimilarity in the digestive and circulatory processes of the two classes ; an assimilarity which obtains in all the other functions enjoyed by them in common. In respiration, the air inhaled through the mouth and nostrils proceeds immediately to the lungs and acts upon the blood ; in plants, when it is inhaled by their leaves, it operates instantaneously upon the sap. The changes that take place have just been imperfectly noticed, and we have no space to do more than add, that the oxygen of the atmosphere is the gas essential to the existence of animals ; but it is its carbonic acid that is quite as important to vegetables. They may be considered the vital airs of the two classes. If animals are placed in a situation where they inhale pure oxygen, their functions are highly and rapidly increased ; but it is an exhilaration which would soon terminate in exhaustion and death, if breathed by them for any extended period. So plants will flourish in an atmosphere containing 1-12th of carbonic acid, but if it much exceeds this proportion, they are rapidly destroyed. During sleep, animals respire less carbonic acid than during their waking hours ; so plants emit little or no oxygen during the night.

After an animal has enjoyed the regular course of its functions for a period varying in its duration, the

time at length arrives when decay commences. The wasted, enfeebled, and relaxed form gradually declines, until death finally closes all activity. The body then becomes contracted and rigid; the skin exchanges the ruddy tinge of health for death's pallid hue. Decomposition speedily ensues, with all its offensive phenomena; and finally, the only permanent remains are the skeleton and a small amount of earthy matter. The same characteristics attend the last period of vegetable existence. Plants may flourish only for one season, or their lives may be extended through centuries of years, yet decay eventually comes over them; becoming more and more stunted, weak, pallid, and ragged, they eventually cease to live, become contracted and rigid, and pass through the same phases of putrefaction that are exhibited by the animal carcass. In both there was a time when warmth and exposure to the atmosphere were the sources of vigour—these now become the agents of destruction; they were once able to resist and to overcome the laws of chemical affinity—they now are destroyed by their attacks. What causes this most striking change? What antiseptic agent have they lost? There can be but one reply. It was their vitality. Now, let us examine how the vitality of plants in other respects resembles the vitality of animals, and we will confine this examination to two or three points.

Plants are excitable. Light acts upon them as a

stimulus. Every body must have observed that plants bend towards the direction from whence its brightest influence proceeds. M. Bonnet, the French botanist, demonstrated this in some very satisfactory experiments, by which he shewed that plants grown in a dark cellar all extended themselves towards a small orifice admitting a few rays of light. Every flower almost has a particular degree of light requisite for its full expansion. The blossoms of the pea, and of other papilionaceous plants, spread out their wings in fine weather, to admit the solar rays, and again close them at the approach of night. Plants requiring a powerful stimulus do not expand their flowers until noon, whilst some would be destroyed if compelled to open in the meridian sun. The night-blooming cereus unfolds its flowers only at night. Heat also acts as a stimulus upon plants. M. Duhamel observed, that during moderately fine weather the foot-stalk of a leaf of the sensitive plant (*Mimosa pudica*) stood in the morning at an angle with the lower part of the stem of 100 degs. ; at noon, the angle had increased to 112, but at night had fallen to 90. If a leaflet of this plant be but slightly touched, it immediately shrinks away ; and the impulse being communicated, each pair of leaflets on the branch collapse in succession ; and if the impulse be strong, the very branch itself will sink down by the side of the stem. If an insect alight upon the upper surface of the

Venus's fly-trap (*Dionœa muscipula*), its sides spasmodically approach each other, and crush to death the intruder. If the inner side, near the base, of any one of the anthers of the barberry (*Berberis vulgaris*) be gently touched, as with a bristle or feather, it instantly springs forward and strikes against the stigma. But the strongest indication, says Mr. Keith, of the existence of a species of sensitive principle in a plant, is, perhaps, that which is exhibited by the *Hedysarum gyrans*. It is a native of India, growing on the banks of the Ganges. Its leaves are ternate, the middle leaflet being larger than the lateral ones. All of them are in constant vibratory motion; sometimes equably, at other times abruptly, but without any unison in the movements. If their motion be prevented, by grasping them in the hand, they renew it more vigorously when the confinement is removed, but by degrees subside to their natural rapidity of motion. This motion does not depend upon the application of any external stimulus, for it continues throughout the night as well as the day. It is most active during a warm day, the leaves then having an additional tremulous motion. (*Keith's System of Physiological Botany*, ii. 464.)

Instinct seems to be a characteristic of plants, from the following phenomena. Some of them close their flowers invariably when rain is approaching. Others have an unalterable direction assumed by them when

climbing. No force can make one twist round a pole from left to right, if its natural direction be from right to left. If a garden pot be divided by a vertical partition, and one half filled with a poor sterile earth, and the other moiety with a rich fertile soil, a geranium or other plant placed in this pot, with some of its roots over the sterile soil, and the rest of the roots over the fertile soil, those over the first named portion will gradually change their direction until they can also get into the richer pasturage. Instances have been known of the roots of trees piercing and destroying walls in their efforts to attain a more preferable soil than that in which they were planted. M. Saussure relates that he placed some plants of *Polygonum persicaria* and *Bidens cannabina* in water containing acetate of lime in solution. These plants then imbibed, with the water, a portion of this salt; but when they had the opportunity of selection given them, by dissolving in the water some common salt, glauber salt, and acetate of lime, they absorbed the two first named, but rejected the latter entirely. (*Saussure's Recherches*, 247—261.)

From the foregoing facts, without arguing that they demonstrate sensation to exist in plants as acute as that possessed by the higher or more perfect classes of animals, yet they certainly are satisfactory evidence that plants probably are nearly as sensient

as the zoophyte, or even as the polypus and the hirudo—animals that may be cut into pieces, and each section become a perfect individual; animals whose heads may be taken off and grafted upon other bodies; animals that may be turned with their outsides inwards, and yet without any apparent inconvenience. If plants be endowed with sensation of the most limited degree, it explains the cause, throws light upon the prevention of many diseases that affect those which are the object of cultivation; warns the tiller of the soil from the late performance of many of his operations, and teaches him generally to be less violent in his field practice. If a grape vine be pruned too late in the spring, the bleeding or effusion of sap has been known to be so violent, that the tree has died from absolute exhaustion. Stone fruits, if severely wounded, are frequently destroyed by the inroads of a disease resembling in all its characteristics the cancerous affections of animals; and we have known a whole crop of wheat affected with a swelling of the stem or culm, evidently caused by an extravasation of the sap from its ruptured internal vessels, owing to the roller being passed over the crop when of a growth somewhat too forward.

After these prefatory remarks, intended to save from fundamental objection the opinion we entertain, that most, if not all the diseases of plants, are connected

with or arising from causes affecting their vital power—for these remarks exhibit facts and reasons establishing the existence of such power in plants—we will proceed to consider in detail the most prevalent diseases of the plant now under consideration.

ULCER OR CANKER.—This class of disease, to which in some form every vegetable is liable, affords a strong demonstration of the vitality—the sensitive energy of life—existing in plants. In dead organic matter decay is total, and pervades the whole mass simultaneously, but when decay or decomposition attacks a living plant, or a living animal, it is local—and the decomposition is restrained within bounds by the wondrous antiseptic power of the vitality in the other parts of the plant. The pine apple affords an illustration of this phenomenon.

Its suckers taken off from their parents before their lower ends are brown—that is, before the woody fibre is sufficiently perfected—are very liable to canker or ulceration in that portion placed within the ground. The same disease often attacks more perfectly matured suckers if these are supplied at first too liberally with water. It is a curious phenomenon, that the upper portion of the leaves of suckers, the basis of which are perfectly ulcerated, continue as green, or even greener than those of plants undiseased. The obvious prevention of this

ulceration is to plant none but well matured suckers, and to avoid giving them excessive moisture.

Nor is the ulcer or canker confined to the sucker of the pine apple, for established plants, if improperly managed, are equally liable to its ravages. Mr. Barnes says that it is the most destructive disease to which the pine apple is liable. It makes its appearance, in the first place, in the centre of the leaves at the base, passing up the centre to the summit, at first of a darker green colour than the other parts of the leaf; after which, during hot weather, it changes to a ferruginous colour. If this disease is amongst the fruiting plants when they start for fruit, it generally affects the stalk that supports the apple, cripples it, and causes it oftentimes to shrivel up long previously to the fruit having reached the size it would otherwise obtain. It is true, the fruit generally colours, but remains deficient of its most essential qualification. Numbers of such fruit were to be observed in former days at Covent Garden Market and in pine growing establishments, where a strong bottom heat was cherished and considered essential, and where strong liquid manure was applied in a thick form so as to stop up the few open pores of the earth that there were under the fine soil system of culture. Of one thing we are satisfied, viz., that this disease does not appear among the pines that are potted in open porous heathy soil, placed on a

moderate heat, and their food only applied in a clarified state or in moderate quantities. Such plants always maintain a green healthy stalk and foliage until the fruit is thoroughly ripened.

Indeed the pine apple is not subject either to disease or vermin, unless it receives a peculiar or unnatural treatment. When it is infected with either, the matter clearly speaks for itself that there is a mistake in some portion of its culture; and to obviate either, instead of shaking the plants out, brushing and washing them in a mixture of obnoxious drugs, still causing them, for a time at least, to look more disgraceful, we should recommend the system of culture to be altered to a more genial one. This being adopted and followed upon methodical principles, the pine plant, subsequently, will neither be infected with disease or vermin for any length of time.

EXCESS OF GILLS.—This occurs chiefly to vigorous plants, of which the growth has been suddenly checked. The gills of pine plants are spurious suckers shooting from the base of the fruit, or from the stalk. Sometimes the whole length of the stalk emits gills, which are very injurious to the swelling of the fruit if allowed to remain for any length of time. Our practice is to take them carefully off with a sharp knife as early as possible after they have made their appearance. Lengthened observation convinces us that if

plants are allowed to stand dormant any time ; or, if they meet with a sudden check after they are set for fruit ; or if they are allowed to stand still, or come on too slowly when first set, or are starting for fruit, they are the plants which always produce gills in the greatest abundance. A healthy growing plant, or rather, we should say, a plant grown into fruit without receiving any check, rarely produces any, or but few gills. We have observed gills push forth from the stalks of pine apples, and at the base of the fruit, with two or three pips in depth of fruit to them, somewhat in the manner of the hen and chicken daisy.

EXCESSIVE CROWN.—This takes various forms. The crown may be flattened, or fasciculated, which is described by gardeners as *cockscombing* ; or several crowns may be produced ; or there may be only one excessively large. Each and all of these may be considered as a disease, being an excessive or plethoric growth.

The cockscombing of pines, to which, by the way, the Enville is peculiarly subject, is a deformity ; and if two specimens, nearly equally swelled, heavy, and otherwise good, are placed for competition, the prize must be given against the cockscomb. But if the cockscombed is decidedly better grown than others not cockscombed, to which it is opposed, then this deformity ought not to be a bar to its winning ; because it is not caused by bad gardening, nor capable of being

prevented by good gardening, but it is an accident that no care can guard against, and one that does not at all interfere with that quality—flavour—for which pine apples are cultivated. (*Gard. Chron.* 1843, 505.) Its excessive development may be checked in the modes hereafter noticed for stopping the other super-productions of the crown, and which are thus noticed by Mr. Barnes. He says that although cockscombing is considered by some gardeners as a disease, yet that he is very far from entertaining such an opinion. There is no doubt that it is a defect or imperfection, but the cause is not yet satisfactorily accounted for. Though an imperfection or mal-formation, yet every one must have observed weighty, handsome, well-swelled fruit bearing cockscombed crowns. Very rarely among the stock at Bicton is seen a cockscombed crown. We make it an invariable rule not to save any succession suckers or crowns from such plants as have produced cockscombed fruit. When such does make its appearance, we reduce the size and shape of the crown in its early stage of growth, if possible, by cutting from each side a part of the crown or bunch of crowns, or by taking the centre or heart out of each, according to circumstances. This is done by turning a small sharp knife round inside the centre or heart of each crown. This operation is practised by us also upon single-crowned fruit, when crowns are likely to take the lead of the fruit, and become

disproportionate. If carefully and methodically performed in due season, the operation is not only most beneficial to the swelling of the fruit, but is not in the least unsightly, as some have erroneously imagined. Indeed we have seen hundreds of crowns which have thus been dealt with, and on which a casual observer could scarcely perceive that any such operation had been performed. Now, as it can be performed without the least unsightliness or mutilated appearance, and the fruit is consequently much improved in size, shape, and flavour, every desirable advantage is gained. We know that the practice has been ridiculed and condemned, but we should imagine by those only who have not seen it put correctly into practice. We would beg to inquire of such men, why we are not assisting nature in performing her functions as much by retarding methodically the disproportionate growth of a pine apple crown, as others are in stopping or pinching out the points of geraniums and other plants, to regulate the growth of these, and produce what is now-a-days considered a superior shape as compared to the poor drawn-up, spindle-shanked, lean plants of former days? Again, why should the former be considered an unnatural mutilation any more than the other? or why should it be considered an unnatural mutilation any more than the stopping the shoots of the vine, fig, melon, or any other fruit-bearing plant?

Some varieties of pine are much more subject to produce cockscombed crowns than others. The Providence and Envile appears more subject to it than most other varieties. The Queen varieties are but rarely subject to such deformity ; at least we have not observed such to be the case.

VERY LARGE CROWNS are not admired, and to obtain smaller ones, under the circumstances of a very high temperature, combined with a very considerable amount of atmospheric moisture, artificial means must be resorted to occasionally. These means are, in the first place, to pierce, or screw out by a small instrument, the centre of the sucker, soon after the pine has done blossoming : another plan, that has been successfully practised at Oakhill, is to thrust a penknife through the base of the crown, about the same period as that before named. Such treatment will check the size of the crown ; but leads occasionally to distortion, unless the process has been very tenderly performed. This consequent distortion is, or ought to be, as a matter of taste, more unsightly than the large crown. The most reasonable way after all of keeping the crown in check, so as to avoid distortion, seems to be to give air more freely, to avoid extremes of temperature and of moisture in periods of comparative darkness, and to persist in coupling high temperature with much solar light. Whatever condition of atmosphere “draws,” technically speaking,

the young or growing plant, must also in degree tend to "draw" the crown. In other words, an unwieldy crown is a drawn crown. (*Gard. Chron.* 1845, 625.)

Mr. Barnes, as just noticed, adopts the following method of preventing the excessive growth of pine crowns, when by any accident a plant tries to produce them. It must be obvious that, if the pine apple plant has to feed both its fruit and a huge tuft of leaves on the top of it, (which, as our clever friend truly says, look like a baby's head with a man's hat on,) the nourishment which the plant is capable of yielding must be divided between them, and the man's hat will be formed at the expense of the baby's head. To prevent this, from three to six days after the blooming is over, he thrusts a small knife into the centre of the crown, and gives it a twist, when out comes the centre of the heart, which checks its growth without disfiguring the plant. Speechley adopted a similar practice with suckers, in order to stop their growth. (*Gard. Mag.*)

PLURALITY OF CROWNS.—Some kinds of pine apples have a greater disposition than others to throw up more than one crown, and this tendency will be greatly increased if the plants have received any check so as to have hastened them prematurely into a fruiting state. Select the centre and strongest one, which must be retained, and remove all the others carefully on

their first appearance. (*Glendinning on Pine Apple*, 481.)

INSECTS.

THE pine apple is not an exception to the rule that if a plant is preserved in a state of healthy vigour it is but little liable to the attacks of vermin, and not at all to the inroads of some—the Scale for example—which appear to delight in diseased juices, and to be able to penetrate through weakened tissues, in like manner as the attacks of flies and fungi are similarly facilitated by putridity.

Considerable experience convinces us that unhealthiness usually precedes invermiation; and we fully believe the statement made by Mr. Nicol, that he received into his stock, plants covered with the pine-scale, (*Coccus hesperidum*,) without the smallest hesitation; made no effort whatever to get rid of them; and by next shifting time, in two or three months, saw no more of them. He says that he never but once tried any remedy for the scale; and as he was completely successful, he gives the recipe, which may safely be applied to pine plants in any state; but certainly best to crowns and suckers at striking them, or to others at the time of shifting. Take soft soap, one pound; flowers of sulphur, one

pound; tobacco, half a pound; nux vomica, an ounce; which boil all together in four English gallons of soft water to three, and set it aside to cool. In this liquor immerse the whole plant. Plants in any other state, and which are placed in the bark bed, may safely be watered over head with this liquor; and as the scale harbours most in the angles of the leaves, it stands the better chance of being effectual, on account that it will also there remain longest, and there its sediment will settle. In using it in this latter way, however, if repeated waterings be necessary, the liquor should be reduced in strength by the addition of a third or a fourth part water. (*Nicol.*)

Various species of scale, of which that noticed by Mr. Nicol is one, are the only insects that materially injure the pine apple, and of these we will now proceed to take more particular notice.

Coccus hesperidum, the Orange Scale Insect, is the

Brown Turtle Insect of Speechley, the first writer who notices the insect ravagers of the pine apple. The female appears like an oval nut-brown shield (Fig. 1), and the male as a winged fly (Fig. 2). Both are highly magnified.

This species is not only found upon the pines, and most other plants which grow in hothouses, but also upon many plants which are kept in greenhouses. These insects, after they have arrived at a certain age, fix themselves immoveably to the leaves of the plant; but before that time, though they generally appear motionless, yet, on a close inspection, in a very warm day, many of them, and especially the smaller ones, may be perceived to move in different parts of the plant, being in appearance much like a turtle in miniature.

A sweet glutinous matter issues from these insects; this soon turns mouldy, and in time becomes quite black, causing the plants to appear very unsightly. (*Speechley.*)

Coccus Bromeliæ.—The Pine Apple Scale Insect—White Scaly Insect of Speechley.—It appears like a grey, elliptical, rather elevated shield, mottled with brown, and is very like the one just described. It lives on the pine apple, the justicia, hibiscus, &c. This parasite propagates throughout the whole year, and great caution must be used in destroying it, as the young

ones, when brushed off, will ascend the plants again, and take possession of their old abodes. (*Kollar.*)

Speechley observes of it, that it seems to be exactly similar to the Orange Scale Insect in its manner of breeding. The eggs, which are discharged from the female, are pushed forward between the skin of the belly and the leaf of the plant to which the insect adheres; in consequence of this, the skin of the belly becomes less distended, which enable the insect to afford a larger covering for the eggs already excluded. When the eggs are all discharged, the skin of the belly retreats close to the back of the parent insect, which then appears like a mere scale. If the insect in this state be raised with the point of a needle from the leaf, a number of eggs may be perceived under it, of a pale red colour, and very transparent, not unlike the roe (or eggs) of fishes; but with this difference, that they are not connected by a membrane, but loosely packed together. The mother not only thus broods over her eggs till they are hatched, but continues to protect her young for a considerable time after, and either dies during the time she is performing this last office for them, or very soon after.

The males of both the above species are much less than the females, and appear very different from them; the latter, except just in their infant state, never assuming any other form than that of a scale,

already described ; whereas the males of both kinds, in their last state, become flies ; but neither of them can probably do any injury to the pine plants whilst they are in that form.

The length of the fly, or male, from the head to the tail, exclusive of the wings and those long hairs which are so characteristic of the flies of this kind, is about the thirteenth part of an inch ; and the length, including the wings when folded one over the other on the back of the fly, exclusive of the hairs before mentioned, is about the eighteenth part of an inch. (*Speechley on the Pine Apple.*)

Coccus Adonidum.—The Mealy Bug ; White mealy crimson-tinged Insect of Speechley.

This species differs from the preceding one in not being shield-shaped ; it resembles the woodlouse, is reddish, and strewed with white dust. At the sides of the twelve segments of the body it is provided with small tubercles. The male is slender, and gnatlike, with two rather broad wings, and two long brush-shaped tail filaments.

This foreign species has become a native of hot-houses, to the great annoyance of plants and gardeners. It attacks a number of species of plants, particularly the soft-leaved dicotyledonous kinds, such as the coffee-tree, *Justicia*, *Ruellia*, *Cestrum*, &c. ; it is also found plentifully on *Musa*, *Canna*, *Renealmia*, &c.

Kollar observes of this pest, that though it may be brushed off, yet it must be with soft brushes ; and care taken not to crush the insects on the plants, as their juice greatly injures the leaves. Brushing them off must either take place at a distance from the hot-house, or they must be killed immediately, otherwise they will creep up on the plants again, as their feet are effective even when they are old. (*Kollar.*)

The two former species are undoubtedly oviparous ; this seems, on the contrary, to be viviparous. It is most probable that the young ones remain some time in the mealy down of the mother, till they have acquired strength, and are arrived to such a degree of perfection as to enable them to support themselves—when they forsake the parent insect, and disperse themselves to different parts of the plant.

When this species is first perceived on the leaves of the pine, it appears to be nothing more than small particles of meal, or powder, collected together ; but in a few days it assumes the form of a louse or bug, thickly covered with a fine meal or down, of an oval form on its upper, and very flat on its under side, from whence proceed its legs, which are six in number. These, as well as many other particulars in the above description, are not to be distinguished without the help of a magnifying glass.

This last described species is of a more pernicious nature than the former ; it attacks every part of the

plant, from the top of its fruit even to the most extreme parts of its root. These animals wedge themselves in between the protuberances of the fruit in a most surprising manner, so as not to be got out without great difficulty, which not only makes the fruit appear very unsightly when it becomes ripe, but, by robbing it of its nutritious juices, is the cause also of its wanting flavour and being ill-tasted.

But the bad effects of this species on the roots of the plants are yet of far more consequence ; for there, even at the bottom of the pots, they increase with an uncommon degree of rapidity, and in the end destroy the principal roots of the plants. The common method to extirpate them from this situation is by shifting the plants in their pots ; at the same time, cleansing their leaves and the roots, which is usually styled a dressing. Decoctions made from tobacco, wormwood, walnut-leaves, henbane, and other herbs of a bitter or poisonous quality, are generally used on this occasion ; and by some, snuff, sulphur, and pepper are added ; but none of these appear to be of a nature sufficiently penetrating. There are insects always between the leaves in the centres of the plants, fixed so low as to escape unhurt. (*Speechley on the Pine Apple.*)

Of all the vermin we have enumerated, the white scale is the most formidable enemy amongst pines ; and if allowed to get numerous, certainly has a very

dirty, disreputable appearance. We believe this insect robs the plants of their sap ; but even if the few practical men of former times were correct who would not admit these vermin caused any serious injury to the pine plant, yet still every gardener will allow that the treatment the plants necessarily have endured to cause them to be so infected must be highly injurious to their size and quality. According to our estimate, however, those plants in a robust, healthy condition, being never infected with such pest, those cannot be termed free from disease that are in a lean, narrow-leaved, invermiated condition, and consequently full of punctures and small ulcers.

That white scale is the kind of insect most commonly met with. It may be readily known by the most inexperienced. It exists in small white patches or spangles on the surface of the leaf, appearing glued, as it were, to the epidermis. Its depredations are not confined to the surface ; the parenchyma soon suffers, and not only a derangement of the tissue ensues, but the very life-blood of the plant—the true elaborated sap—is progressively exhausted ; and if tolerable fruit is produced in spite of its depredations, it merely proves that there has been a good root action to support such a waste, and that the fruit would have been much finer had the ravages been prevented in proper time.

About three distinct operations are practised by

skilful gardeners in order to get rid of this pest. One plan is to dress the plants with a very powerful mixture ; the second is to shut the plants up in a confined atmosphere, charged with the powerful gases of fresh dung, in a highly fermentative state ; a third, which is perhaps the most reasonable mode of procedure, is to administer successive syringings with water heated to 130 degs.

With regard to the latter operation, a somewhat wider range should be taken occasionally, according to circumstances. The point, therefore, of 130 degs. must be taken in a relative sense : for instance, for pines in a wintering state, with an average temperature of 55 degs.—say in the beginning of January—130 degs. would in all probability prove fatal. It would therefore appear that, if the scale can only be combatted successfully by a temperature of 130 degs., another season must be sought for the operation. We must honestly confess that we never tried the hot water cure ; nevertheless, under a judicious application, we should not doubt.

Why, however, not medicate the water ? We should certainly add the amount of soft soap which it is known the pine will endure—say rather more than an ounce to a gallon. To revert, however, to the matter of temperature. We would advise the application of the heated medicaments either in the beginning of September or in the early part of April,

taking care to inure the plants for some weeks to an unusually high temperature ; by which means, cautiously pursued, we have little doubt that a very much higher temperature might be practised. One piece of caution should here be given, and that is, to keep a thin skreen over them, both during the highest temperatures preceding the operation, and also during the operation itself, which should extend over three days, during which time they may receive many syringings, increasing the temperature slightly each time. After all these points are duly carried out, the temperature and shading should be reduced in a progressive way. Under such high excitement it will require a week or more to bring the plants to their due position.

The next best process—indeed, perhaps quite equal to the former—is one practised first, we believe, by Baldwin, who was gardener to the Marquis of Hertford, at Ragley, about thirty or forty years since. It consists in so preparing a pit, frame, or house, as that the atmosphere for some time shall be strongly impregnated with the effluvium of rank dung steam. This is understood to be quite effectual, when properly carried out. The mode in which to perform it scarcely needs description—certainly not to pine-growers ; we, however, write for the uninformed, and therefore beg to say a few words about it. It matters not whether the structure be a house, pit, or frame,

as far as construction is concerned, only the smaller and closer the structure the more effectual will the process be. The ordinary process is to make up a pit on purpose : this is done by excavating to the depth of five or six feet from the roof at least, and by putting nearly a yard in thickness of fresh manure from the stable-door into it. The pines must not, however, be plunged, but merely set on the top ; and no tan or other surfacing body must be used. They may be crammed here as thick as they can stand together ; and the sides of the pit being pigeon-holed, or walled in some way, rank linings may be applied when the dung from the interior becomes weak. Some caution should be used at first, or if the dung is very new, and from high-fed horses, it may possibly overpower them. It would, perhaps, be better to give the manure one sweating before using, and to increase the bulk of such manure as an equivalent for the loss of rankness. During the operation, which may last as long as the dung continues sufficiently warm, a very close and confined atmosphere must be preserved ; especially, we would say, when the very rankest of the gases have passed away, which will be in the course of about a week. The manure will then begin to require water : this will facilitate the production of a considerable amount of steam or gaseous matter, which is absolutely necessary, in order to penetrate every crevice ; in fact, it should, more or less

every day, be considered in the light of a stoving process. After awhile—say about three weeks—steps must be taken to cool them down by degrees, and to gradually inure the plants to the light. It is best, in this case, to have a clean and sweet pit duly prepared, with a bottom heat of 85 degs. some time previously. All that is necessary here is to take care that the plants, as before observed, are gradually inured to light, air, and, if in the autumn, to a comparative dryness of atmosphere ; providing, at least, that they are to be kept in dung-pits through the winter.

The third class of remedies prescribed for the destruction of the scale insect, are powerful medicated mixtures ; and from the very numerous recipes which have been recommended we select such as we know from our own experience, or from the experience of practical gardeners among our friends, have been found to be efficacious.

Mr. Griffin's recipe is :—To one gallon of soft rain water, add eight ounces of soft green soap, an ounce of tobacco, and three table spoonsful of turpentine ; stir and mix them well together in a watering-pot, and let them stand for a day or two. When you are going to use this mixture, stir and mix it well again, then strain it through a thin cloth. If the fruit only is infested, dash the mixture over the crown and fruit with a squirt made for that purpose, until all is

fairly wet, and what runs down the stem of the fruit will kill all the insects that are amongst the bottom of the leaves. But when young plants are infested, take them out of their pots, and shaking all the earth from the roots, (tying the leaves of the largest sized plants together) and plunge them into the above mixture, keeping every part covered for the space of five minutes. Then take them out, and set them with their tops declining downwards, for the mixture to drain out of their centre ; immediately filling the vessel again with fresh plants, until all is finished. As soon as the plants become dry, pot them, and plunge them into the bark bed again. (*Griffin on Pine Apple*, 77.)

Mr. Mills recommends, for destroying the Mealy Bug and other Cocci, that the plants requiring to be cleaned should be allowed to become dry ; they are then to be washed in clean water, and the insects removed, as far as practicable. A tub or other vessel, capable of holding as much liquid as will allow of their being immersed, is to be filled with soap-suds from the laundry, and a quarter of a pound of yellow soap is to be added to every gallon. When the soap is dissolved, let the plants be immersed while the liquid is in a tepid state, (though it is not required to be kept in a tepid state) and allowed to remain immersed twelve hours. Let them then be so placed that the liquid may drain from the hearts of

the plants ; after which they may be planted, and treated as advised for fresh-potted suckers. (*Mills on Pine Apple*, 79.)

Mr. John Bowers, gardener to Lord Selsey, at West Dean House, in Sussex, destroys the bug and scale on pine apple plants by a wash consisting of three gallons of rain water, two pounds of soft soap, eight ounces of black sulphur (*sulphur vivum*), and two ounces of camphor, boiled together for an hour, and to which is then added three ounces of turpentine. He turns out his plants, divests the roots of their fibres, and immerses them in a trough nearly filled with the liquid, at a temperature of from 120 to 136 degs., for about five minutes. Queen and Sugar-loaf pines he finds require the highest heat stated ; Antiguas and others need not have it above 124 degs., but those to which a lower temperature is used must remain double the time immersed. When taken out of the liquor they are well drained, and set on the flue of the house with the roots upwards, until they become dry ; they are then put into small-sized pots, and plunged in fresh tan, with a good bottom heat kept up by dung linings. They are shaded from the sun in the heat of the day, and a little air given until they begin to grow, which will be in about three weeks from the time they are potted. The above operation may be performed between the months of February and September. (*Hort. Soc. Trans.* vi.)

Mr. Hamilton gives the following as an unfailing recipe for destroying the Cotton (Mealy) Bug and White Scale :—Sulphur 8 oz., Scotch snuff 8 oz., hellebore powder 6 oz., nux vomica 6 oz., soft soap 6 oz., Cayenne pepper 1 oz., one quart of tobacco liquor ; add one quart of boiling water ; stir the mixture well, breaking the lumps ; when cool, strain it through a rough cloth ; after which it may be used at any time. Having provided a brush of sufficient length, let the plants be washed with the mixture on both sides of their leaves, allowing a portion of the liquor to run down to the bottom of each leaf. When the mixture is used for the white scale, the insects should be removed during the process of washing. After the leaves have all been washed and tied up, they must then be turned out of their pots, and the balls reduced ; the trunk itself must be well washed, as the scale will sometimes have reached its very base ; when it is applied for the destruction of the cotton bug, the roots also must be well washed. (*Hamilton on Pine Apple*, 97.)

The following is a receipt of the late Mr. Runciman's, who was a good pine-grower, for destroying the scale insects which infest that plant :—Boil gently together, in four gallons of soft water, 1lb. of tobacco, 1lb. of sulphur, 1lb. of soft soap, and $\frac{1}{2}$ lb. of nux vomica, until the quantity is reduced to three gallons. In this the crowns and suckers should be steeped for

a quarter of an hour, after which they should be well rinsed in a tub of clean water. They should be turned bottom upwards until the wet is drained from them ; and after being potted they should be kept in a strong moist heat. Where it is requisite to dress large plants, great care should be taken to drain the water from them thoroughly, and not to wash too near the hearts. (*Gard. Chron.* 1843, 7.)

Mr. Barnes utterly abjures all medicated compounds for the destruction of the scale insects, maintaining that the best remedy is to restore the plants to robust growth. To aid the expulsion of the insects, however, he recommends that, instead of pure water, clear soot water and weak ammonia water, syringed not only over the pit but over the plants, will be found of great service.

A most effectual remedy is to brush the cocci over thoroughly twice, after an interval of a day, with spirit of turpentine.

Now all the foregoing recipes offer very powerful agents to work with, and the process, moreover is a rather tedious one. We strongly suspect that it is the soft soap which effects the cleansing. This is known to be destructive to the common apple and pear-tree scale ; and it is by no means improbable that it suffocates them, by casting a sort of Mackintosh wrapper over them, impervious, in a great degree, to the atmosphere. It appears that Mr.

Hamilton reckons this equally efficacious with the cotton or mealy bug, and the ordinary white scale.

The brown scale is also known to infest pines, but somehow the latter is not so fatal as the white. Indeed, most gardeners care little about the brown.

When, however, high cultivation—or, in other words, abundance of lively roots unchecked, accompanied with a proper moisture—is carried out, the scale and all other insects will assuredly vanish of their own accord. But let a check come, and they will speedily recover their lost ground. This points out the safe character of the Hamiltonian plan. Larger pines may, or may not be, produced by other modes, but this above all others recommends itself to the amateur, and to all those who desire a succession of good fruit throughout the year, with as little trouble and expense as possible.

We certainly opine that, before many years are passed, the great majority of pine-growers will fall into this most simple and inexpensive mode; and that houses running north and south, of a flat pitch, and containing a middle walk, with a single or double row of Hamiltonian stools, planted out over tank-heated pits, will become very general indeed. A little top dressing, with frequent syringings, and a little ventilation, will be all that is necessary; and will be merely a source of amusement to the proprietor: whilst a mere boy or woman may attend the fire.

In conclusion, let every possible regard be paid to the permanency of the roots of the pine. It is not their excessive luxuriance at any given period, so much as their uniform and steady action : this last is the grand desideratum. In addition to this, secure a genial atmosphere, generally loaded with moisture, and accompanied by an almost constant circulation or motion.

Acarus (Erythræus) tellarius.—The Red Spider.—This pest of the gardener is very rarely found on the pine apple, and never will occur if the air of the pit is kept duly impregnated with watery vapour. Sulphur fumigations and a more free supply of atmospheric moisture will speedily remove and continue to exclude this insect.

The Red Spider cannot thrive—scarcely exist—where a sufficiency of water is regularly applied. As, however, syringing cannot be persisted in at all times, something else is requisite at those periods, when the syringe is laid by. Sulphur, then, is the best thing at present known for this purpose ; but as many persons are deterred from the use of it, through a fear of its pernicious effects, we will here detail our mode of using it, by which we have been kept (we might almost say entirely) free of this pest for the last twelve years. We apply it about three or four times in the course of the year, to each house ; the houses are on the average about 30 feet long, by some 16 feet wide,

and we use about six ounces to each house each time, applied in the form of thick paint. The houses are heated by hot water, and the sulphur paint is applied to the under or return pipe alone. The best way is to beat a lump of soft soap, as large as a walnut, up in warm water; and to add some clay water, made by working a lump of clay in warm water until the water becomes a thin paint; then to blend this with the soap water; and finally to mix the sulphur also. The soap and the clay form a body, and prevent the sulphur washing or rubbing off. (*Johnson and Errington on the Grape Vine*, 134.)

USES.

To the Mangostein, in India, and especially by those who have eaten it in the Straits of Malacca, on whose neighbouring shores it is alone found in perfection, is ascribed the superlative place among fruits. In England, where the Mangostein is unknown, the pre-eminence of excellence is assigned to the pine-apple, and this high merit was assigned more than a century and a quarter ago, when its fruit was far less in colour, size, and flavour than at present. We gather this from the following inscription, copied from the picture in the Fitzwilliam Museum, and noticed by us at p. 6

of the preceding volume. The picture, we are obligingly informed by Professor Henslow, represents a pine apple of the full size, with this contemporary inscription beneath.

Perenni Memorix
Matthæi Decker Baronetti
et
Theodori Netscher Armigeri
Strobilus hic
Regio convivio dignatus
Istius impensis Richmondix crevit
Hujus arte etiamnum crescere videtur.
H. Watkins, inscripsit, A.D. 1720.

In the East Indies, the pine apple is so abundant that it is universally substituted by Europeans for the common apple of our more temperate climate. Thus, pine apple sauce with goose, and pine apple fritters, are the every-day preparations in the Calcutta kitchens.

The utility of the pine apple is not confined, however, to its excellence as a dessert fruit. Scarfs and other most beautiful articles of dress are imported into the Calcutta markets from Manilla and other islands of the China seas, manufactured from the fibres of the pine apple leaves.

We saw two skeins of fibre made from the leaves of the wild pine apple, and two net-bags made from the same material, which were sent from Gowhatty, in Assam, by Captain Jenkins, to the Horticultural Society of India. The sample was not sufficient for

any fair comparative trial of its tenacity. The society is also in possession of fibre from the leaves of the Black Antigua pine, and from the Penguin pine of Jamaica, which latter is occasionally made into ropes in the West Indies, but is not the object of any regular manufacture, the expense of labour in these colonies rendering it more advantageous to import from England cordage ready made. It appears likewise (*Bennett's Wanderings in New South Wales*, &c., vol. II. p. 207), that at Singapore the Chinese settlers obtain fibre from the leaves of the wild pine apple, which fibres are exported to China, where they are employed as a material for linen. Also, in the *Journal of the Asiatic Society of Bengal*, for January, 1832, is a paper by Lieutenant-Colonel Watson on Cherra-poonjee, the sanatory station recently occupied by the East India Company, in which it is stated (p. 27) that the pine apple plant flourishes in great abundance in the adjacent vallies, 4200 feet above the level of the sea; and that the leaves are gathered by the natives for the purpose of obtaining from them, by a very simple process, a strong fibre, which they employ as the material of the net pouches or bags in common use among them.

Miss Davy, having resided in a district of India where the pine apple grows wild, tried to prepare a thread equal to the finest flax thread manufactured in Europe, and she forwarded this to the Indian Hor-

ticultural Society. The thread so prepared cannot be spun in the way of flax, wool, or cotton, from the length of the staple, but must be joined and twisted together in the same way as silk is treated, when wound off from the cocoons. The thread, in its coarsest state, might be made into a cloth, equal in strength and durability to a fabric resembling Russia duck, and would make beautiful table linen ; when prepared as fine as the specimens submitted by Miss Davy, it would be equal to the finest cambric, and make a lace resembling blond.

Mr. Solly, in consequence of communications received from India, made inquiries respecting the probable value of the fibrous matter abundantly contained in the leaves of the ananas or pine apple, which, being very plentiful in several parts of India, might be imported from thence in large quantities, and at no very great cost. The result of his inquiries amongst spinners generally was, that they did not consider the fibre as capable of being substituted for flax, in the manufacture of linen and similar textures, because the trials hitherto made with it had been unsuccessful. Mr. Solly observed, that this was certainly no proof that the fibre could not be spun, but merely that the method at present employed in flax-spinning was not suitable to the pine-apple fibre ; he had no doubt that it could be employed advantageously either alone or in combination with other fibrous materials,

and stated that a patent had been recently taken out by Mr. Zincke for the manufacture of thread from this fibre, and from the patentee's statement, it appeared that when the fibre is bleached it becomes capable of being spun in the manner now adopted with flax, and by the same machinery, because the process of bleaching, by destroying the adhesion between the bundles of fibre, renders it much finer, and hence enables it to be extended between the rolls in the process of spinning.

The patentee considers, that from its beautiful silky lustre, combined with considerable strength, it is well adapted to form a substitute for linen. Mr. Solly thought that many other means might be found for effecting the object besides bleaching; he also suggested, as being worthy the attention of manufacturers, the possibility of the fibre being employed in the manufacture of paper, as its strength would perhaps be useful in combination with cotton and other tender materials, or in the manufacture of paper for particular purposes, when strength combined with lightness is a desideratum. (*Proceedings Royal Asiatic Soc.* 1841.)

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