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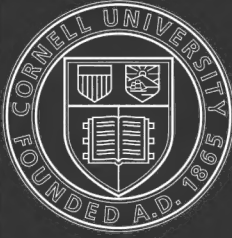
ORANGES, LEMONS, NAARTJES, etc.

By R. A. DAVIS

Chief, Division of Horticulture

*Obtainable at 1/- per copy from the Librarian, Department
of Agriculture, Pretoria*

PRETORIA
THE GOVERNMENT PRINTING AND STATIONERY OFFICE
1919



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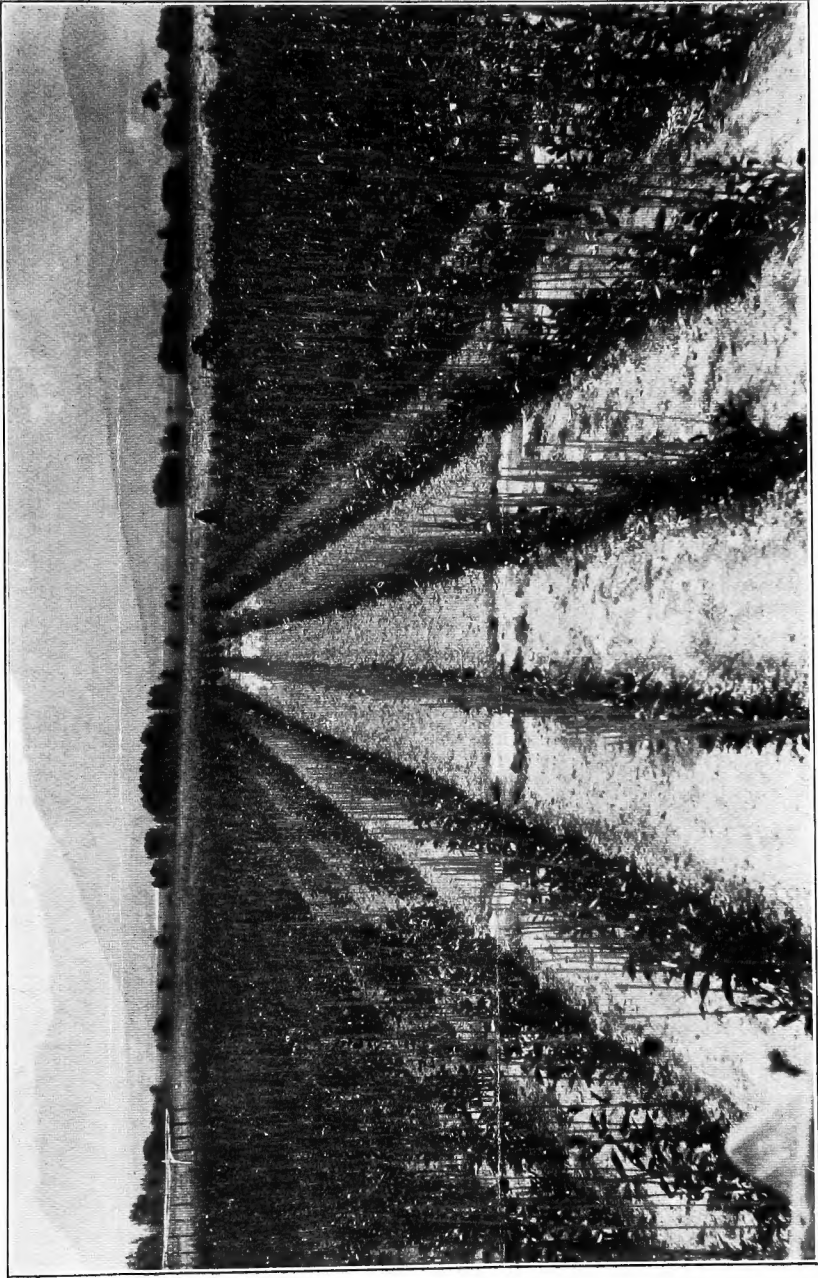
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Printed by the Government Printer, Pretoria.
6598—17/9/18—4000.



Frontispiece.

Young Trees in Nursery.

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INTRODUCTION.

RECENT developments in the citrus fruit industry have made it necessary that some information of a reliable nature should be available for distribution amongst inquirers, whose number appear to be constantly increasing. It is with that object in view that the following notes have been written. They will not dwell upon the history of the orange, its introduction into South Africa and subsequent neglect for a long period, but will deal in a practical manner with those questions which present themselves to all who, with or without a previous knowledge of citrus growing, contemplate embarking upon this undertaking in our country.

The extent of country embraced in the Union of South Africa is so vast, and the diversity of climatic and other conditions so wide, that it will be somewhat difficult to present any one system which shall be applicable to the needs of every section thereof.

There are, however, certain fundamental truths upon which the whole superstructure of actual practice is based, and these will be presented as simply as possible, leaving it to the reader to adapt them to the conditions under which he may be living. As instance of what is meant by diversity of conditions, compare the humid atmosphere experienced in all the coastal orange districts with that of the higher plateaus of the Central Cape Province and Transvaal, where the air is remarkable for its lack of moisture. Again, take the question of altitude. We find a large area of coastal-grown fruit produced at little over sea-level, while inland some of the finest groves may be found at 4000 feet above. As, of all the members of the citrus family which we produce, the orange is at present the most important, it is proposed to devote more time and space to that fruit than to the other types.

SOILS FOR THE ORANGE.

There is a fairly wide range of soils quite suitable for citrus culture in South Africa.

One finds typical orange soil in many portions of the Cape, Transvaal, and Natal; such may be described as red soils, deep, and free from objectionable sub-soil features such as impervious clays, iron-stone, etc., varying on the one hand from a texture verging on what may be termed sandy loam to a fairly but not too heavy chocolate loam. Amongst these are the best orange soils we have, and their presence in perfection in certain localities has had much to do with the reputation which these have achieved as producers of oranges of the very best quality.

Soils of lighter texture are also well adapted to the growth of this tree; much depends upon the roots used as stocks, to which reference will be made later. There is a general opinion adverse to the use of light soils, but it must be remembered that much can be done to ameliorate extreme lightness by constant cover cropping, so it is as well not to omit this class of soil from consideration.

Deep alluvial grey loams also offer ideal conditions for orange culture. The presence of lime or other stones in gravelly or boulder form need not be regarded as a serious obstacle, indeed, lime is of benefit rather than the reverse. One imperative condition is always present, that is, that all soils selected for the planting of an orange grove must be ploughable. This remark seems, perhaps, superfluous, but from what the writer has seen it is really far from being the case. Soils to avoid embrace all such as may be underlaid by undesirable sub-soils which would tend to the retention of standing or stagnant water round the roots. Whilst it is true that the tree demands and must receive a plentiful supply of water, good drainage is equally a necessity. Turf soils, as they are called here, and which resemble somewhat the "adobe" of California, are objectionable, and so are any other types which tend to "bake" and crack. Clay soils come under this head, and should not be considered where any other are available.

SITE FOR GROVE.

This should be chosen with care and a bearing in view of a good many considerations: proximity to rail; shelter from high winds; availability of irrigation water by gravitation if possible; an exposure to the north and east is recognized as being most desirable; cost of land and suitability for irrigation purposes. The average annual rainfall must also be studied; upon this depends the amount of water necessary to be provided in excess for irrigation purposes, and, finally, in certain parts of South Africa a study should be made of avoiding those belts of country which are known to be subject to hailstorms. It will be seen, therefore, that due thought should be given to the many points enumerated, as the success or failure of a grove might easily rest upon the neglect or disregard of any of them.

As regards climate, the orange tree will put up with a certain amount of frost as it attains maturity. The writer has seen trees successfully pull through a winter during which they experienced a temperature of 19° F. at an altitude of 5000 feet for several nights in succession, but that is an exceptional occurrence, and it is only fair to say that there were no sudden fluctuations, which, as a rule, prove more disastrous in their results than a steady low temperature.

By freedom from frost is meant freedom from such frosts as that mentioned, which would prove fatal to young trees. An ideal state of affairs as regards temperature would be found within a range of from 24° to 100° F., and this is quite frequently attainable. A good deal depends also upon the season of the year in which the rainfall occurs. By far the greater portion of the country rejoices in a summer precipitation, and this for all citrus fruits is ideal. Winter rainfall and drizzly, misty conditions during harvesting time demand the exercise of extreme care as to when the fruit is gathered, and this is especially the case when it has to be exported. However, such conditions as those last described are only found as a rule near the coast, and the influences imparted by the surrounding ocean in a climate almost entirely free from frost more than compensate, perhaps, for the drawbacks to which allusion has been made. Protection against high winds can be provided for by the selection of a naturally sheltered position, or, where this is not possible, by the planting of suitable wind-breaks.

There is a present-day tendency in some citrus growing countries to do away with wind-breaks after the fruit trees have arrived at maturity, the argument being that they are then able to shelter one another. It is to be feared that in windy South Africa resort will be made to wind-breaks for protection purposes for some time to come. One of the most satisfactory forms of wind-break is that in use at the Government Citrus Experimental Station, Warmbaths, Transvaal. It consists of an outside row of *Eucalyptus viminalis* planted at a distance of 15 feet apart and an inside row of peppers (*Schinus molle*) planted the same distance apart and alternating between the gum trees.

The planting of wind-breaks between the trees after the orchard has been laid out, or even before, is not generally undertaken; given a good, sturdy shelter round the outside of the grove the trees will eventually develop to such an extent as to afford mutual shelter inside. It is a melancholy fact that in ninety-nine cases out of every hundred wind-breaks are planted at the same time as, or even after the fruit trees have been set out, instead of a year or more in advance. That is, perhaps, to be explained by the fact that just now the planting of orange groves is proceeding very rapidly, and many are being laid out to-day by persons who had no idea of going into the business twelve months ago.

PROPAGATION: BUDDING AND GRAFTING.

This subject is divided into two branches, i.e. the work necessary for the production of young trees in the nursery and that required in the top working of older trees which for any reason it is desired to change from one variety to another.

The first branch includes the "propagation" of citrus trees, and therefore some notice must be taken of general nursery practice.

Citrus trees can be grown from seeds, inlayers, and cuttings of either roots or branches of most varieties of the citrus family.

There are, however, objections to the use of any other than nature's own methods of reproduction, i.e. by means of seeds.

Branch cuttings do not produce a strong, well-developed root system, and trees grown from such are as a rule short lived.

Root cuttings produce a better tree, but propagation by their use has never been resorted to even on a small commercial scale.

Layers or—as they are termed in South Africa—inlayers, whilst they afford a means of procuring the very earliest bearing type of tree, are undesirable because the root system they produce is more liable to disease than any other. The fact that the roots are the product of a mutilated branch, with a pronounced tendency to spread in one direction, should be enough to demonstrate their unsuitability as a foundation for a large healthy tree. Recourse must therefore be had to propagation by means of seed. Trees so produced are grown in accordance with nature's laws. They develop a strong, healthy growth and their roots spread equally in all directions, thus enabling them to resist the strongest wind pressure to which they are likely to be subjected. Unfortunately the fruit borne on such trees cannot be depended upon to result in uniform specimens, that is to say, in an orchard of 100 orange trees grown from seed there may easily be found twenty or more different types of fruit. Variations occur in shape, size, quality, and colour, also in the number of seeds. The fruit of some trees may have but few seeds, whilst others may contain

a large number. There will be found also considerable variation in the time of ripening, some trees yielding early and others late ripening fruits. Such an orchard cannot be as profitable as one which produces fruit of uniform character, and so the practice of setting out trees of certain varieties having characteristics of a desirable nature is now fast coming into general use in this country. These favourite varieties may have originated in the first place from seedling trees which have been recognized as possessing certain advantages over others and then set aside for purposes of propagation. They are generally given a distinctive name. The Jaffa and Malta Blood oranges betray their origin in their names, and in South Africa we have our "Clanwilliam" seedling.

It is in connection with the propagation of varieties of citrus fruits that we will now deal.

The preparation of "seed beds" is the first operation, and this is undertaken by selecting a position sheltered as far as possible from high winds and not liable to flooding; the soil must be suitable and a supply of water easily obtainable. Soil such as is usually termed "good garden soil" answers well; those in which gravel or clay predominate are the least suitable. It should be broken up deeply either by trenching—which is perhaps the best method to adopt in small undertakings where only a few thousand trees are to be grown—or by ploughing and subsoiling, disking and thoroughly harrowing until a fine surface is reached in those cases where work on an extensive scale is contemplated. During this operation such fertilizers as are considered necessary should be applied.

Generally speaking seed beds of four feet in width are regarded as being about right. They are then easily kept free from weeds without trampling on the land—any convenient length may be adopted.

Selection of Seeds.—No matter what kind of seed is to be planted there are two points to be observed, the first is that it must be taken from fruit which is thoroughly ripe, and the second that such fruit should have come from perfectly sound and healthy trees—the latter is one of those matters which is frequently lost sight of.

The seed itself should be selected on account of its fullness and plumpness, and light undeveloped specimens rejected. There are various methods of extracting seed from the fruit. Left to nature the fruit drops from the tree, rots, and the seeds get scattered about—some may take root, the majority are lost.

Trifoliata oranges, containing little pulp, may be simply opened and the seeds washed. Rough lemons and oranges may be allowed to rot in barrels and the seeds washed out through a sieve. They may also be cut up when ripe into quarters and halves (though some seed is lost this way), placed in a barrel, and covered with water; in a few days the seed may be washed out almost as easily as if the fruit were rotten.

Whatever method has been adopted to secure it the seed itself should, after selection, be placed in damp (not wet) sand if not for immediate use. It may either be stratified or mixed up indiscriminately. After a few days it is ready to plant. The method of drying seeds of citrus fruits customary in some countries does not seem to answer well in South Africa; the object sought here is to keep it moist until it is in the ground. The seed will not keep long in this way without attempts to germinate, so that for transmittal to any oversea

country the drying of the seed would be imperative, but it can be sent all over South Africa in the manner indicated with perfect safety.

Planting should take place when the ground is warm and fairly rapid germination likely to occur. This points to our Spring months, such as September and October, as being the most suitable, but there are so many different climates and circumstances to consider here that no one month can be definitely named. The seed should be set out in rows across the bed, say 6 or 8 inches apart, and the seeds 2 or 3 inches apart in the row. This affords room for a hoe to be used to keep down weeds, etc. Water in the requisite quantities must be forthcoming, but too much should not be given or "damping off" is likely to occur. In the hotter parts it is necessary to provide some kind of protection from the sun during the day, and this may be done by placing strong stakes along the edges of the beds with a piece of No. 8 galvanized wire along the top. To this wire either canvas or straw or reed mats should be attached in such a manner as to admit of its being easily and quickly rolled up. During the extreme heat of the day the covering is unrolled over the young plants and rolled up again before evening—gradually as the plants gain strength the exposure to the sun is extended until eventually no further shading is needed. The covering is also useful when the nights are cold and any danger from frost is feared. Frequent stirring of the soil is desirable, and no crust should be allowed to form on it or weeds to appear.

Transplanting from the seed beds into the nursery should take place when the little trees are 8 to 10 inches high. They should be planted in rows at least 4 feet apart and at about 12 to 15 inches in the row. These distances admit of the development of a well-grown, healthy young tree. Transplanting may be done at any time when the trees are sufficiently grown and the soil in good condition to receive them. Dull, rainy weather is desirable for the operation, but as in South Africa this is not always to be had, a plentiful supply of water becomes of the utmost importance, and the young trees should be maintained as far as possible in constant growth until such time as they may be ready for budding. During the transplanting process care must be taken that the roots of the seedlings are not allowed to dry, and an effort should be made to effect the work with as little check to the growth of the plant as possible. Any poor and unhealthy looking specimens should be thrown away—a tree stunted in its infancy is never likely to become a source of pride or profit to any one. The actual method of planting is dependent on the individual preference of the grower (some may wish to plant in furrows made by a plough); a more general practice, however, is to plant by hand with a spade, and this method is for small undertakings usually quite satisfactory.

Nursery soils should be properly prepared to receive the young plants from the seed bed. Deep ploughing is essential; if possible trenching, or at least sub-soiling with a sub-soil plough, should be adopted. Fertilizing should also not be neglected. This is one of the most important considerations and requires to be so adjusted that no undue stimulus should be given to the trees; should this occur when the time arrives for them to be planted in ordinary orchard soil a period of stagnation often prevails—the tree does not come on properly and altogether behaves in an unsatisfactory manner. This is due to the change from a highly fertile soil to one of ordinary character. On the other hand, the land must be rendered sufficiently fertile to

enable the trees to grow fairly quickly and a sufficiency of water be provided for irrigation purposes. Judicious irrigation and cultivation methods should be depended upon to assist the growth of the trees rather than heavy fertilization. The surface of the soil should be kept loose and porous by means of a one-horse cultivator or harrow and no weeds permitted to appear.

Budding.—When the trees have attained the diameter of a lead pencil at a few inches above the ground they are big enough to be worked over. Methods of doing this were formerly by means of either budding or grafting. In actual practice to-day the number of worked trees produced by grafting is so infinitesimal that it is not considered worth while to discuss that practice. Budding may be done in some parts of South Africa during any month in the year; there are so many localities which are practically frostless that it is only necessary to



Fig. 1.—Budwood.

select a period when the bark "slips" readily, i.e. when there is a good flow of sap. In other parts, where the winters are colder, it is customary to bud just as the sap goes down at the commencement of the cold weather; in this case the bud remains dormant until the spring growth commences, hence this is called "dormant budding," or else to bud in the Spring or early Summer months. Budding in January or February results in the production of tender young growths which are liable to suffer from the cold of the following winter.

Buds are taken from well-matured round wood of the previous season's growth, the small, angular, somewhat sappy, growths are to be avoided—they are not as nice to handle neither are the results usually as successful as those obtained from older wood.

The budwood should be taken from trees of healthy growth with good bearing qualities and of known pedigree. This is especially necessary in the case of the navel orange, of which there are a good

many different types in South Africa; none equal to the "Washington," and even of this variety there are several different "strains," some of which are far better than others.

Buds should not be taken from trees which have not borne fruit—there is always room for doubt as to whether such are really true to name. This is the principal objection, although it has been stated that buds taken from immature trees are liable to develop into those of an unfruitful character.

Oftentimes budwood is taken from the parent tree and used almost immediately; in this case it is necessary to keep the "bud sticks," as they are called, in a damp cloth in order that their freshness may be maintained. In other cases this is not possible, and so the budwood is kept until needed either in damp sand, moss, or cloths; the use of the latter calls for frequent attention in order to prevent drying out.

The budding outfit calls first for the budwood, then for a good, sharp budding knife of the type shown, and, lastly, for material with which to wrap the buds after insertion.

Custom differs according to individual taste as to how and with what the bud should be wrapped. In some cases ordinary raffia grass is used with good results; in others—and this is especially so in those parts where budding is done in the rainy season—a waxed cloth is used, which is wrapped entirely over the newly-set bud, thus excluding the possibility of the injurious action of air or water.

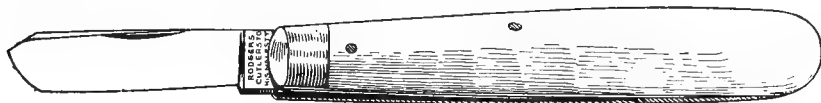


Fig. 2.

Wrapping of this description is made best from thin white calico. Tear it in pieces of half a yard or so and then dip them into a mixture composed of equal parts of beeswax and best paraffin candles, melted together in a fairly open tin or iron pan, strain off the superfluous wax by drawing the calico through two pieces of thin board, and hang the material on a line. As soon as it is dry it is ready for use, and may be torn or cut up into lengths suitable for wrapping round the buds.

If it is too much trouble to make wrappers this way, tape of the right width may be purchased and treated in a similar manner.

Cutting and Insertion of the Buds.—Buds are severed from the budstick as shown in the illustration. The knife used should have a razor edge, so that the buds may have a clean-cut, smooth surface at the back, and so unite readily with the growing wood of the stock.

The bark of the stocks is opened, as depicted, and in a similar manner to the method adopted in the budding of deciduous fruit trees, with the exception that the T-shaped cuts are inverted and the buds pushed upwards under the bark instead of downwards as in the former process; the object of this reversal is to prevent as far as possible the entrance of water behind the bud, quite a necessary precaution in some parts of South Africa. After the bud is inserted the whole stock is wrapped over with waxed cloth sufficiently firmly to bring the bud and stock into close contact. Wrapping the bud too loosely or too tightly affects its growth adversely, in fact oftentimes prevents growth at all.

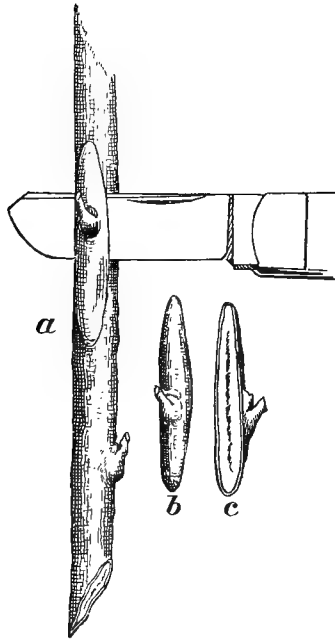


Fig. 3.—Shield, or eye, buds : *a*, method of cutting bud from round twig ; *b*, bud cut ready to insert ; *c*, face of bud showing the cut surface. (From Yearbook U. S. Dept. Agr., 1896.)

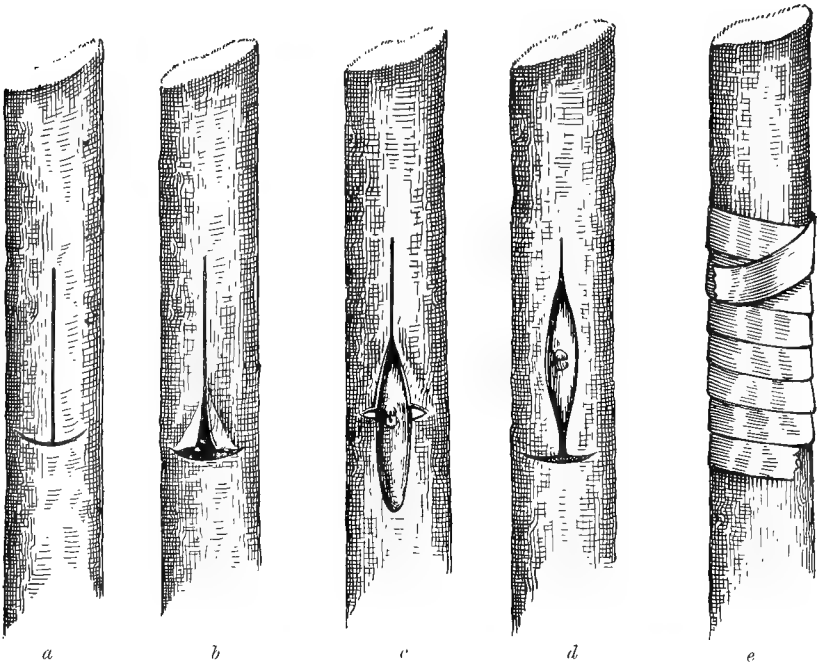


Fig. 4.—Shield, or eye, budding : *a*, incision on stock ; *b*, incision with lower ends of bark raised for inserting the bud ; *c*, bud partially inserted ; *d*, bud inserted ready to wrap ; *e*, bud wrapped with waxed cloth. (From Yearbook U. S. Dept. Agr., 1896.)

Position of Buds.—The buds should all be set on that side of the trees which is least exposed to the extreme heat of the afternoon sun and placed at least 6 inches above the level of the ground. This is necessary in order to keep the sweet orange variety as far as possible away from the influence of any disease which may affect the roots, and also to counteract to a certain extent the evils of too deep planting when trees are set out in orchard form.

After about twelve days have passed from the date of the budding the buds may be examined to see if they have taken. The wrappings must be unwound carefully and an inspection made of each bud. If a good job has been done, under favourable conditions the buds should look fresh and healthy, and, if the union between bud and stock is satisfactory, and the buds taken well, the wrappings may be removed. When buds look black and show a mildewy appearance arrangements must be made to do the work over again. Wrappers should not be allowed to remain too long round the buds, as there is a possibility of them being overgrown by the bark of the stock, and their natural attempt to push out young growth frustrated.

As soon as signs are in evidence that the buds are about to shoot out, the whole of the stock should be removed to a distance of some three or four inches above the bud. As the young shoot grows and attains a height of six inches or so it should be tied to the stub left with a piece of raffia—this affords a little support and prevents the tender shoot from being blown out by high winds. As the trees increase in height this single support becomes insufficient and should be supplemented in the case of each individual tree by a stake to which it is tied. When at Whittier, in California, in 1911, the writer realized, perhaps more than ever before, the extreme care with which orange trees were grown in nursery form there. Each tree was staked and trained to a single stem only. From the time the young buds have a few leaves until the tree is about three feet high, and the time for heading back comes, the appearance of each new leaf is the signal for a raffia support, thus a young nursery tree appears to be tied to the stake every couple of inches. Such work calls for a very large amount of labour, but it results in the most perfect trees obtainable, which sell readily at 4s. to 5s. each, and thus undoubtedly justifies the expense, the great object being to obtain the very best tree possible and not to take anything but the best.

It is necessary to remove the “ stub ” some time before the young trees are lifted from the nursery, and this should be done with a sharp pair of shears by a cut made diagonally and *not* horizontally across the stock.

The importance of correct stubbing is considerable, as, if a horizontal cut is made, the process of healing over occupies about three times as long as when a diagonal one is used, and should the horizontally cut stub be left and the tree planted just a little too deep collar-rot promptly appears.

After cutting off the stub the exposed surface should be painted over with a little common paint—any colour will do. This precaution prevents evaporation and consequent liability to rot.

The trees should be ready for planting out in orchard form as soon as the bark commences to grow over the cut and shows signs of healthy granulation.

Top Working of Old Trees.—It becomes advisable at times to work over a block of citrus trees of one variety to another which is more profitable. Thus one may see a good many seedling orange trees just now being changed over to either Washington Navels or Grape Fruit. It also happens occasionally that the fancy of an individual grower leads him to believe that certain kinds of fruit which he has not got would prove more desirable than those which he has, and so the knowledge of how to work over trees from one kind of citrus to another proves of assistance. It saves the expense of purchasing new trees and uprooting the old ones, and produces a crop of the variety desired in good quantities and a short space of time.

As in the propagation of young trees, the practice of grafting has been entirely discarded by the best growers, so also it has been found that budding has entirely superseded the older method in the working over of mature trees. It is a most unusual thing to hear of any one attempting the grafting of citrus trees either for propagation or renewal to-day.

Top-working of old trees with the object of changing the variety of fruit borne thereon may be undertaken by means of either budding or grafting. It has been found in South Africa that the former practice as a rule gives the most satisfactory results.

When budding is resorted to it is customary to go to work on one or other of the following methods:—

- (1) The entire top of the tree is removed and buds inserted into the new growths which appear; or
- (2) buds are inserted into the old wood in suitable places prior to the removal of the top, then, as it is seen that these buds have "taken," the branches are cut off a little above the bud.

Perhaps the method first mentioned is the easier of the two, and, in the opinion of the writer, it is the more satisfactory. Assuming that it has been decided to make use of it, the first step is to select those branches which are best suited for budding on. This is decided by choosing, say, three or four good, strong-growing ones which emerge from the trunk at some little distance apart and are well distributed round the stem, so that the new growths may be such as will give a symmetrical form to the tree. All other branches are removed and the exposed cuts must be painted over. Care should be taken that the cuts are made as close up to the trunk of the tree as possible, and no stub must be left. If this work is carefully done the wound will heal over nicely in due course. Finally, the branches selected for budding into are cut off about 12 to 16 inches from the fork of the trees, the exposed surface painted over, and the whole tree whitewashed from top to bottom. This prevents damage to the bark from sunscald, and is a most necessary precaution. Work of this kind is best done prior to the first flow of sap towards the end of July.

With the warmer weather new sprouts will appear in large quantities, and these should at first be allowed to grow until it is seen which amongst them is most suitable both from its position and vigour of growth. After these have been decided on the remainder should be gradually reduced in number until finally none are left but those selected for bud carriers. Budding in these is done in the same manner as for young stocks. As the buds grow they require watching,

and the main growths must be pinched back when they have reached eighteen inches to two feet in length. This process not only strengthens the growth, but to a large extent affords protection against high winds.

It may be said on the whole that the above method is more generally used in South Africa than any other; the sole disadvantage in its use is that it takes more time than does

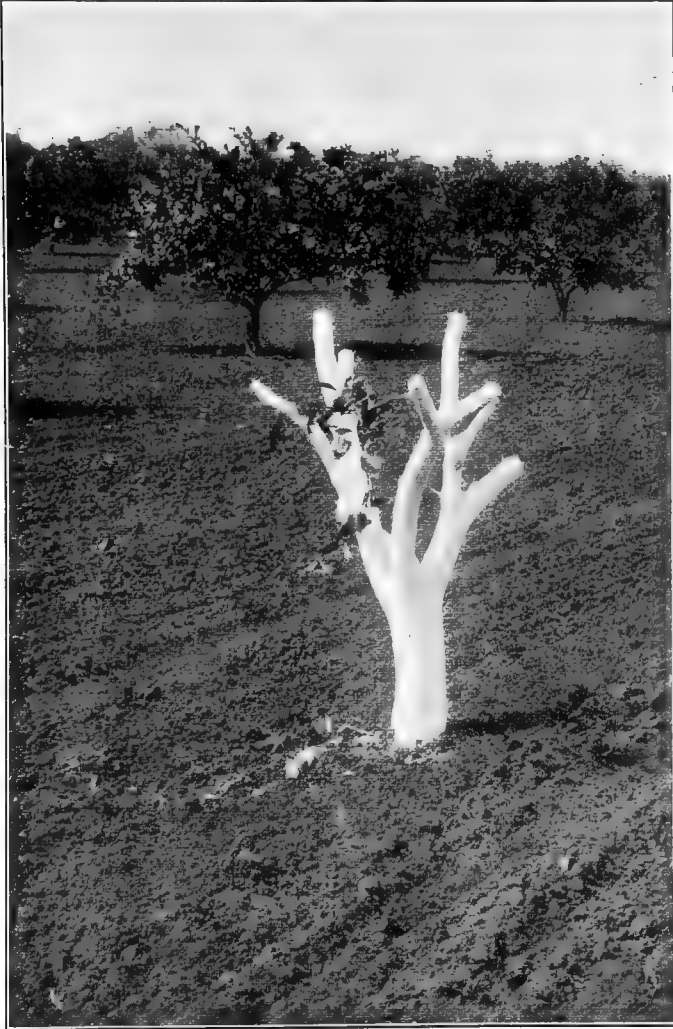


Fig. 5.—Tree beheaded for working over.

Budding into the Old Wood.—This practice is carried out on lines somewhat similar to that just described. Objections have been raised that in some old trees the bark is so thick that it is most difficult to insert buds at all. This may be overcome by whittling the bark round

the spot where the bud is to be inserted down to a thickness which presents fewer obstacles in handling. The branches should be prepared beforehand, by trimming away small sprouts, and the buds inserted in those selected, before beheading the tree. As soon as the buds have "taken" the tops of the branches can be removed, and the same precaution of whitewashing the tree should be taken as previously described. Sometimes one or two branches may be left for the purpose



Fig. 6.—Tree beheaded for working over.

of shading the buds and tree stem; these must be removed later when the new growths have arrived at such dimensions as will afford the necessary shade.

This class of budding should be done either in spring or the fall of the year. In the former case growth starts almost immediately; in the latter the buds remain dormant until the Spring, and such are called "dormant" buds. All sprouts and suckers on the old stock should be kept rubbed off so that the buds may receive plenty of nourishment.

Grafting over orange trees from one variety to another is carried out on much the same lines as in grafting deciduous trees. The practice is almost in disuse in South Africa, but it is mentioned here because some growers may wish to test the method, and others have an idea that a graft is always better than a bud.

The two methods likely to prove of any profitable use are those known as Cleft and Bark grafting, and are shown in Figures 6, 7, and 8.

Cleft grafting may be done at almost any time of the year, but the best months as a rule are June and July, the latter for preference in those districts where the first after-winter growths take place at the end of the month.

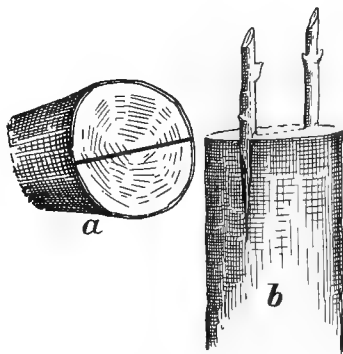


Fig. 7.—Cleft grafting; *a*, showing the cleft; *b*, grafts inserted.

The operation consists in beheading the tree and the selection of those branches which lend themselves best to the purpose. The branches are cut off much the same length as is mentioned for budding purposes and then are ready for grafting. One may be left for shade purposes, to be removed later, or that also may be worked over at some future date when the scions inserted have grown out to a nice bushy head. The leaving over one branch is also supposed to have a beneficial effect, in that a constant flow of sap is maintained by that means, and so any injurious effect caused by a superfluity of sap is avoided. The writer has always found that where plenty of scions are inserted it is not necessary to insist on the retention of a branch for the purpose named.

Splitting the stock is done by means of a suitable knife or other instrument; whatever is used must be strong and sharp. The split should not be made through the centre of the stock in any case, and when more than two scions are inserted the cuts should be made parallel one to the other. Judgment is needed so that the split is made neither too shallow nor too deep; if the former is the case the wood of the stock will press so tightly against the scion that circulation of sap is impossible, and, if the latter, the pressure will be insufficient and there will be no proper contact between stock and scion.

After splitting, the stock must be kept open for the insertion of the scions, and that may be done by a small piece of wood or bone, or even a chisel may be used. Something with a fairly long handle is required so that a good leverage may be obtained and the crack in the stock opened with ease.

The scion may be cut from small angular wood of recent growth, from the green round wood which is slightly older or from the grey-green wood of two or more years of age; perhaps the round green is the best. Two buds or, at most, three are sufficient on each scion.

Cutting the scion is simple when one gets used to it. Care must be taken to leave the edge of the wedge which is to come in contact with the split sides of the stock a little thicker than the other or inner edge. The scions are then inserted in the cleft so that the inner bark

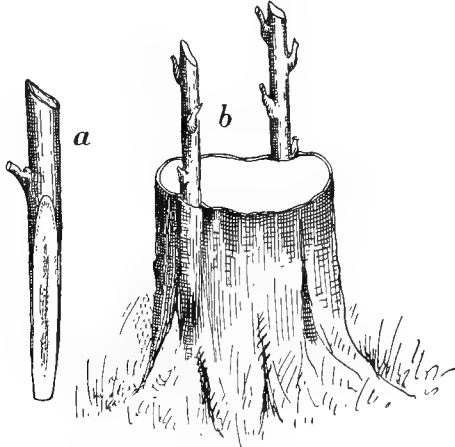


Fig. 8. Method of bark-grafting an old orange-stock: *a*, base of scion, showing slanting cut; *b*, method of inserting scion. (From Yearbook U. S. Dept. Agr., 1895.)

of the scion comes in contact with the inner bark of the stock if not throughout the whole length then to as great an extent as possible in order to ensure a perfect union. After inserting the scions the whole of the exposed surface, including the tip of the scion, must be covered with some good grafting wax, which may be either purchased or made at home.

Bark or crown grafting does not require that the stock or branch to be operated on shall be split at all. The scions are cut showing one exposed surface only, and that is pushed under the bark of the stock, which should be previously loosened for its reception so that it comes in contact with the wood of the stock. Sometimes one may find that the stock is not quite round in shape but that there are slight incurving indentations; these should be used where they occur as being the most suitable place for a graft to be inserted. If it is difficult to insert the scion under the bark then the latter may be split open with a sharp knife and the scion pushed under, keeping the middle of the scion in the centre of the slit.

After the new shoots have attained a length of about twenty inches they should be nipped back with the finger and thumb to strengthen

the growth and so prevent loss from high winds. Whether the trees are grafted or budded they should with careful handling be bearing a crop in the third or fourth year after the operation has been completed.

VARIETIES.

At the Government station at Warmbaths there are some ninety-six varieties of citrus fruits of one kind and another under test. These consist of a collection of many, if not most, of the kinds recognized as standard varieties. In addition there are others originated on the station as a result of hybridization.

Out of all these kinds there are but a very few which appeal to the present-day planter of a commercial orange grove.

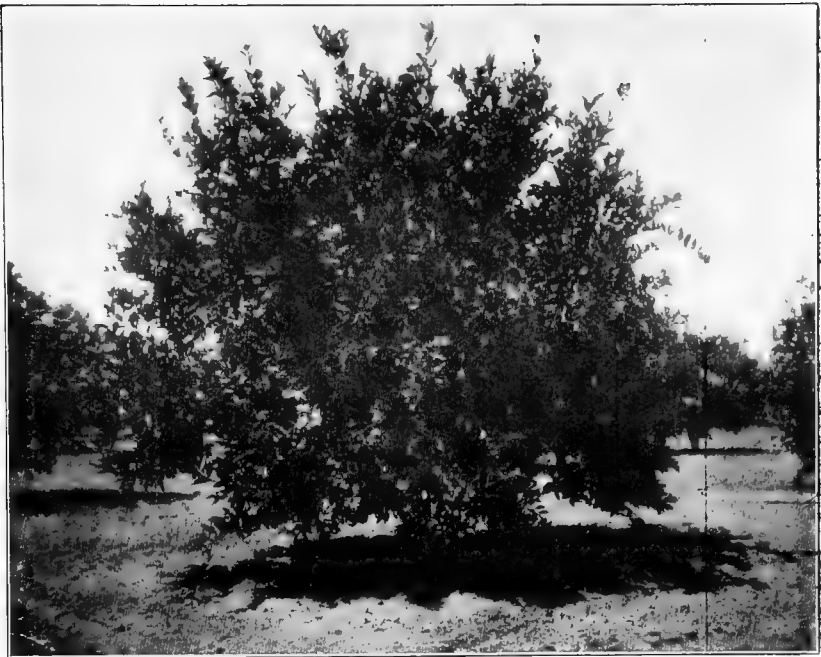


Fig. 9.—Three-year-old Budded Navel Tree.

Placed in order of favouritism, the list would read something like this: (1) Washington Navel, (2) Valencia Late, (3) Jaffa, (4) Du Roi, (5) St. Michael, (6) Blood Orange, (7) Mediterranean Sweet, (8) Seedlings.

No allusion need be made to the other varieties, excepting to say that many of them have some distinctive quality which has led to their propagation, but which has not so impressed itself upon public favour as to render them a commercial success. Of the eight kinds enumerated above it may be said that the first two named stand pre-eminently as the favourites for planting now, and possibly 85 per cent. of the orange trees set out in South Africa within the past five years belong to these two kinds. The *Washington Navel* is, and rightly so, the most popular orange in the world. Its history is so well known

that it is not proposed to repeat it here. It is seedless where properly grown, of exquisite flavour, with carrying qualities second to none, and an appearance so strikingly different to all other oranges as to immediately attract the eye. Of comparatively recent origin, its career has been one long success, and there is no prospect of its losing its place in public favour for some years to come, if ever.

Valencia Late is, as its name denotes, an orange with late ripening qualities. It is also one of those which contains but a few seeds, is extremely hardy, and a regular bearer of good, medium large, somewhat elongated fruit. It is a favourite here, as it comes on our markets when most other oranges have long since disappeared and prices are therefore at their best.

Jaffa.—This is another orange with very few seeds, and is borne on a tree which is almost without thorns. The quality of the fruit is good, and is in great demand in European markets. The popularity of the above two kinds has, however, hitherto prevented as much attention being paid to this variety as it deserves.

St Michael (paper rind) is also a favourite on the markets of Europe. Very few trees of this type are to be found in South Africa yet. For quality, flavour, thinness and smoothness of skin it is entirely without an equal. It is, however, rather small.

Du Roi is largely grown in Natal and parts of the Transvaal. It is equally as late as the *Valencia Late*, and one of the heaviest bearers known, in fact, the tendency to bear too heavily is its chief fault. The fruit is good, very free from "rag," but frequently does not possess that dark-coloured skin which is supposed to denote quality in an orange.

Blood Orange.—This is not as general a favourite in South Africa as any of the others named. It is mentioned here because a demand at a good price exists in Europe, and it is a variety worth cultivating.

Mediterranean Sweet ripens between *Navel* and *Valencia Late*, has proved a good shipper from Rhodesia to England. This orange should be planted more extensively than it is at present; tree practically without thorns, and never attains large size, but bears regularly.

Seedlings.—These are to be found all over South Africa, and represent 75 per cent. of the bearing orange trees in the country to-day. Many districts have types peculiarly their own; thus one hears of "Clanwilliam Seedlings," of "Rustenburg Seedlings," and others. They are the present-day representatives of the original trees introduced now some three hundred years ago. In some instances one may find an orange equal to the best-named variety, whilst others again are not as good. A striking characteristic of all these is the great size and uniform shape of the trees, together with freedom from many scale insects and pests to which nursery raised trees are liable. It is fruit from these trees which forms by far the larger portion of our citrus export to-day, and it says much for the quality of the fruit that it has already achieved so good a reputation in the markets of Europe.

SELECTION OF VARIETIES.

Selection of Varieties.—Due consideration should be given to the selection of varieties for planting; and the eventual disposal of the crop, the turning of fruit into money must always be borne in mind.

If it is decided to plant principally with a view to export, the most popular oversea varieties must be chosen. It may be accepted, perhaps, that the general policy of most present and prospective planters is and will be to plant for the export market.

Roughly speaking, our citrus export covers the four months of June, July, August, and September; the object of the exporter should be to be represented by the best varieties during the longest time possible during these months. This is at present accomplished by the export of early seedlings, Washington Navels, and late seedlings. Naturally, the Natal fruits are first on the market, owing to the hotter climate of that Province; then come the Transvaal shipments, and later those from the cooler parts of the eastern districts of the Cape. It appears to the writer that such an arrangement, falling in a natural sequence as to the priority of ripening, simplifies matters somewhat and emphasizes the necessity of Natal studying the best early kinds to plant; of the Transvaal and certain parts of the Cape going in for mid-season, and the south coast specializing on later varieties.

There are many seedling oranges which may be depended upon to supply the needs of the earlier months of export. Washington Navel and others of the previously named kinds cover the mid-season, and Valencia Late and Du Roi, with other seedlings, are available later on.

Selection of suitable seedlings is not an easy matter, the chief difficulty being to get fruit of uniform quality, and it is just possible that eventually some particular one with marked and suitable characteristics, such as thinness of skin, freedom from rag and seeds, fine texture, and good flavour, will be selected for propagation by nurserymen, who are constantly on the lookout for a "good thing." There are early named varieties on most trade lists, chiefly importations from America, but they do not appear to be as satisfactory as some of our own better class seedlings. The greatest care should be exercised in the selection of young Washington Navels for planting. There are a few strains of this fruit which are no credit to the name. Fortunately, a good number of trees of undoubted pedigree have been introduced into South Africa at different times from California, and there are many thousands of trees of this true type propagated annually. It is worth a large sum of money to be sure that one is getting the right strain; given such, a good step forward has been made to the success of the orchard. On the other hand, the purchase of trees of an inferior strain and bearing qualities can lead to little short of disaster. Oranges from the southern and coastal districts ripen somewhat later than Natal, Transvaal, and central Cape fruits. Advantage is taken by some growers of the lateness of the district, and Valencia Late oranges from these parts appear on local markets when they are bare of aught else. So far no attempt has been made to export a really late orange, such as would arrive in Europe in November and December. This will occur when more late varieties have been planted, and there is every prospect of success in the venture. Fruits from South Africa arriving in Europe during those months would be ripe and sweet as compared with the early Spanish shipments arriving at the same time in a half ripe and wholly sour condition.

The selection of late varieties to be produced in the late districts is seriously commended to growers in those localities.

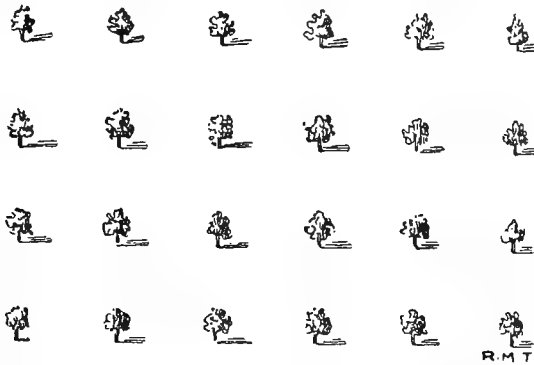
PREPARATION OF LAND.

Assuming that a suitable orchard site has been selected, it will be perhaps necessary to "clear" it of growing bush or trees. There are many "stump pullers" on the market, but in any case a good deal of work is required to get things in order and the land freed from roots, etc. The use of dynamite for such work has been much advocated, and considerable work done by means of that agency. Speaking of the use of dynamite generally, the reader is referred to the words "suitable orchard site"; such site does not require the use of dynamite, excepting, perhaps, in the connection referred to.

The principal points to be borne in mind in preparing the land are that it must be (if necessary) thoroughly cleared, deeply ploughed and sub-soiled, cross ploughed, and levelled so that the water may be easily led, and finally thoroughly well harrowed so as to leave it in a fit condition for marking out. In many cases land would be better if a crop of some kind were planted the first year instead of being at once laid out to fruit trees. If of poor quality, a leguminous crop planted in spring and ploughed under when in blossom during the summer would have a beneficial effect; given moderately good soil a crop of mealies may be taken off with advantage—there are few crops so well calculated to open up the soil as this. In most cases, however, the desire is to get the land planted with orange trees at the earliest possible moment, and so the preparatory crops are likely to be passed over.

LAYING OUT THE ORCHARD.

There are many ways of laying out an orange grove. If economy of space is an object of little importance then no method is equal to the old-fashioned rectangular or square system of planting, i.e.



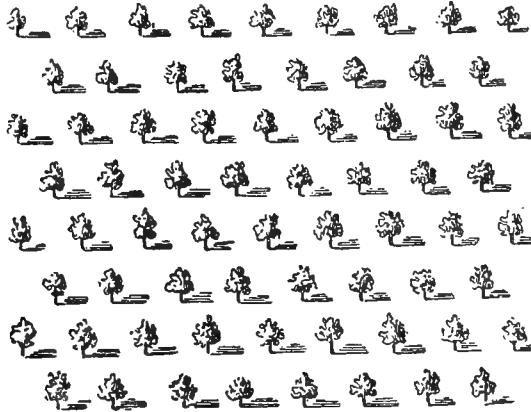
By this system more room is allowed for each tree than by any other, more room is allowed for ploughing and cultivating, and good and simple methods of irrigation may be resorted to. True, exact economical distribution of space does not occur, but the trees are likely to benefit by that very fact, as each will get more root feeding space under this system. Trees at 20 feet apart planted thus go 108 to the acre; at 22 feet, 90; and at 24 feet, 76.

Hexagonal Planting.—As opposed to the square, this method is the most economical which can be adopted; the trees stand equi-distant

one from another right through the orchard; they are, in fact, planted each at the apex of an equilateral triangle, and every tree is the centre of six others. Economy of space is thus secured to the utmost. Against this system may be advanced the plea that one can only plough or cultivate the land in three directions instead of as in the square planting in four. It is more difficult to irrigate and to draw furrows for so doing, and less convenient for the hauling out of a crop of fruit.

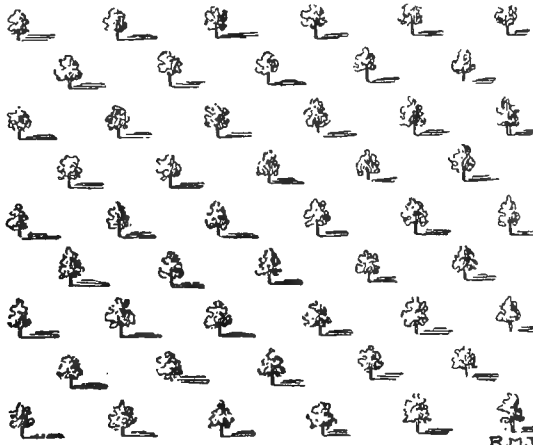
Planted on this system, 20 feet apart, there are 126 trees; at 22 feet, 103; and at 24 feet, 86 per acre.

Hexagonal Planting.



R.M.T.

Quincunx System.—This is a favourite way of setting out an orchard, when what is known as fifth trees are planted; generally speaking, fifth trees are only set out for the production of catch crops, and do not form part and parcel of the permanent orchard. They



R.M.T.

stand each in the centre of a square of four trees, and by their inclusion add very materially, though not in an economic manner, to the number of trees which can be planted on an acre of land; thus trees

planted in this way at 20 feet apart in the original square with the centre trees added go 199; at 22 feet, 173; and at 24 feet, 137.

Laying out an Orchard in the "Rectangular" System.—There are several ways of doing this, and most of them are to be relied on. The use of a wire marked at intervals with lumps of solder annealed to it at the exact distances at which it is desired to set the trees is perhaps the most reliable and simple. Thus if the trees are to stand 20 feet apart in the orchards the marks are placed on the wire at those intervals. It is a good plan to stretch the wire before affixing the solder, as if it stretches after the marks are made the correct laying out of an orchard would not be possible.

If the area to be marked out is large, one may take a wire, say, 100 yards in length and start by fixing on a base line from which to work. Such a base line should constitute one side of the orchard, and that the longest. It should be 20 feet from the actual boundary, thus allowing room for animals to turn between the end trees in the row and the fence or hedge or whatever constitutes the boundary. At each end of the wire should be placed an iron ring about two inches in diameter. Three or more men (four is the best number) are needed for the quick use of this method; in addition to the wire they are provided with stakes about 18 inches in length, and if they are of light-coloured wood so much the better. Spanish reeds answer the purpose, or occasionally one finds 1 in. by 1 in. stakes (deal), cut in lengths of 18 inches and painted or whitewashed, used for the purpose. Two men take the wire in hand, one at each end, and lay it along the base line; the other two immediately drive stakes into the ground along it at each of the solder marks, being careful to put them all on the same side of the wire. When this is done, the wire may be moved along in a straight line and the same operation repeated until one side of the field is staked off; then a sight taken down the line will show at a glance whether the work has been correctly done or not; if the latter happens to be the case the mistake must be rectified, as with an incorrect base line no success is possible; seen from either end, if planted in a straight line, the stakes will look as if they were one continuous piece of white wood from one end of the line to the other.

Having secured a base line, the next proceeding is to mark out another exactly parallel with it some 85 yards or so away. This is a comparatively easy matter, but in order that exactness may prevail in the measurements, it may be well to explain how to find a "true corner" giving another line at exact right angles to the first.

From the third stake along the base line, i.e., if the trees are to be planted at 20 feet apart, is a distance of 60 feet. Next mark off another 80 feet as nearly as you can guess at exact right angles to the base line and put in a stake there, then take the line and measure the distance between the stakes at the 60 feet and 80 feet marks. If the distance is 100 feet, then you have a true corner, and the line can be shifted and marked out with stakes at one end of the base line in the same manner as that was done. The same operation takes place at the other end of the base line, and then the wire is shifted over and the line parallel with the base line staked out at the same intervals. With these two parallel lines obtained the rest is simplicity itself. The wire is taken and laid across from the 20 feet mark on the one to the corresponding mark on the other line, stakes are driven in at the solder marks, and then the wire is moved down the lines step by

step until the whole space between the base line and the one parallel with it is filled with stakes and the marking out in rectangular form or "squares" is completed. From this original block the marking may be extended indefinitely, the same system being used. It may occur that only small areas require to be marked out, but the same methods will give the same results. It is common to use a wire just the length of one side of an acre, i.e. 70 yards, less 3 inches, in marking out small orchards; by the use of a wire of this length the land may be marked out in acre blocks.

Laying out on the Equilateral or Septuple System.—Assuming that 20 feet is the distance at which the trees are to be planted, a base line is laid out as mentioned above and stakes set out at the right distances down the line. Again one must be particular to place them all on the same side of the wire. Then take two pieces of wire with a 2-inch iron ring at each end and make them fit over two stakes set at precisely 20 feet apart, that is, each wire with its rings attached must cover exactly 20 feet. Two men then take one wire each and fix an end ring over the first and second stake in the row. Then they approach each other until the rings at the other end of the wire come into contact. One ring is placed exactly over the other, and a stake driven into the ground at the spot where they meet gives the first equilateral triangle. The operation is continued until further orders, and as a rule is beautifully effective and simple.

Another method calls for the use of a wooden frame, triangular in shape, having the exact dimensions required and holes provided at each corner. This frame is moved down the base line, placed over the stakes in place thereon, the apex of the triangle pointing inwards towards the land to be marked out and a stake driven in through the hole there; this method is almost equally as simple as the one previously mentioned, but takes three men instead of two. Modifications are necessary in both these systems when the land to be marked out is not level.

Still another method of laying out an orchard on the septuple plan is possible by the use of the wire previously mentioned marked in half distances. The stakes at the sides of the land, those at right angles to the base line, require to be set at different distances to those in the base line. For instance at 20 feet equilateral triangles are formed by setting a stake exactly in the centre between the first two stakes at a distance of 17 feet 4 inches; a 22-foot triangle by setting the middle stake at 19 feet; and a 24-foot one by placing stake 20 feet 9 inches away. Suppose trees are to be planted at 22 feet apart, the measuring wire is marked each 11 feet, and the base line staked every 22 feet; the lines at right angles to the base line are marked every 19 feet, and the wire, which should be long enough to reach well across the land, is moved back to the first row of 19 feet stakes, and one end of it pulled out to the 11 feet mark; the wire is then staked out as before. This goes on alternately, marking from the 22 feet and 11 feet marks until the land is finished. All stakes should be set the same side of the line, and each alternative side stake should be pulled up.

The Quincunx System.—The simplest way of laying out on this system is to adopt the rectangular method just mentioned, and set out your stakes at the necessary intervals. For instance, an orchard is marked out for rectangular planting in squares of 35 feet apart. Take

four men and give each pair a wire; let them go each to one of the corner stakes and hold the wires so that they cross in the centre; a fifth man drives in another stake. This is the quickest and easiest way of marking out on the quincunx system.

DIGGING HOLES AND PLANTING.

The orchard having been laid out according to the system decided upon there may be no need of immediate hurry in the matter of holes. Planting can be done over almost the whole of the country from September to the end of January. This is spring and summer planting, and experience has shown it to be well suited to our conditions.

Perhaps one of the chief inducements to planting citrus trees at this time of the year in South Africa is to be found in the fact that our rainy season should commence some time early in September or October, and that this precipitation renders the need of artificial irrigation less frequent. It is certain that as a rule citrus trees set out during these months succeed better than when planted during winter. Any later planting than the latter end of January is as a rule to be deprecated, as trees started later than that have a habit of growing late in the season, and so exposing the young growth to the danger of being nipped by frost.

Holes may be dug about 2 feet deep and 2 feet 6 inches across, or occasionally to an even lesser depth. The danger is not in planting too shallow but too deep. The deeper and more suitable the soil the deeper the hole may be dug. Holes dug deeply in hard soil with an underlying layer of clay mean death to the trees. Practically they are not holes, but wells in which water accumulates and stagnates, causing decay of the root-hairs first and eventually of the tree. When the drainage is good there is less danger on this score. In digging the holes the top soil should be carefully placed on one side and the bottom soil taken out and placed on the other side of the hole, the bottom of which should be loosened to the full depth of the spade.

Much has been said and written lately about the use of dynamite for blasting out holes. Given suitable soil—and the orange should not be planted in soil which is unsuitable—no necessity should arise for the use of dynamite. If unfortunately, a ridge of rock should occur across the position of an orchard site, then, perhaps, an excuse exists for blasting a few holes in order to preserve the symmetry of the rows of trees.

In order that the rows should correspond exactly to the stakes forming the lay-out of the orchard, it is a good plan to use a "planting-board." This may be made from a piece of flooring 5 feet long by



5 or 6 inches wide. A notch is made exactly in the centre, and a corresponding one at either end as shown.

In the operation of hole-digging the centre notch is placed close against the stake which represents the spot where the tree is to be planted. Other stakes are placed closely against the end notches, the board removed, and the hole dug. When planting time comes the board is again placed with the outside notches set closely against the

stakes, and the tree set so that when the operation of planting is completed it exactly fills the middle of the centre notch. Planting should be done after the following fashion: The top soil taken from the hole should be first replaced and brought up into something of a cone shape in the centre of the hole. The roots of the tree should be trimmed with a sharp pair of shears in order to remove all that may be bruised or broken, and then placed on top of the cone and more top soil thrown over them until they are well covered, the planter keeping the tree in the notch of the board all the time. He then removes the board, gets into the hole and tramples the soil firmly round the tree, especially at the ends of the roots. If the root system is large it is well to work the soil in around the roots with the fingers, nothing else does quite as well; after this is completed a little more top soil is put in and water run into the hole and allowed to remain until it has all soaked in. This may be done a second time if the soil is light and porous, then after all the water has disappeared finally the hole may be filled up with surface soil taken from near at hand.

The tree should not stand after planting is finished as low as it stood in the nursery. It is quite easy on all trees to see the mark made by the contact with the soil and defining accurately on each tree the exact height at which it has previously stood. After planting, water should be given as needed, and the ground kept loose round the tree. The top should be cut back in a corresponding degree with the root pruning.

CULTIVATION.

The rainfall throughout the principal orange growing districts in South Africa occurs during the summer; in the so-called winter months rain is seldom, if ever, seen. Cultivation is, therefore, undertaken so as to best allow of the absorption of as much moisture by the soil during the rainy season as is possible and the retention thereof during the dry season, when harvesting of the crop takes place.

The citrus family, all of them, appreciate thorough cultivation and clean tilth. The growth of weeds in a citrus orchard should not be permitted; each individual weed acts as a pump extracting water from the soil for its sustenance.

When a "cover" or "green soiling crop" is grown that is another matter, as it is specially planted for a specific purpose.

In order to prepare the soil for the admission and retention of as much of the summer rainfall as possible, at least one deep ploughing should be given annually. It should take place after the fruit is gathered and before the rains set in if possible; usually there is plenty of time to arrange the annual ploughing between these periods.

Assuming that the crop is harvested by the end of August or the middle of September, there remains, as a rule, a period of six weeks in which to attend to ploughing. It is best to use a single-furrow plough and set it to 8 or 10 inches deep for the middle of the rows. A smaller one should be used when ploughing round the trees in order to avoid cutting more roots than necessary and also to enable one to get closer to the tree than can be done with a large plough and a heavier team.

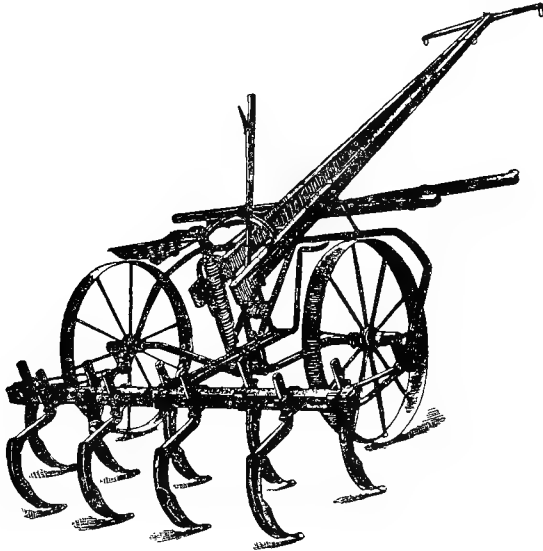
Horses or mules should be used for draft purposes. The ox should have no place in an orchard of any kind, and especially a citrus one. This statement is one which is eminently sound, and made wittingly

in the face of the common practice in South Africa of using oxen for traction purposes. An orchard makes a good burial place for dead oxen, but they should not be admitted in any first-class, well kept plantation in a live state.

In ploughing one must be careful always to keep in view the necessity of having level land for irrigation furrows; as a consequence the constant turning of the soil either towards or away from the trees must be avoided. Ploughing always at the same depth is also undesirable, as it tends to form a hard pan under the plough sole, and the land should not be ploughed more than twice in the same direction.

When an orchard is laid out in squares there are always two well-defined avenues, and these should be dealt with alternately, so that the whole of the soil in the orchard is deeply broken up.

After ploughing at the time of the year mentioned it is not necessary to bring the surface soil down to a particularly fine condition of tilth unless a cover crop is to be planted. If it is left fairly open and not broken up too finely the rain soaks in more readily and deeper than



it would if a finer tilth had been arrived at. When the rains are over, there is no prospect of more for months, and so the land has to be disked and brought down to as fine and deep a surface condition as possible. This surface soil acts as a mulch, and if frequently stirred, as it should be, evaporation is reduced to a minimum.

It is here that a good two-horse cultivator is of the greatest assistance. Given a good machine of the type shown, five to seven acres per day can readily be dealt with, and it is this frequent cultivation which retains the moisture. Should rain occur the machine should be run over the ground as soon afterwards as possible. One of the oldest axioms of the orchardist is "After irrigation, cultivation."

But cultivation does not benefit the soil, only by assisting in the retention of moisture; it also affords an opportunity of aerating the roots of the trees, and this is a very important function. It should be hardly necessary to ask any one to call to mind the appearance of an orange grove where cultivation has been neglected or, perhaps, scarcely ever practised. As a rule, in such cases, the leaves of the trees are yellow, and often one sees the dying back of young twigs. In fact, uncultivated trees usually have a sickly look, which denotes their condition, and it is when in this state that they are most susceptible and most readily succumb to the attacks of the numerous army of insect and fungus pests to which they are subject.



A homely illustration of retention of moisture is occasionally afforded by the turning over of an old sack or bit of wood left about in the garden. Whilst all around the soil may be to all appearance quite dry, that immediately beneath the sack or wood is found to be damp; this is because evaporation has been prevented, or at any rate hindered, just in that spot.

The fine top soil or mulch of an orchard in a good state of cultivation acts in just the same way; it prevents evaporation. The frequent stirring with a cultivator prevents capillary action being set up, and the mulching qualities are thus retained.

IRRIGATION.

No citrus orchard should be laid out in South Africa without facilities for irrigation. It is true that the same need for water does not exist on the coast-line as it does on the high plateaus of the interior, but that the need does exist is proven by the fact that some of the largest growers on the coast have been compelled to make arrangements for a supply of irrigation water. Assuming for a moment that no facilities for irrigation exist—that a rainfall of forty inches is present on the coast citrus belt, that precipitation occurs, as would normally be the case from September or October to March or April, one finds a most important period in the annual life of the tree passing without any adequate water supply. If forty inches could be

guaranteed to fall as occasion required that quantity would or should prove sufficient. We have not so far been able to make the arrangement, and so must find water some other way.

Perhaps a few words may not be out of place here with regard to the so-called dry system of culture as applied to the citrus family. Briefly no such thing is possible. Water is an absolute necessity and must be applied. In order to afford an approximate idea of the quantity needed we will take thirty inches as a coastal and forty inches for the interior districts as a minimum. If the question is examined from a common-sense standpoint the absurdity of "dry" citrus growing is at once apparent.

An orange orchard in full bearing produces an enormous quantity of fruit, the constituent parts of which are chiefly water. Evaporation is extremely rapid in South Africa and is answerable even under the best possible conditions of tith for the loss of a large amount of soil moisture daily. When to these factors is added the third and most important, that of "transpiration," it must be recognized that a large supply of water *must* be supplied in order to render these functions capable of satisfactory fulfilment. It must be remembered that citrus are evergreen trees, that their need for water does not, like deciduous trees, comparatively cease with the fall of the leaf, but continuous for three hundred and sixty-five days each year. When one bears in mind that a sunflower plant with a leaf surface of 5616 square inches transpires one and a half pints of water daily, it is more easily realized that the moisture requirements of an orange tree are far greater than is generally supposed.

When to Irrigate.

Having shown the necessity for the application of water, it may be well to state first when, and afterwards how, to irrigate. The trees require water at the time of blossoming in order to enable them to set a full crop of fruit, and from that time onwards until the crop is harvested water is required at intervals. It is not possible to state any exact period, because soils and their requirements differ so extensively, but the leaves must not be allowed to show any signals of distress such as curling up or wilting. As the orange takes about nine months to mature from the time of blossoming it will be seen that irrigation must be spread over this period. It was formerly customary to cease the application of water as the orange commenced to turn yellow, the idea being that by continued irrigation the carrying qualities of the fruit became impaired. Experiments have shown and practice has established the fact that oranges may be watered up to within a couple of weeks of long distance shipment with benefit to the contents of the fruit and without impairing its carrying qualities.

There are many ways of irrigating citrus trees. Here are a couple of different methods of how *not* to do it. Don't let the water run over the land every eight days or whenever it is your turn to use the furrow and then let it sink in until next water day comes along; that is just feeding the sun, also getting the roots of the tree into bad habits; they come to the surface for moisture instead of going where roots ought to go, deep down in the soil to seek it. Should a dry spell occur and no water be available then these surface-fed roots dry out and the

trees sicken, perhaps die. Don't make basins round the trees for the water to run into and sink away; this method is the best known for inducing "collar rot," and this disease kills more citrus trees than all the others in Africa put together; besides, the feeding roots of the tree require water, not the trunk, and they are away out in the middle of the row.

Furrow and Check Systems.

The best method in use at present is that known as the *furrow system*. The late Professor Hilgard, of California, one of the leading men of the world to-day on soil matters, advises deep and narrow furrows. Three or at the most four are ample; they can best be drawn with a plough running as deeply as possible and followed by the water as soon as practicable. After irrigation is finished a harrow can be driven over the dry portions of land and the wet soil covered over so as to reduce evaporation to a minimum.

Some cultivators, chiefly of American manufacture, have furrower arrangements which may be attached to the machines, and these are capable of drawing three furrows at once; one can also make such an article from a couple of 3 by 9 planks. The disadvantage in their use is that they do not go down as deep as the plough.

What is known as the *check system* has some advocates, but this is not considered suitable for South African conditions. Whatever system of irrigation is adopted the one important point to bear in mind is to get the water as deeply as possible into the land, and by after-cultivation to retain it as long as possible. Frequent use of the cultivator means less work in connection with irrigation, and this fact is worth bearing in mind. Cultivating is far easier than irrigating, and this ought to appeal to most of our citrus growers in these days of scarcity of labour.

PRUNING.

Although the orange requires less attention in the way of pruning than most other trees, it is still necessary to do a little work in this direction. Left to itself it usually assumes a symmetrical form, and as far as the shape of the tree is concerned there is little to be done. Efforts are sometimes made to induce a tree of willowy habit to grow upright, but as a rule little alteration of the natural form of an orange tree is either desirable or necessary. There is one point in the tendency of the outer branches of the tree to grow downwards which needs correcting. Even this particular feature is not without its use, for young trees, if left alone for the first five years of their lives, will nearly always put out a number of branches carrying quantities of fruit, the weight of which causes them to sag down to the ground. If, therefore, these are removed, or not allowed to grow, that much crop and a corresponding amount of money is lost. Against this must be set the fact that if these branches are not allowed, or are removed, the tree attains its natural form and grows more quickly, upwards. During a recent visit to California the writer spoke to several different growers on this point; their replies in nearly all cases were indicative of their financial status. Said one:—"Yes, I know I ought not to allow the branches to drag on the ground, but that lot is worth a

dollar to me"; whilst another remarked, "No, I want my trees to grow properly. I can do without a little extra money now, and later on the trees will be all the better for it." In no case were the branches of full bearing trees seen sweeping the ground.

An Ideal Appearance.

An ideal appearance is obtained when the lowest of the outside branches of an old tree do not approach it nearer than eighteen inches or two feet. This admits of the free circulation of air round the trunk, also the sun has some opportunity of access, and this factor is of importance in that sunlight is the greatest enemy of the bacterial world, and thus prevents to a certain extent the advent of such a trouble as collar rot. The old-fashioned plan of allowing the outside branches to sweep the ground, under the impression that the shade derived therefrom kept the soil cool, is all wrong. What does happen when this occurs is that scarcely any circulation of air can take place under the tree; the space round the trunk is dark, and affords a delightful breeding-place for insects, besides favouring the development of all bacterial and fungoid troubles to which the orange is subject. All dead wood should be removed annually, also water sprouts, unless one should occur where the formation of another branch is needed; it may then be cut back and encouraged in the right direction. The trees should not be allowed to become too dense. One often sees an orange tree with a perfect wall of foliage from top to bottom; there is no chance to see inside the tree, the leaves are so thick. This kind of tree is all right to look at, but all wrong from the point of view of healthiness and profit. The trees should be kept fairly open so that the inner branches may be encouraged to bear, and it is well to recollect that fruit so borne is always the largest and latest and nearly always fetches the highest prices. A good plan is to keep the tree so that one can easily see well into the interior of it. This admits also, should occasion arise for spraying against insect or fungus pests, of every part of the tree being easily reached with the spray.

The best time to prune is after the crop is off; the weather is cool then, and a little exertion is not as conducive of fatigue as during the heat of summer. When pruning use the best tools you can get and do the best work you can, leaving no stubs an inch or two long, but cutting in all cases close up to the limb of which you remove a portion—all cuts over one inch in diameter should be painted over; any kind of paint will do. The object is to exclude the air and so prevent decay.

FERTILIZING THE ORCHARD.

Possibly less attention has been given to this than to any other matter in connection with citrus culture in South Africa. Whilst it is admitted that there are instances in which individual growers have made careful study of their soil and its requirements, the majority have gone on from year to year without much thought about correct methods of fertilizing the orange grove, giving perhaps a yearly dressing of kraal or stable manure from sheep, goats, oxen, or horses indiscriminately. Possibly also credit has been taken from this "gift" to the land and a sense of satisfaction experienced at having done the "square thing" by the trees. It is unfortunately a fact that

more harm than good is usually done by such slipshod methods of manuring. Looking at the matter from a broad standpoint, one may say that fertilizers of this class should never, or at any rate very rarely, be used in the citrus orchard. Exception is made in favour of the application of absolutely rotten stable or cow manure when applied to trees of mature age standing in some of the heavier soils. In such cases the manure should, for preference, be spread over the land and turned under with the plough just before or during the rainy season so that assimilation with the soil may take place as rapidly as possible. The application of fresh stable manure, largely consisting of undecomposed bedding and reeking with urine, is decidedly injurious to the fruit produced, causing thick coarse skins with that tendency to puffiness which is decidedly objectionable in an orange. Reports to hand from the Government fruit inspectors during recent export seasons go to bear out this statement. Oranges from districts where nothing but such manures have been used have invariably received unfavourable comment at the hands of these officers, their remarks in all cases being strongly condemnatory of the quality of fruit produced under such conditions. In order to arrive at some clear understanding of soil requirements recourse should be had to analysis, and this is provided for by the Agricultural Department chemists.

Soil Ingredients must be Replaced.

This, however, is not the only thing to be studied. The ingredients removed from the soil annually by large crops of fruit must be replaced and no shortage allowed to occur in any particular. Phosphoric acid, lime, potash, and nitrogen are the principal items, and it is therefore these particular constituents which must be returned to the land in order that a good state of fertility be maintained. Citrus soils should be kept "in good heart," meaning that all necessary constituents for crop production must be present in a form readily available for use by the roots of the trees; also that the mechanical condition of the soil should be as nearly perfect as possible. There are pamphlets mostly issued by dealers which would tend to confuse an unpractical grower. For instance, one may advise the use of nitrate of soda, another basic slag, and a third potash in certain forms. Naturally each pamphlet advocates a large application of the particular ingredient the sale of which it is advertising. It is obviously impossible that all of these different formulæ should be correct. It is also true that no exhaustive experimental work has been hitherto undertaken in South Africa which could serve more or less as a guide as to exactly what fertilizers to give to bearing citrus trees, and even had such work been done there would still remain the difficulty of correctly applying the results of the experience gained to an orchard containing a diversity of soils.

In order, however, that some approximately correct idea may be formed, the following suggestions are put forward:—

From an analysis of the ash from 1000 lb. of oranges, made at the University of California, it was shown that the following ingredients were withdrawn from the soil: Potash, 2.11; nitrogen, 1.83; lime, .97; phosphoric acid, .53.

These constituents must, therefore, be returned to the soil without any reference to the analysis first mentioned. It is, of course, possible that an abundant supply of any one item might render further application of this particular ingredient less necessary were it present in available form.

Effects of Potash.

The effect of potash is most readily noticeable in the quality of the fruit, its carrying capacity, sweetness, and a marked thinness of skin. These are all factors in producing a good class of orange. Potash is usually applied in the form of either sulphate or muriate; very occasionally kainit is used. Experience has shown that the sulphate is the most acceptable form in which to apply potash to bearing citrus trees, and a good grade is preferable to a low one. Wood ashes are quite a good source of potash also and should not be allowed to go to waste. Nitrogen may be applied in various ways. Its effect is to produce luxuriant growth of young wood and to increase leaf development. Formerly it was largely applied in the form of sulphate of ammonia and nitrate of soda, the latter being by far the readiest and quickest in its action.

More recently in South Africa organic nitrogen in the form of dried blood has become available from the abattoirs of our large towns, whilst the system of cover cropping with some leguminous crop supplies a large amount of nitrogen to the soil. When this system is resorted to it is unnecessary to apply as much nitrogenous fertilizer in any mixture of a commercial nature which may be used. It may be added that many other results are obtained by the use of cover crops. For instance, a large amount of humus is added to the soil which not only improves it but is useful in assisting in the retention of moisture. Planting a leguminous crop in September or October for ploughing under later also prevents washing away of the soil in orchards which are laid out on a slope. We have also further sources of supply of nitrogen in the guano supplied by the Agricultural Department from the Guano Islands, and also in the fertilizers from the whaling stations to be found round our coasts; the latter supply an exceedingly useful article. Lime need rarely be applied alone to any of the soils on which citrus trees are planted. It enters into the composition of most fertilizers containing phosphoric acid, and is present especially in Thomas's phosphate powder or basic slag in a large percentage. The part played by phosphoric acid in nature's economy in connection with the production of a healthy tree bearing good fruit is an important one. It is found in the fruit, bark, peel, and seeds of the orange, and induces maturity, both of wood and fruit, by its presence. An inadequate supply of phosphoric acid often means late ripening of fruit, and this is more especially the case when a quantity of stable manure has been used.

It is impossible to lay down one formula which will suit all soils, and there may be some who would prefer to purchase their own ingredients in suitable quantities and mix them on the farm. Phosphatic manures most in use in South Africa are superphosphates, bone meal, and basic slag.

The diagram prepared by Dr. Geeken (and revised by Mr. Brunnich, chemist to the Department of Agriculture, Queensland) shows at a glance what fertilizers may be mixed before application with safety and those which may not be mixed owing to the liability of decomposition.

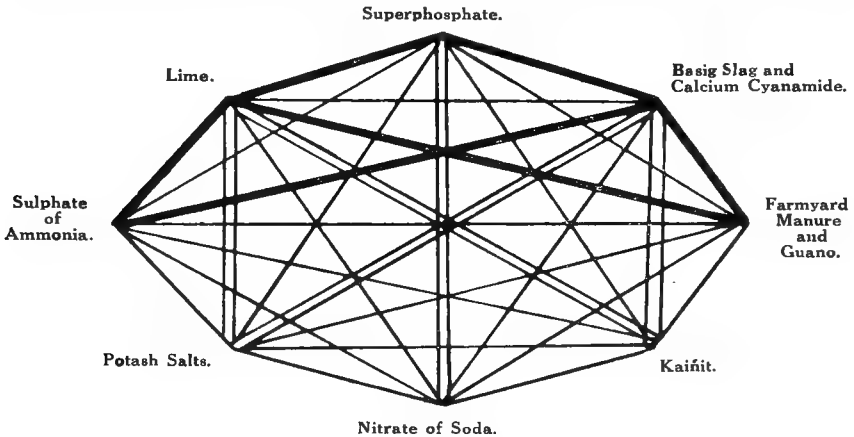
It has been stated that phosphoric acid should form one-half of the total fertilizer supplied, and on that basis one may safely work in our soils, for nine-tenths of them are deficient in that particular

constituent. Approximately equal proportions of potash and nitrogen depending on soil analysis go to make up the other half of a complete fertilizer.

It is during the present war, and it is feared will be for some time to come afterwards, impossible to secure the once ordinary chemical fertilizers to which reference has been made.

Under the circumstances, resort must be had to those substances which are obtainable within South Africa.

Taking phosphatic manures first, one finds the principal supply must be derived from bone meal. It is time, and efforts are being made, to open up other sources from which to obtain phosphates of some kind or other, but the results of these are not yet apparent.



Bone meal, however, is an excellent source of supply, and should answer all our requirements if a sufficient quantity is obtainable. Analysis of locally ground bone meal gives the following:—

Nitrogen	6.216
Phosphoric oxide	11.26
Phosphoric oxide (soluble)	6.91

Such an article should be supplied from the abattoirs of any of our large towns at a moderate price.

Potash is to be found on the Karroo in the form of “burnt kraal manure.” This is obtained by burning out the old sheep and goat kraals which have been present in various parts of that country for ages. The result is a most useful ash which contains 10-12 per cent. potash, besides lime, there is no nitrogen present. Unfortunately the supply is far from being inexhaustible, and, further, the approaching scarcity is attracting the attention of speculators, who buy up whole kraals, grind the ash up fine, perhaps add a little sand, and then sell the material by weight. One should therefore be careful from whom this kraal ash is purchased.

Nitrogen is obtainable from dried blood—also the product of the abattoirs—and this usually contains about 12 per cent. nitrogen. Its use is not advocated to any considerable extent, and certainly not as a source of regular supply of this very important element of plant-food. An occasional application in moderate quantities is, however, frequently of great benefit. Bone meal also contains a certain amount

of nitrogen, and a very useful adjunct to these sources of supply is the use of cover crops of leguminous plants, such as cowpeas, velvet beans, kaffir beans, etc.

Some idea may be gathered as to the quantities to be applied per tree from the following:—

Trees two to four years old, not bearing:—

- 1 lb. Kraal ash.
- 1½ lb. Bone meal.
- 1½ lb. Dried blood.

Trees five to eight years old:—

- 2 lb. Kraal ash.
- 3 lb. Bone meal.
- 1 lb. Dried blood.

And older trees in proportion.

These quantities are supplied as a kind of general guide, and allow for an annual supply of nitrogen by means of leguminous crops ploughed under.

It is hoped that further and more general information will be available on this matter at a later date.

Method of Application.

The method of applying fertilizers to the soil depends upon the age of the trees. If they are young the material may be scattered by hand round the trees from a radius of 18 inches from the stem to 18 inches beyond the outside spread of the branches, and either dug, cultivated, or harrowed under. In the case of old trees whose roots form a regular network and interlace beyond the middles of the rows, it is best to broadcast whatever fertilizer may be used. This may be and usually is done by hand in South Africa or a "spreader" may be employed. If unskilled labour were highly paid possibly one of these implements would be used; as it is, native labour can be depended upon for work of this kind provided a watchful eye is kept on the proceedings. After broadcasting, the manure must be incorporated with the soil as soon as possible; it should be ploughed or cultivated under, and if a rain comes along soon afterwards all the better—if not, irrigation should be resorted to.

Before Spring Rains.

The best period of the year to apply manures is before the spring rains as a rule. If applied during the rains in summer time, as is the practice occasionally, there is a tendency on the part of the trees to go on growing too late in the season; a consequence of this may be the cutting back of tender sappy growths by frost in winter. Roughly speaking, a bearing orchard requires from 600 to 800 lb. of complete fertilizer per acre per annum. The requirements of younger trees are of course much less. In some countries, such as California, where fertilization of orchards is practised to an enormous extent, as much as £15 to £20 per acre per annum is spent on manures.

SELECTION OF TREES FROM NURSERY.

The preceding has been written entirely on the assumption that growers would purchase the trees intended to be set out from nursery-men. There is much to be said in favour of such a practice. The

nurseryman has had a training in his work, and it is his business to know how to produce a tree properly—he is in fact as much of a specialist in his line as the analytical chemist or the diamond cutter, and has in many cases served a long apprenticeship to the business.

It is therefore a matter of common sense that a nurseryman should be able to supply a first-class article in the matter of trees, and it is accordingly presumed that our nurserymen know their business and that growers will approach them for their requirements. At the same time when scores of individuals are rushing into citrus growing, it may be well to indicate what they should require at the hands of the nurseryman.

What is Wanted.

1st. "*Pedigree Stock.*"—One hears of pedigree bulls, rams, horses, and wheat. It is of equal, if not greater, importance that pedigree trees be planted. Trees of good lineage, with good healthy ancestors which bore annually good crops of fine, well-formed fruit.

During the present rush for trees there is a possibility that this point may be overlooked, and mention is specially made of it on that account. Consider for a moment the position of the planter of 1000 orange trees, who after waiting for five or six years finds out that his trees are of a non-bearing strain—even that 20 per cent. of them are not properly productive; the time, labour, and money wasted on them for the whole of that period is lost. The remedy is to work them over to a better strain, but that does not make up for the disappointment and, worse still, loss of income.

It will be seen, therefore, that the future of the citrus industry of South Africa is bound up largely in the integrity of our nurserymen. It is a pleasant fact to record that as far as the writer is aware, and he knows most of the leading nurserymen in South Africa, the trust of the public in these will rarely be misplaced. One point, and a very important one, to keep in mind is that for a good article a fair price must be paid. The usual figures quoted for citrus stock of the best type is £15 per 100 throughout South Africa. That is a lower figure than demanded in California and higher than in Australia. It appears to be based upon the supply of a good article at a fair profit to the grower, and planters are warned that any beating down in price can only result in the supply of an article which will not be quite as good in some one or other particular as the goods usually supplied at the price mentioned.

2nd. *Size and Height.*—No hard and fast rule can be laid down as to the exact size of tree to plant, excepting that those listed as second size should be avoided and very large ones rejected. It is not likely, in view of the present demand, that many very large trees will be offered. A medium size, therefore, would appear to be the most desirable form of tree to secure. Orange trees of from 2 feet 6 inches to 3 feet 6 inches in height, with a clean, straight stem branched out to a head of three or more limbs, represent the most acceptable types for planting. The trunks should be correspondingly strong, not less than $\frac{5}{8}$ of an inch in diameter 6 inches above the bud. Trees with a multiplicity of branches covering the trunk from a few inches above the bud should not receive a moment's consideration.

3rd. *Guarantees* should be procured that all trees purchased are "true to name." This is a safeguard against substitution of one variety for another. As a rule, when a grower orders Washington

Navels he wants that variety of fruit, and would be grievously disappointed if in a few years he found that some other kind of Navel "just as good" had been supplied.

4th. *Roots.*—Most nurserymen in South Africa are in the habit of using the rough lemon as a stock on which to bud. All kinds of oranges and lemons and some naartjes are budded on this stock. In Natal exceptions are made in favour of the sweet seedling orange, whilst in the Midlands of the Cape Province the pampelmoes is frequently used.

Why the Lemon Stock is Selected.

Primarily the lemon root is selected on account of its resistant properties against the disease known as "collar rot," "root rot," or "mal de goma." Secondly, on account of its suitability to different soils, and perhaps, lastly, on account of the fact that it is easier to "work" than any other stock. It may be stated broadly that the lemon stock is perhaps the best general stock to use. This is certainly the case in the dry lightish sandy loams and granitic soils of the Transvaal. As a stock, however, it is not ideal, in that for the first ten years in the life of a tree grown upon it there is a tendency on the part of the fruit borne to inherit a slightly "lemony" taste, also for the skin to be a little coarse and the shape of the fruit to be somewhat elongated. Later on in life the orange trees worked on lemon stock appear to overcome these tendencies, and it is difficult to tell the difference between the fruit grown thereon and that produced on the orange budded on sweet orange roots. During early life, however, these faults do occur, and the ideal citrus stock or root has yet to be found.

The Sweet Orange Root.

Natal growers claim that the sweet orange root suits their conditions best in that it produces fruit of first-class quality from the very beginning and it is less subject to collar rot.

As a rule one may say that different classes of soil, taken in conjunction with climatic conditions, require different roots; for instance, sweet orange or pampelmoes roots are useless in the Transvaal, whilst Natal soils and climates suit them. Deep and somewhat heavy soils carry the latter better than any other, whilst only very occasionally can one find a soil suitable for the "bitter Seville" root; yet this latter is largely used in California and Australia.

Another Stock.

Still another stock is the *Citrus trifoliata*, and this has been experimented with on the Government citrus orchard at Warmbaths. The results are so far satisfactory, but not sufficiently so to justify its recommendation as a stock for general use. There is a marked tendency towards early development, in that trees 30 months from the bud have carried crops of 100 and more fruits. Such phenomenal bearing interferes with the proper growth of the tree, and, consequently, those which have been allowed to bear are somewhat small. Enough has been said to enable the prospective planter to gain a good idea of the right kind of tree to plant.

There is a further piece of advice to be given, and that is if you wish to secure a good lot of trees of any special kind of uniform size

and quality to place your order well in advance of the time the trees are likely to be needed—the demand is and will be so great for some years to come that no nurseryman in South Africa will be able to keep stocks on hand.

A Word of Warning.

Perhaps a word of warning may be needed to those who think that they ought to grow their own trees and save the nurseryman's profit. Twenty years of South African experience has shown the writer many failures in this line and very few successes. It should be remembered that the nurseryman's business is a specialized one, and does not begin and end by putting a bud into the stock—that is one of the easiest parts of the whole. The very word "nursery" indicates that something young which requires nursing is in contemplation. It is the nursing part of the business which usually proves a stumbling block to the amateur. There is a time to give and a time to withhold water—a time to admit and a time to exclude sunlight; some buds to be pinched off and others to be encouraged, and a thousand and one trivial details which the trained man deals with from mere force of habit, but which the amateur does not know anything of until the loss of a batch of trees provides him with the experience.

REMOVAL OF TREES FROM NURSERY.

No matter whether the trees are home-grown or purchased from a nursery, there are certain points worth keeping in view in planting them out in the orchard form. It must first of all be recognized that a young orange tree is an extremely delicate one to handle, and for that reason the least possible delay should take place between the time of its removal from the nursery and being set out in its permanent place in the orchard. Whilst it is true that with careful packing citrus trees will travel long distances and still grow successfully, it is best to make the distance or at any rate the time occupied in the journey as short as possible. All exposure of roots should be avoided, and trees should make the journey with the roots embedded in soil. Balling the tree is a quite satisfactory procedure, i.e. covering the roots and the ball of earth which surrounds them with a piece of sacking, and dispatching each tree done up in that way. This is not usually resorted to in South Africa, but it is common practice to send out six or eight trees temporarily established in wooden boxes, and this answers very well. Some nurserymen do not resort to this method, and claim good results from the practice of taking the trees up in bundles and covering them with ordinary sacking. In some instances the roots are puddled, whilst in others again this precaution is not taken.

THE LEMON.

It is only, comparatively speaking, within a very short period that the European lemon of commerce has been grown in South Africa. When the writer arrived, some twenty years ago, it may be said that the production of this class of lemon was non-existent. The few trees standing were to be found in the Western Province of the Cape and in Natal. Mr. H. E. V. Pickstone, of nursery fame, was, I believe, the introducer in the former, and the late Mr. Wilkinson, of Maritzburg.

in the latter Province. Distribution took place, principally in the Cape, and to-day large and profitable lemon orchards are to be found both in the eastern and western portions of that Province. Later, when the development of the fruit industry assumed larger proportions in the Transvaal, many hundreds of lemon trees were planted there also, and these have thriven remarkably well. Indeed, the European varieties of the lemon, without exception, appear to appreciate their surroundings throughout the whole of the many citrus-growing districts of South Africa, and, without doubt, were there a profitable market for this fruit in Europe, many more plantations would have been set out than is the case at present.

Unfortunately, however, the supply from the islands of the Mediterranean and the littoral of that sea is so plentiful, and the prices which growers there are compelled to accept so low, that for ten months at least out of the twelve they hold a monopoly of the lemon market. Some conception of the magnitude of the lemon-growing industry in Sicily may be gathered when it is stated that in the year 1912 the total production in the island amounted to 240,300 tons, and this was a poor year, for in 1911 it totalled no less than 350,000 tons.

MONTHS WHEN LEMONS ARE SCARCE.

It so happens, however, that the months in which lemons are comparatively scarce in Europe are those during which they are most plentiful here. During July and August, therefore, it should be possible at a later date to export some of our superfluous lemons thither, with some chance of doing profitable business.

In 1913 the import of fruit into South Africa from Italy amounted to £2,187, and this consisted chiefly of lemons sent to arrive during December, January, and February, just those months when we require them most. All these lemons are "cured" before despatch, the curing process rendering the skins thin and tough, and as a rule they arrive in this country in excellent condition. Very little has been done in South Africa in the way of "curing" the lemon, but it is one of those problems which will have to be taken in hand when the time arrives for our export business to begin. Our growers will also have to study the requirements of the European markets, especially in the matter of the size of the fruit sent away.

VERY LARGE FRUIT NOT WANTED.

The demand is for medium-sized fruit—this point cannot be too fully emphasized; none should be exported of greater than $2\frac{3}{4}$ inches in diameter, and none under 2 inches. In order to make this possible, the fruit must be picked when perfectly green and of the correct size, and then stored away or cured until the right colour has developed, when it is in a fit condition to travel oversea.

The "curing" process is, however, worth studying for our own use, in order that South Africa may be able to supply its own markets throughout the whole of the year.

THREE PRINCIPAL POINTS.

Consideration must be given to three principal points, namely, temperature, ventilation, and atmospheric moisture.

It may be said at once that no particularly low temperature is required, and that as the question of cold storage on farms is not possible, it need not be discussed. Some of the cool wine cellars to be found in the Western Province of the Cape are well adapted for the storage of the lemon, the only drawback likely to occur being lack of ventilation; if this could be suitably provided by the installation of electric fans or any other method of circulation of the air, the Western Province producer of lemons would be well situated for the curing of his crop.

The stacking of the boxes of fruit just as they come from the orchard, one on the other, is practically all that would be required; it is, of course, understood that these boxes should be of regulation pattern, and afford opportunities for the air to pass both above and below the fruit. Lemons in boxes, stacked one on the other, without cleats of some kind between, cannot be expected to keep.

The first method in use in the storage of lemons in South Africa was that of placing the fruit in boxes and stratifying with dry, clean sand, i.e. a layer of sand at the bottom of the box and then a layer of fruit, and so on alternately until the box was full. Lemons keep fairly well under these conditions, crude though they are.

The principal objects to be secured in the curing of the lemon are the even colouring, toughening and thinning of the skin so that the fruit will keep and carry any distance in reason. If this can be done, the large lemon crop ripening in July could be held and supplied for use through the summer months when prices are at their best.

METHODS IN CALIFORNIA.

As the bulk of the lemons produced here do not come from the Western Province of the Cape, it may be as well to indicate the methods in use in California, where climatic conditions are somewhat similar as regards temperature, though not in the matter of rainfall. This, in those districts of South Africa which produce lemons, apart from the Western Province, takes place in our summer, when the young fruit is on the trees, whereas in California what rain falls comes during the winter months. It follows, therefore, that we are able to handle the lemon crop during that portion of the year which is most favourable for the purpose—the days are bright, clear, and comparatively cool, and the air crisp and dry—conditions which are admittedly ideal for handling citrus fruits of all kinds, and it may also be said here that they are unequalled in any country in the world.

A LEMON GROWER'S EXPERIENCE.

The following is the experience of Mr. Teague, one of the largest lemon growers in California:—

“Proper ventilation is the keynote of success in keeping lemons, and after extensive and expensive experience along the old lines, Mr. Teague concludes that lemon handlers have been on the wrong track in believing a low temperature first in importance. If the ventilation is right the temperature will take care of itself. He decided that proper conditions for keeping lemons lie just between the points where they wilt and where they sweat, including neither, if possible, for too much moisture induces decay and too little causes shrivelling. The fragment of the stem left on the fruit by the cutter

may be used as a test; if it adheres, the conditions are right for slow curing. If it detaches easily, the best keeping quality is not being secured."

QUESTION OF STOCKS.

Lemons are generally worked on the ordinary rough lemon throughout the different Provinces of the Union.

The bitter Seville orange has also been used to a limited extent in the Cape, and varieties of European lemons have been resorted to in some instances in Natal. The best fruit has been secured from trees budded on bitter Seville roots, but as the range of soils in South Africa on which this root (after working) thrives is only of limited extent, it is evident that the majority of our lemon trees are growing on the roots of the ordinary rough lemon. It is probable that this will continue to be the case, and there appears to be little advantage at present in seeking further—the root is hardy and a vigorous grower, it can put up with more neglect and drought and accommodate itself to more inferior soil conditions than any other.

Another stock which might eventually be of use is the lime. The theory has been advanced in some quarters that the skins of lemons worked on lime roots are of finer texture, smoother, and more glossy than those of lemons grown on rough lemon roots.

From experimental work undertaken at Warmbaths (Transvaal), there would appear to be something in this contention, but sufficient time has not yet elapsed to afford definite data on which to base final conclusions.

Work is going on at the same station with the *Citrus trifoliata* as a lemon stock; here again indications tend to show that as a stock this variety will not be without its uses.

THE BEST SOILS.

The soils on which the lemon thrives best depend largely on the stock upon which it is worked. Lemons on lemon stock like a sandy loam best, and some excellent specimens of trees may be seen all over the Union of South Africa on soils of that description.

On bitter Seville, the writer has seen lemons growing satisfactorily on ground which at certain seasons of the year was almost a swamp. The Seville root must have deep soil if it is to grow to the best advantage, and as it is not subject to "rot" the lemon on this root may be planted in situations where other stocks would not live. It will be seen, therefore, that by the use of different stocks the range of soils on which the lemon will thrive is a fairly wide one, and under these circumstances one can understand how it is that lemons can be, and are, grown successfully from the slopes of the sandstone and granite hills in the Northern Transvaal to the deep alluvial loams on the south coast of the Cape, and from the Natal Littoral to Clanwilliam.

The range of soils and climate in which the citrus family in general, and the lemon in particular, can be produced is perhaps more extensive in South Africa than in any other country.

RANGE OF CLIMATE.

The lemon does not require as high a summer temperature as the orange. On the other hand, the tree will not put up with as much cold in the winter: it is more susceptible to frost than any other

member of the citrus family. Care should, therefore, be used in the selection of suitable sites for planting a grove and extremes of temperature should be avoided. Freedom from frost is, of course, assured in all the citrus growing districts round our coasts, and it may well be that eventually these will be devoted to a far greater extent than at present to the production of this fruit.

THE DIFFERENT VARIETIES.

The number of varieties grown in South Africa to-day is fairly large, and comprises those which have been imported from Europe and America, as well as one or two which have been originated here. The following are listed by different nurserymen:—Messina, Spanish, Villa Franca, Lisbon, Sicily, Belair, Eureka, Imperial, Sweet, Rough or Old Cape, Genoa. From this list a good selection may be made, suitable for planting in any part of the country. It is hard to say which is the best to plant, as much depends on the locality in which they are to be situated. It may be said, however, that the Sweet, Rough, Spanish, and Sicily are not, strictly speaking, commercial varieties. The demand for the two former is practically non-existent when better fruit is to be had. The "Spanish" is out of court on account of its large size, and as to the "Sicily," the word is somewhat vague, it may mean any of the many lemons grown on that island. Of the remainder, Villa Franca, Lisbon, Belair (originated in Natal), Imperial, and Eureka are all good. Villa Franca and Lisbon, perhaps, do best in the warmer parts of the Transvaal, both being vigorous growers, and the former more hardy than any other kind, whilst Eureka is more suitable for culture on the coast on account of its tendency to put on a foliage less dense than most other sorts, and thus exposing the fruit to sunburn in the hotter parts up-country. Lisbon also does well in the coastal districts.

LAYING OUT THE ORCHARD.

The preparation of the land, laying out of the orchard, etc., have already been described under the section dealing with the orange, and the same methods are applicable in the case of the lemon. Distances of planting, however, are not quite the same, and it will be found that the more liberal one is in the matter of space, the more the trees appreciate and repay. Twenty-five feet should be the minimum distance between the trees, and occasionally, in rich soil, thirty feet is not too much to allow. The more space one gives the more moisture the trees obtain and their liability to suffer in times of drought is thus considerably reduced.

IRRIGATION FOR THE LEMON.

Irrigation is as necessary for the lemon as for other citrus fruits. Possibly in coastal districts lemons can be grown successfully on a total water supply of 35-acre inches per annum, rainfall and artificial irrigation included. In some instances the attempt has been made in these districts to grow this fruit without the aid of irrigation; on the whole it is an unwise proceeding if regular and large crops of fruit are desired. Whilst it is admitted that the lemon *can* be grown on the coast with no other water than that which falls in the shape of rain, it is equally certain that with irrigation at the right time, and by that

means only, can results of the most satisfactory nature be achieved. The question of cultivation of the lands is described in the previous notes referring to the orange, and it is, therefore, unnecessary to recapitulate it here, as the needs of the trees in this direction are almost identical.

APPLICATION OF FERTILIZERS.

The lemon removes more potash and lime, about the same quantity of phosphoric acid and rather less nitrogen, from the soil than the orange does. It follows that the application of fertilizers should be made in proportions bearing some reference to these facts. The use of basic slag as a source of phosphoric acid and lime is generally advised. Resort should, on no account, be made to stable or kraal manure at any time, the effect of the use of these is an undue coarsening and roughening of the skin of the fruit, which is most undesirable, as one of the best points of a lemon is its smooth, silky skin. It should also be borne in mind that in some of the hotter valleys in the interior there is already a marked tendency to the production of coarse fruit, and the addition to the soil of any ingredient likely to accentuate this most undesirable feature should be avoided.

Use of Legumes.

The use of leguminous cover crops is advised as long as they can be grown between the trees; these supply humus and nitrogen, and are altogether desirable from every point of view. Perhaps the best are velvet beans, cow-peas, ordinary Kaffir beans, or, where they can be grown, vetches. They should be sown either broadcast or drilled in. About 70 lb. of velvet beans or cow-peas, or 30 lb. of Kaffir beans, should give a good crop, and this should be turned under with the plough just as the blossoms appear—it is better to be a little early than late.

THE POOR MAN'S FRIEND.

Pruning.—The lemon tree has been called the "Poor Man's Friend," because it is possible to pick, at any rate, a few fruits for sale at almost any period of the year, and thus there is always a little money coming in. Although this is perfectly true, the bulk of the crop ripens during the winter, and from May to August are the months during which it is gathered. If the trees are left unpruned, as is too frequently the case, there are several ways in which both fruit and tree are liable to be exposed to injury, and consequently the owner thereof to loss.

As is well known, many varieties of lemons, especially Villa Franca, have the habit of putting on fruit at the very tips of the branches, which naturally sag downwards as the fruit gets heavier and heavier, causing the tree to have a sagged opened-out appearance. One effect of this is that the fruit is exposed to the hot sun from the time it has set until it is harvested. It is thus subject to the danger of sun-scald, and this is manifested in the discoloration of the exposed side of the fruit to a dark brown colour, rendering it unsaleable. In addition, the straggling branches of an untrimmed lemon tree are easily blown about by high winds, this means they are often broken, the fruit falls off or gets knocked about and bruised, and this is another source of loss.

A LESSON IN PRUNING.

When in the lemon districts of California in 1911 the writer had the opportunity of seeing how the growers there kept their trees trimmed, and was at once struck by the healthy appearance and density of the foliage. It was difficult, on many trees, to notice a single lemon at the first glance, but on opening the branches the fruit was there in plenty—growing practically in the shade. There was no opportunity for it to get sunburned or to suffer from being thrashed about by the wind, and any method of pruning which will obtain those results is better than none. The trees were not allowed to grow high, but a widespreading low tree seemed to be aimed at. This appears a rational form of tree, and might be advantageously adopted in South Africa. It is secured by preventing long upright growth and encouraging laterals, and can only be maintained by regular annual pruning, much like that which deciduous trees are subjected to.

THE NAARTJE.

Under this heading are classed all kinds of Mandarins and Tangerines. Though it is a somewhat convenient word it does not at once convey to the reader an exact meaning with regard to any particular fruit. It may, for instance, refer to what is known as the "Natal Naartje" or the Cape "Platskil Naartje," fruits of great excellence, or it may allude to either the Bombay Naartje or the Emperor Mandarin, both of a different shape, size, and quality to those just mentioned.

THE TYPE FOR EXPORT.

For export purposes, however, with which this book chiefly deals, the latter types may be omitted as they are not regarded as being suitable. The naartje for export must be of good red colour, the deeper the better, firm flesh, with a tight-fitting, smooth skin. This class of fruit finds a fairly ready sale at not unprofitable prices; indeed occasionally, and especially in the very earliest part of the season, high prices are realized in England.

The demand for the naartje oversea does not equal that for the orange. This is due to one or two causes, principally because the European public, which our fruit reaches at present, is not accustomed to it, and to a lesser extent owing to the habit we have dropped into of sending away naartjes in small layer boxes. Whilst admitting that this practice is sound when applied to extra choice specimens it is considered that if naartjes were exported in bulk the demand would be likely to increase.

The expense of handling all kinds of fruit is far less when packing in bulk than in single layer boxes, the naartje can be dealt with in this way and the adoption of the "half strap" naartje box as an export package is recommended for trial, if only in an experimental way.

With a more widely distributed supply the demand may be regarded as certain to increase; indeed, in the fruit business generally the supply creates the demand, provided that the fruit is placed before the public in a tasteful and appetizing manner.

THE KID GLOVE ORANGE.

Both Mandarin and Tangerines in America rejoice in the appellation of "The Kid Glove Orange," owing to the fact that it is possible for a lady to eat these fruits with a new pair of gloves on and not soil them.

The arrangement of the different sections lends itself to assist the most fastidious in the delicate manipulation of the fruit—each is perfect in itself, easily detachable and perfectly dry, yet the skin film which contains the juice sacs is of the thinnest, and "rag" which is present to a greater or lesser extent in all oranges is practically unknown. In addition, the flavour of a really well-grown "naartje" is inimitable, the absence of any superabundance of acid renders it acceptable, even when in a half ripe condition, and it is difficult to believe that, when this fruit becomes better known, the demand will not increase a thousandfold.

In discussing the naartje, it is not proposed to do more than touch on some points whereon the treatment of the tree in matters of growth and cultivation differs somewhat from that dealt with when speaking of the orange.

SOILS AND STOCKS.

Both trees belong to the same family, and have similar likes and dislikes in regard to climate, irrigation facilities, cultivation methods, etc. The question of soil, however, is one which can only be approached from the point of view of its suitability to the root upon which the naartje is growing; this brings us to the question of stocks for the naartje, and it is an extremely wide one in South Africa. On its own root the tree puts on a vigorous upright growth, not unlike that of a seedling orange, produces fruit typical of the variety to which it is budded, and is, generally speaking, healthy and long-lived. The naartje on its own root, either budded or grown from seed, rejoices in a deep rich loam, capable of absorbing, and moderately retentive of, moisture, yet not sufficiently heavy in texture to prevent good drainage. The deeper the soil the longer-lived the tree should be.

Budded on Sweet Orange.

Budded on sweet orange, the fruit produced is equally as good as that borne on trees on naartje stock; on account, however, of its tendency to disease the sweet orange is not extensively used, is not a favourite with nurserymen, generally, perhaps, on account of a little difficulty in "working," yet there are circumstances and conditions under which it would be well to consider the use of this stock. Such, in any case, would be of infrequent occurrence and limited to those sites for a citrus grove which may be termed "ideal." On rough lemon the naartje puts on a vigorous growth, scarcely as upright as when found on its own root, the tree is hardier perhaps than when worked on either of the stocks already mentioned and can be grown on a wider range of soils. The use of the lemon as a graft carrier enables the naartje to be cultivated with success on light, sandy loams and on silicious red ones, and greatly extends the area over which the fruit may be grown. It cannot, however, be said that the fruit produced on trees worked on rough lemon is as good as that found on either of the stocks mentioned.

When Worked on Lemon.

As is the case with oranges worked on lemon, so with the naartje one may find a coarsening of the skin, a tendency to puffiness and a slight "lemony" flavour. All these points are objectionable and do not tend to perfection of fruit. With age, however, these features are modified, though perhaps not entirely eliminated. The writer has been informed by one of the oldest citrus growers in the Western Province of the Cape that he could tell from the taste of the fruit from a 50-year-old naartje tree whether it was worked on lemon root or not. Possibly the sense of taste is more fully developed in some individuals than in others.

On Shaddock.

The behaviour of the naartje when budded on the root of the shaddock is somewhat peculiar. In some instances no apparent difference can be observed between the fruit produced on such a tree and that borne on the parent stem. In other cases the fruit develops in size enormously, becomes unnaturally large, and does not improve in flavour. Owing, perhaps, to the unreliability of this stock the shaddock is rarely used as a root for the naartje.

Citrus Trifoliata.

This stock has not been thoroughly tested in South Africa as a graft carrier of any kind of citrus fruit. Experiments are, however, in course of progress at the Warmbaths (Transvaal) Experimental Station, and the results as far as they have been reached seem to indicate that its use in certain districts and climates will be beneficial in the extreme. With regard to the naartje worked on *Trifoliata*, it may be said that the fruit produced is apparently equal in flavour to that grown on naartje trees, either as seedlings or grafts, whilst for texture of flesh and fineness of skin it is superior. Little tendency to dwarfing has so far appeared. This is, in other countries, a common complaint, and it is singular in the course of the experimental work referred to that in all cases the root appears to be a more vigorous grower than the graft it carries, which is shown by the fact that at the junction of the bud and the stock the latter is invariably 25 per cent., and in many cases 50 per cent., greater in circumference than the former.

Additional good qualities are that it is practically resistant to root disease of all kinds and extremely hardy.

As a Stock for Satsuma Mandarin.

In America it is used somewhat extensively as a stock for the Satsuma Mandarin, and it is claimed that the stock confers frost-resistant qualities on the fruit borne, thus extending the range within some degrees north of what was previously recognized as the limit. However, it is not necessary to make use of it in South Africa for that purpose. Our limits here are not defined as much by latitude as by the supply of irrigation water. It will be recognized, therefore, that the possibilities of beneficial use of the *Trifoliata* as a stock for the naartje are well worth exploiting; and this has especial reference to the coastal districts of Natal where an ideal stock does not at present exist.

SITES AND CLIMATE.

Sites for a naartje orchard must be chosen with regard to the same requirements as those of the orange. Similar remarks apply as to

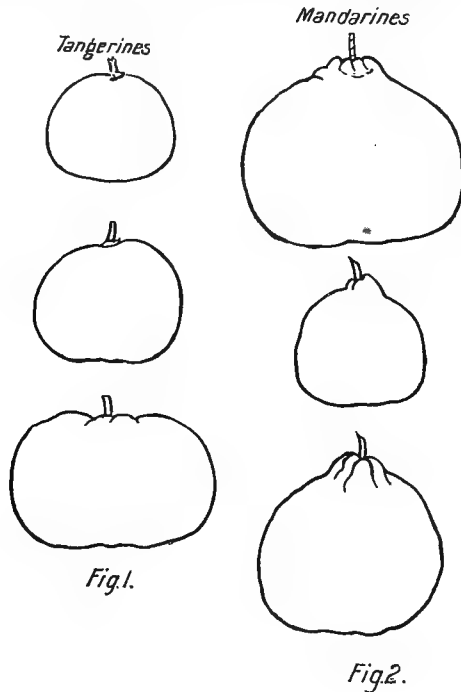
climate, with perhaps a reservation in favour of the naartje that, being a tree of hardier constitution naturally, it can put up with a degree or two less of temperature.

VARIETIES FOR PLANTING.

Varieties for planting should be chosen with care. There are so many inferior types of this fruit to be found in South Africa that when a really good article appears on the market it commands a price of its own, frequently over 100 per cent. more than is said for the ordinary article. Perhaps the best of all, both for local and export trade, is the "Natal" naartje, with the old Cape "Platskil" a good second. Both these fruits possess the necessary qualifications of good "carriers," good solid flesh, with plenty of juice, contained in a tight-fitting skin of rich red colour.

Of imported varieties, "Beauty of Glen Retreat" and "Dancy's Tangerine" take pride of place, whilst puffy fruits of the Bombay and "Emperor" type had better be left severely alone. Selections for planting should be made from the first-named—they have the dual advantage of being the best and most suitable, not only for export, but also for local business. The preparation of the land and laying out of the orchards are precisely the same as for the orange. It is, however, permissible to plant seedling naartje trees of good type as opposed to the seedling orange, which should never be planted.

Pruning and irrigation methods are also identical with those in use for the latter fruit. Below are shown diagrams which convey to the reader the general idea of how the fruit we term the naartje can be divided into its proper classes, "The Mandarin" and the Tangerine, the shape of the latter is what the export trade demands:—



There is little inquiry for fruit of the Mandarin type in the oversea markets; apparently the public fails to recognize that it differs from a small orange.

THE POMELO OR "GRAPE FRUIT."

There are but few "Grape Fruit" trees in the whole of South Africa, and those which we have do not appear to appreciate their surroundings as do the other kinds of citrus fruits which have been discussed previously. The fruit has neither the size, flavour, nor appearance which the same varieties possess when grown in the western hemisphere in Jamaica and Florida. These two countries at present produce the choicer grape fruits; they command the markets of New York and London, and so far their position has been unassailable. California, which is the premier citrus producing State in America, cannot grow this fruit to equal the Floridan article, and what is more, is not now making any very strenuous effort to do so, being content to develop to the utmost those lines in which she excels. This is sound business procedure.

WHERE THE GRAPE FRUIT FLOURISHES.

Bearing in mind the surroundings in which the grape fruit flourishes best, it is only natural to assume if, in South Africa we can find something similar in the way of climate, soil, and altitude, together with proximity to ocean influences to that which exists in Florida, that in such localities we should be able to produce this fruit to the best advantage. Whether or not we shall be able to equal the product of the countries already mentioned remains to be seen. Such conditions as exist there are more nearly to be found in the coastal districts of Natal and the south-eastern portion of the Cape Province than in any other part of the Union.

NECESSITY FOR EXPERIMENTAL WORK.

Very few trees indeed of any variety of pomelo are to be found in those districts, and it is necessary that prompt experimental work be undertaken in order to find out whether it is not possible for South Africa to make just as great a success with the grape fruit as she has done with other members of the citrus family. A beginning has been made in Natal at the Experimental Station of the Cedara School of Agriculture at Winkelspruit, and the work is also being carried out with the same object in view at Komgha, in the Cape, by Messrs. Flanagan Brothers.

Before proceeding to discuss cultural methods, it may be as well to state a few particulars with regard to this fruit, of which so little is known in this country.

WHAT IS THE POMELO?

The Pomelo is a kind of extra fine Shaddock and is as superior to that member of the citrus family as a Washington Navel is to a very common thick-skinned seedling orange. It does not attain the same great size as the Shaddock, and is without its coarseness, but contains

the same bitter principle in its juice and flesh, and there is a similarity of flavour. The skin is thinner, finer in texture and has a silky feel and glossy appearance, which is not found in the larger fruit.

Botanically, both Shaddock and Pomelo belong to the same family; from a horticultural point of view there are many differences. The most important is that the Shaddock being of little if any value, its culture is not worth wasting time and money over, whilst the growth of the pomelo is of considerable profit, and the improvement of its varieties well worthy of all the time and attention which may be spent on them. The name "Grape Fruit" has been given to it on account of the habit of the fruit being to grow together in clusters, not unlike a bunch of grapes. Recent developments have, however, resulted in the introduction of varieties which have the habit of bearing one fruit only on a stem. Pink flesh pomelos are also to be had, although so far one cannot say what success this type is likely to meet with commercially.

POPULAR IN THE UNITED STATES.

The fruit is extremely popular and in great demand in the United States, where it is looked upon as a breakfast necessity, not only on account of its appeal to the palate, but also because of its medicinal qualities. Its popularity has also spread to England, and the demand for the right type of grape fruit there is good and prices paid are such as to make its growth profitable. Travellers on the steamer lines between England and South Africa are now accustomed to look for it daily at breakfast, and although it will never have the same universal distribution and sale as the orange and lemon, it may safely be said that, provided we can supply the right type of fruit, our South African growers would be justified in planting out a good many thousands of trees.

STOCKS FOR GRAPE FRUIT.

As is the case with other members of the citrus family, there are a number of stocks on which the grape fruit can be successfully worked. On the sandy loams of the Transvaal, deep, not particularly rich in some cases, and occasionally in recent years with a shortage of water, it has been found that the rough lemon makes the most acceptable stock. This is also the case on the red loams, but in soils of a moister and heavier nature the same remarks do not apply. Ordinary sweet orange seedlings should make suitable stocks for some parts of Natal where the lemon does not succeed as well. In those parts of the Union where pampelmoes succeeds as a stock—principally in the midlands of the Cape—that particular one is marked out as the best on which to work the grape fruit; there are also instances of successful growth on its own roots. As the coastal districts must, of necessity, prove to be the headquarters for the development of the pomelo, experiments embracing its working on the following stocks would not be out of place:—

Sweet orange.
Sour orange.
Pomelo.
Shaddock.

THE QUESTION OF CLIMATE.

The principal object to study, apart from what has already been mentioned, is that the grape fruit must have a site which confers immunity from frost. Whilst the tree will put up with a few degrees and give no immediate evidence of suffering, it is a well-recognized fact that it fruits more regularly and consistently, and gives better fruit where there is no possibility of its being subjected to any frost at all. In fact, it can be regarded as the one tree of the citrus type which does better under almost tropical conditions than any other, and the moister these conditions are the more they are appreciated.

VARIETIES IN SOUTH AFRICA.

The following varieties are to be obtained in South Africa: "Marsh's Seedless," "Royal" and "Triumph," in addition "Aurantium" and "Duncan" are to be found, but are not stocked, as far as the writer is aware, by any nurseryman. Amongst the above are some which in Florida are quite satisfactory and have proved acceptable in the world's markets. It cannot be said, however, that either of them is exactly the fruit we are looking for to build up our export trade in this line, and it remains for some variety either to be introduced or originated which will prove equal to our requirements. New varieties are being produced at the Citrus Experiment Station at Warmbaths; but before anything definite can be stated as to their suitability for our needs they will have to be tested at some point along the coast, because the conclusion has been arrived at that none are likely to succeed as well inland as in more congenial surroundings.

IRRIGATION AND CULTIVATION.

There is no need to further describe approved methods, as they are practically the same as those in use for the orange. The distance apart at which the trees should be planted should not be less than 25 feet, and 30 feet is even better.

PRUNING THE TREE.

Owing to the extreme toughness of the wood, the branches of the tree seldom break. When one considers the weight of a cluster of half a dozen grape fruits, and observes that frequently the bunches occur at the end of a branch, it is at once evident that a great strain is made on the limb holding them. One of the objects, therefore, in pruning the tree is to prevent long and straggling branches and to render it as compact as possible. Judicious thinning-out is also necessary, not only to ensure the free access of light and air, but also in order that any sprays used may be able to easily penetrate to the interior of that tree.

During 1914 a few hundred cases of grape fruit were shipped to England. The prices realized have proven quite satisfactory, as much as 30s. having been paid per standard box. The varieties sent have been principally "Triumph" and "Marsh's Seedless," and these have done better as to price than in previous years. This may be due to the fact that the Jamaica supply was a little later, and, possibly, somewhat scarcer than usual.

EXPORT OF CITRUS FRUITS.

Previous bulletins on this subject have been issued in 1913 and 1915. The supply of the latest has been exhausted and it becomes necessary to issue a new one.

Perhaps the present period, when no export is possible, is not entirely an inopportune one in which to pass briefly in review the outstanding features of the industry since its inception in 1907 until its temporary eclipse in 1916.

The number of boxes exported the first year came to a little over 3000, and advanced steadily; high-water mark was reached in 1913 and 70,000 boxes were sent away; then owing to war conditions the business fell to a total of 56,000 odd boxes in 1916, since when we have been compelled to consume all of our product in South Africa. It must be admitted that after the first year of experimental work, when railway and shipping rates were prohibitive, very considerable assistance has been rendered to the grower by the action of the Government. Firstly, by arranging a flat railway rate for export of citrus fruit from any station to any port in the Union, and, secondly, by inducing the Union-Castle Steamship Company to provide cool chamber space at a particularly low rate. The rail rate of 15s. per ton of 2000 lb. and the ship's rate of 25s. per ton cubic in cool chamber are both, as far as the writer is aware, lower than in any other citrus exporting country.

In 1914 a Fruit Export Act was passed which did much to regulate citrus as well as deciduous fruit export. Standard sizes of boxes were introduced and their use made compulsory, and by the same law it was laid down that no fruit would be permitted to be exported unless it had been previously inspected and passed by a competent official. The benefit to the industry of this law has been great and will be incalculable. It has compelled the grading of fruits for size all over the Union; it has standardized packs and given a certain guarantee of quality; it has made it possible by the use of standard sizes of boxes for any grower to know at once the market price of his fruit as cabled from oversea. Previously, boxes of many different sizes were used, and as a consequence no one knew the market price of oranges from the day's cables. Regulations have been made in consultation with growers and exporters, and, on the whole, it may be said that without this Act the outlook for the fruit industry in South Africa would be far less bright. Annual meetings have taken place between the growers and officials of the Agricultural Department, and all matters in connection with fruit export discussed fully and freely, with the result that mutual confidence has been established and a general good feeling prevails. Some little differences arose in the early stages with regard to the adoption of the different sizes of boxes as standards, but those have all been satisfactorily settled.

Regulations under the Act as they stand to-day are as follows:—

FRUIT EXPORT ACT, 1914.

Under this Act the inspection of all fruit exported oversea by an officer appointed by the Government became compulsory, and regulations were framed in consultation with leading exporters and members

of the Agricultural Department, which have as their object the general improvement of our export fruit business.

The following extract from these regulations is inserted to show just what is required of exporters and the procedure necessary to ensure the prompt inspection and dispatch of fruit:—

1. Every person who intends to export fruit from the Union to a place outside the limits of the Union, but not declared by Proclamation No. 143 of 1914 to be an exempted place, shall give notice of such intention to the Government Fruit Inspector at Capetown, Mossel Bay, Port Elizabeth, East London, or Durban (as the case may be), in the following form:—

Address.....

Date.....

I/We hereby give notice that I/we intend to export through the port of.....commencing on or about the.....day of.....next.

My/Our boxes of fruit will bear the following distinctive mark, namely:.....

Signature.....

2. The name, address, and distinctive mark of the applicant shall be registered by the inspector, by whom the applicant shall be informed of such registration.

3. For each consignment of fruit examined by the inspector the exporter shall pay at the rate of 1s. 4d. per 40 cubic feet on all boxes going 25 or less to the ton, and 2s. on all boxes going over 25 to the ton.

4. The exporter shall make his own arrangements for the disposal of his fruit oversea.

5. Citrus fruits shall be packed in boxes, the size of which shall be:—

Oranges: 26 × 12 × 12 inches, or 26 × 12 inches (depth optional) for single-layer boxes only.

Naartjes: 18 × 12 inches, depth optional, and 24 × 12 × 6 inches for half-boxes.

All fruit boxes shall be cleated on the top.

6. Every box of fruit submitted for inspection shall be clearly marked on one end thereof with

(a) the registered mark of the exporter (or his name or other means of identification);

- (b) the variety and the kind of fruit, the grade thereof, and the exact number of fruits contained in the box;
- (c) in the case of loose-skin or green-skin naartjes, the word "loose-skin" or "green-skin," as the case may be;
- (d) in the case of oranges the consignee's brand on the top and also on one end of the box.

7. Every box of fruit submitted for inspection must be consigned to the Dock Goods Superintendent, Capetown; the Goods Agent, Mossel Bay; the Port Goods Manager, Port Elizabeth; the Port Goods Superintendent, East London; or the Port Manager, Durban, direct or to him through an agent, and bear on the top of the box the shipping mark of the agent appointed by the exporter to dispose of his fruit oversea.

8. (a) Each orange, naartje, or any other kind of citrus fruit shall be wrapped in or surrounded by tissue or other more or less similar paper.

(b) All fruit, excluding apples and citrus fruits, may be placed in wood wool or cork dust (in the case of Almeria grapes only) or other material considered by the Department of Agriculture to be suitable for packing

9. All fruit shall be in sound condition, fully developed, not too unripe, free from disease, bruises, cuts, or from other blemishes affecting its appearance and be of the characteristic shape of its variety.

10. All fruit in one box shall be of uniform size and of one variety, except fruit consigned to private order, in which latter case the box shall be marked on the end thereof "private order."

11. All fruit, other than citrus and pine fruits, and other than fruit intended to be shipped in ventilated hold, shall, forty-eight hours previous to shipment, be in a cold store approved by the Department of Agriculture, and in the case of fruit placed in a private cold store, so approved, the exporter or his agent shall produce to the inspector a certificate to that effect signed by a person approved by the said Department for the purpose.

Citrus and pine fruits shall be delivered for inspection not less than twenty-eight hours prior to the sailing of the vessel by which the exporter intends such fruit to be shipped.

12. The following shall be the grades for the fruits mentioned:—

Oranges shall be packed so as to contain in the box of 26 × 12 × 12 inches (outside measurements) standard packs of 80, 96, 112, 126, 150, 176, 200, 216, 252, 288 oranges, as the case may be, or such additional standard packs as may be prescribed by notice in the *Gazette*.

Naartjes (Grades)—

Extra selected: Not less than 2½ inches in diameter.

Selected: Not less than 1½ inch in diameter.

Graded: Less than 1½ inch in diameter.

The receptacles of loose-skin and green-skin naartjes shall be marked "graded" and shall not be marked by any other grade term.

13. The Boards of Reference to which an exporter may appeal if the inspector refuse to brand or stamp any box of fruit belonging to such exporter are:—

In Capetown: Messrs. Maynard Nash and A. A. Persse.

In Mossel Bay: Messrs. J. C. Goldsbury, H. Kitching, and F. Dickinson.

In Fort Elizabeth: Messrs. J. W. Whitehead, A. Baldie, and C. H. Mackay.

In East London: Messrs. David Rees and C. P. Perks.

In Durban: Messrs. F. L. White and W. R. Hansen.

14. A fee of 10s. shall be deposited by the consignor with the inspector in respect of each consignment of fruit which the consignor may require the inspector to obtain the decision of the Board of Reference upon under the provision of section *five* of the Act.

15. The consignor shall, within seven days of the date of the inspector's notice, remove from the place of inspection any fruit which the inspector has refused to brand or stamp, or which, having been referred to the Board of Reference, has been decided upon by the Board in favour of the inspector.

16. Boxes of fruit marked so as to represent a grade higher than the correct grade shall be re-marked by the inspector, and, if otherwise complying with these regulations, branded or stamped by the inspector as provided in section *four* of the Act.

17. In case any variety of fruit not specified in Regulation No. 12 be offered for inspection, it will, if otherwise complying with these regulations, be branded or stamped by the inspector as provided in section *four* of the Act.

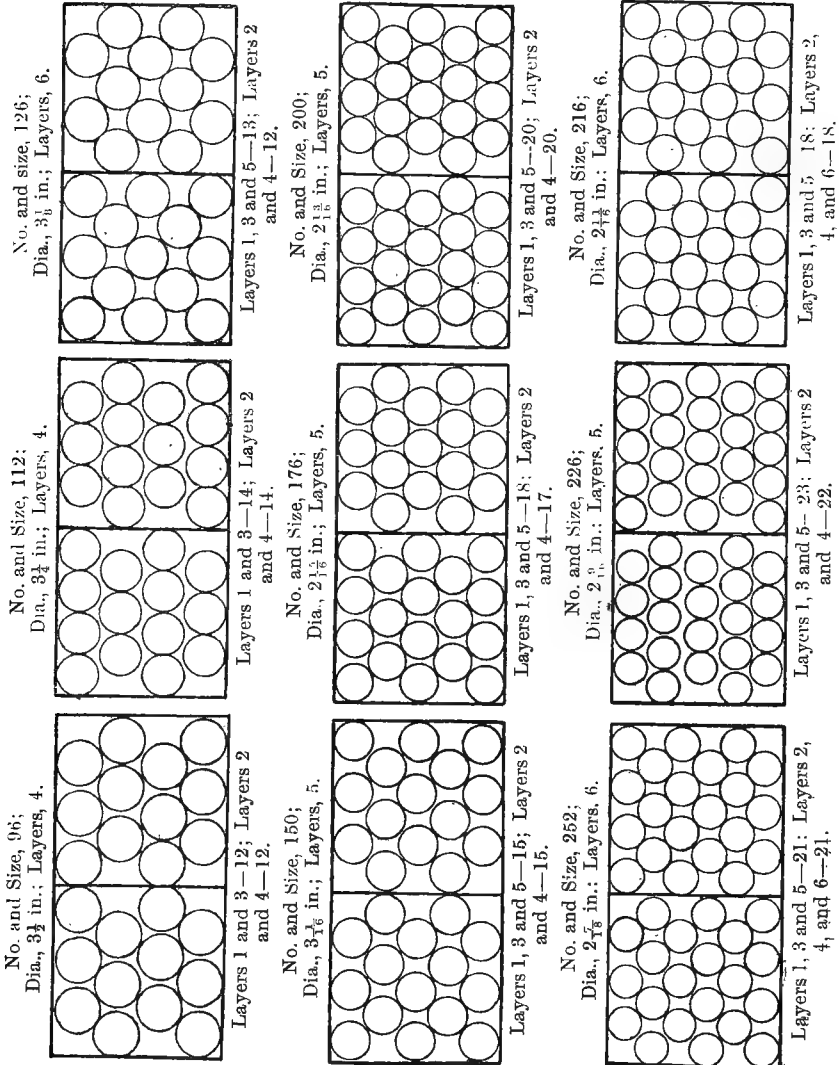
18. Not less than 5 per cent. of the boxes of fruit in each consignment shall be opened by the inspector for examination, and all boxes so opened shall be stamped by the inspector to that effect.

19. Only new and clean boxes or packages shall be used by exporters, except in the case of melons.

It may be noticed that some slight difference exists between the size of the standard orange box in these regulations and those previously issued in the 1915 bulletin; also that an alteration has been made in the sizes of the orange packs and an addition made in the inclusion of the 288-pack. The latter change is due to a demand in England for smaller oranges, and as there are plenty of them in South Africa there is no reason why they should not be exported. It was considered well to delete the 226-pack entirely as being too near the 216 in size, a difference of just 10 oranges in a box, so now the small sizes are 216, 252, and 288. It is not by any means impossible that a demand for still smaller sizes will arise, and when that time comes the necessary diagrams for packing purposes will be supplied by this Department. Another reason for the very slight alteration is that as the citrus industry develops, we shall, at any rate for a time, import most of our machinery, such as box-makers, graders, and presses from oversea, and as California is headquarters for these goods it is reasonable to suppose that the bulk will come from that State. Naturally, if our sizes with regard to boxes and grades are identical with those in use in California, no trouble at all will arise in having to adapt them to our use, but if we had retained the original standards there would be some difficulty in using this machinery, and alterations

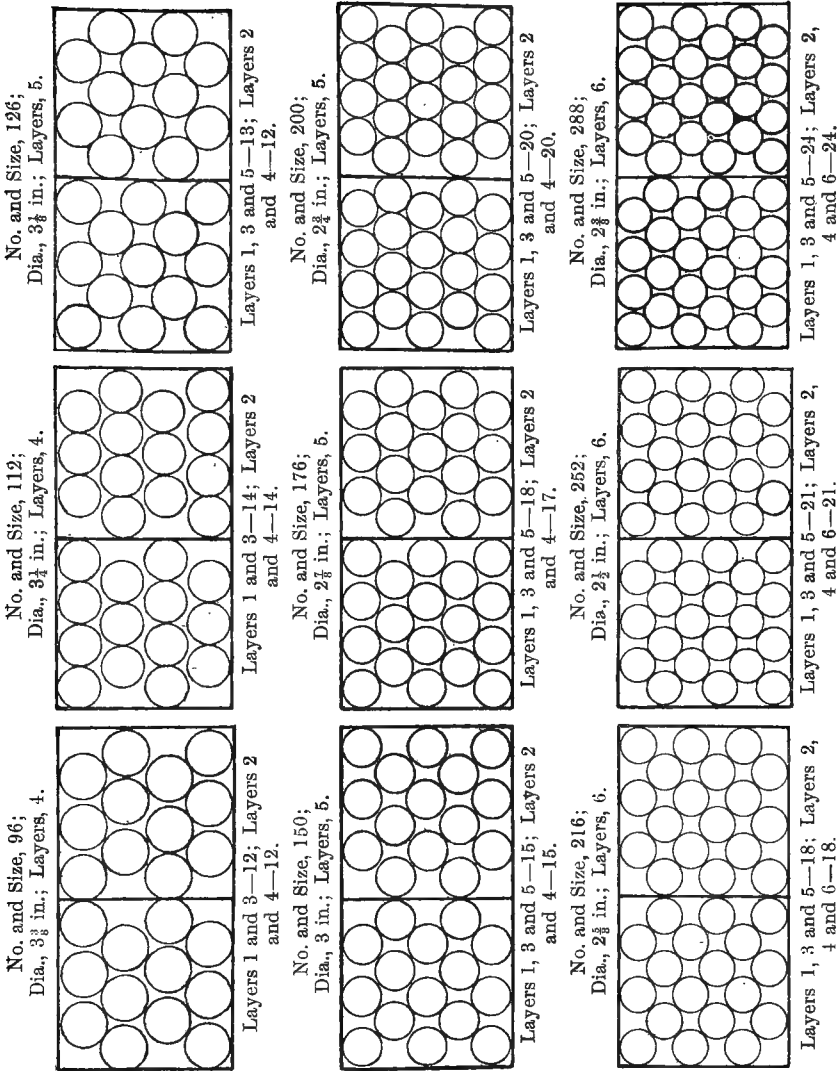
would be necessary and perhaps costly. Still another reason for the change is it may possibly happen in the future that boxes may be purchased in California at a less cost than elsewhere if, for instance, large stocks were left on hand in that State at the end of the season it might be possible to secure them at a reasonable price, whilst such would not be the case had these boxes to be specially cut. Add to these reasons already given that fact that nearly 8 per cent. more boxes of oranges are packed in the latter sizing than the former, and that oranges are invariably sold by the box, it follows that exporters will get just that amount more for their fruit than formerly—and this, I think, makes the case for the change a good one. In order to make the alterations clear, two sets of diagrams are given.

OLD PACKS.



SHOWING METHOD OF PACKING ORANGES.

NEW PACKS.



SHOWING METHOD OF PACKING ORANGES.

Shooks for making the above size of box measure:

Tops, bottoms, and sides: 8 pieces, $26 \times 5\frac{1}{2} \times \frac{1}{4}$ inch.

Middle and ends: $11\frac{1}{2} \times 11\frac{1}{2} \times 11$ -16th inch.

Cleats: $11 \times \frac{3}{8} \times \frac{3}{8}$ inch.

The box, when complete, measuring $26 \times 12 \times 12$ inches outside as against $26 \times 12\frac{1}{2} \times 12\frac{1}{2}$ inches. All boxes used for export should be strapped at each end with thin iron strapping, and this may be also used round the middle of the box, but, in this instance, must not be put on so tightly as to interfere with the "bulge," which should be present on every box.

Orange boxes should be made of clear, white pine-wood, for preference, but when export is resumed it is extremely unlikely that any such wood will be obtainable. There are certain woods in the Union which may be used and some of them make a box which is by no means unrepresentable. The question of box-making for fruit export has, in fact, been taken up by two or three firms who are giving the matter a good deal of attention, and it should be possible to obtain a box which would be suitable for the purpose even if it is not exactly as we would like to have it.

In order to make the package as attractive as possible, a prettily coloured label should be pasted on the end of each box bearing the "brand" or mark of the shipper, and also the number, variety, and kind of fruit contained therein. The shipping mark of the agent to whom the boxes are consigned oversea should appear in letters not less than one inch in depth on the top and other end of the box; these are easily and quickly put on by means of a stencil plate and may take the form of a triangle, square, or circle, thus:—



The labels referred to may be purchased from most prominent printing firms in the country; some of them already in use are most artistic, and tend by their presence to greatly improve the general appearance of the boxes.

We have an inexhaustible field on which to draw for subjects fit for illustration, what with animals, birds, and natural features of the country, and use has already been made of some of these. One sees the "Silver Leaf," "Star," "Ostrich," "Dragon," and numerous other brands.

Practically all the Californian, Floridan, and Jamaican growers have adopted some pretty or striking label of this kind. They have in fact set the fashion, and it is up to the growers and exporters of this country to go one better and place South African oranges on the markets of the world in packages as well made, solid, and attractive as those from any other country—all this decorative work, of course, costs money, but it is repaid over and over again in the enhanced prices obtained for good fruit in a good package.

EXPORT SEASON.

This starts at the end of April from Natal and has, so far, finished in October, fruit from the Eastern Province of the Cape being the latest we have hitherto had.

Early consignments frequently have brought good prices, second early not quite as good on account of competition with locally grown berry fruits. As a rule, regular weekly shipments arriving in England from July onwards have paid best. A good deal depends on the weather; if a very hot September is experienced the demand for citrus fruits is good and prices correspondingly so, and this remark applies to any other month. There appears to be every reason why the export

season should in the future be extended well into November and later, so that Europe may be able to get some of our nice sweet Valencia Lates and Du Rois for consumption at Christmastide instead of the sour unripe produce of Spain which usually appears on the markets of Northern Europe about the end of November. Prices for such fruit as we can send at that period of the year should be satisfactory.

WHAT TO EXPORT.

The orange which has fetched the highest prices consistently at the Covent Garden Market is the Washington Navel. Packed in single-layer boxes tastefully gotten up, arriving in good order, as much as 6s. per dozen has been realized for extra fine specimens. Others, in similar packs, reached 3s. 6d. and 4s. 6d. per dozen. Packed in standard boxes, this fruit sold at from 12s. 6d. to 28s. per case. During the war, in 1914 and 1915, prices were much higher. These were "war prices" and therefore exceptional.

Good seedling oranges have also fetched fair and reasonable and, occasionally, high prices. Each orange district naturally considers the fruit grown in that district the best, so it is useless to make any pronouncement as to what particular one sends the best fruit. In all cases, however, it has been found that a nice round smooth-skinned fruit, well coloured, is preferred to an oblong or egg-shaped coarse-skinned article, so that, when deciding on what fruit to export, the above facts should be borne in mind.

Besides the above, very few named varieties of oranges have been shipped. There is little doubt but that some of the kinds which are favourites in other countries would also be profitable for export from South Africa. Jaffa and St. Michaels are well liked on the English market, whilst export of Mediterranean Sweet, Joppa, Valencia Late, and Du Roi have proved profitable. There is also a demand for blood oranges at good prices. Grape fruits, or "Pomelos," are in demand and sell at from 15s. to 30s. per box of 36 to 80. This fruit is worth attention, especially in our coastal districts.

Naartjes in England have so far met with only moderate demand. There are certain varieties which appear to be more appreciated than others, and these are the "Natal" and "Old Cape." Both are of attractive appearance and carry well. They are of the "Tangierine" type, flattish, as opposed to the "Mandarin" or roundish type of naartje once sent from Natal under the name of "Orangettes." The writer is of opinion that this fruit will eventually come into its own not only in England, but in other parts of the world. It has hitherto been shipped principally in single-layer cases, but if the half-box described in the regulations be generally adopted and adhered to the naartje should become less expensive and more popular in England. Lemons have been sent from South Africa to Europe, but the business has yet to be shown to be profitable. There are just two months in England when our lemons could be sold with little competition from the Sicilian product: these are July and August. Even then such prices as they would realize would not prove sufficiently attractive to our growers. Further, all lemons for export would need to be properly cured, and the curing of lemons has yet to be undertaken and understood here. The Kumquat is a pretty little fruit which should sell readily in Europe and America; on the latter continent a demand already exists and the fruit is well known. Our supply at present is, however, so small as to be not worth considering.

HOW TO GO ABOUT EXPORTING.

There are so many little details in connection with the actual handling of the orange for export which should be observed that it is proposed to set them all forth in hopes that the *careful shipper* at least will give them the attention they deserve.

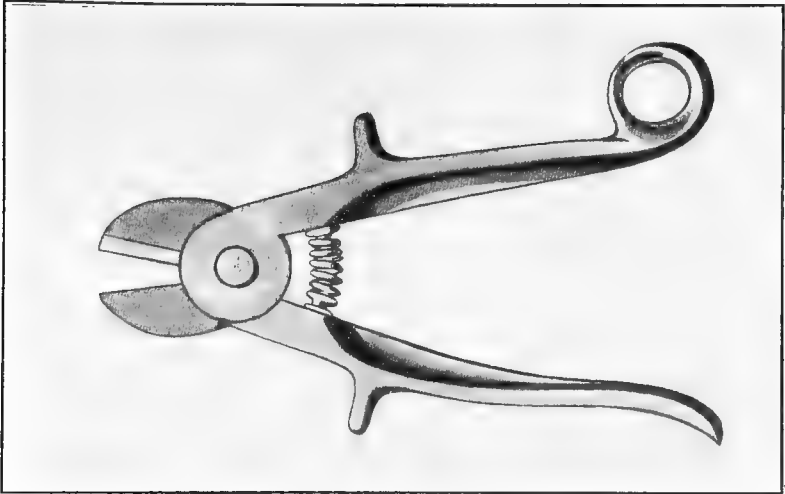
PICKING THE FRUIT.

Picking is really not the right word, because in no case should an orange intended for export or, indeed, any marketable purpose, be removed from the trees by any other means than "cutting." In order to do this properly, and with the least possible chance of injuring the fruit in the operation, a special clipper is made for the purpose, as shown in the illustration. It will be noticed that the points of the blade are rounded, so that the risk of pricking the fruit is reduced to a minimum. These clippers are now stocked in all our large towns, are easily obtained, and not expensive. The stem of the orange is first severed, perhaps an inch or two away from the fruit; then a second cut should be made removing the entire stem with the exception of the extreme end by which it is attached to the orange. The removal of the stem close to the fruit is of much importance, because when it is left half to three-quarters of an inch long it is a constant menace to other fruits with which it may come in contact. The Trades Commissioner in his reports has frequently mentioned how much damage has been done to oranges in this manner, the stems left having punctured the skin of the adjacent fruit and thus afforded an opening for the *Penicillium digitatum* or blue mold.

Pickers should be made to understand that their *work* must be done carefully; their finger nails should be trimmed so that there may be no danger of even the slightest puncture of the skin from that source or, better still, cotton gloves can be worn. In this country, where so much coloured labour is used, it is imperative that some responsible person should be placed in charge of the picking gang, and it should be his duty to watch each man at his work and see that it is done as it should be. The fruit should be picked with the idea of giving as little work in sorting for blemishes afterwards as possible; to that end no fruit with any kind of blemish should be picked for export. That which is picked should be ripe, but not over-ripe. It is quite useless to pick green oranges with the idea that they will "colour up" in transit; even if this were the case, which it is not, fruit picked in a green condition does not open up sweet at its journey's end. Pickers should carry bags slung round the neck into which to place the fruit when picked. There are many devices for making it possible to employ the bag without removing it from the neck. Tin buckets and sometimes baskets are used instead of bags, and these appear preferable, as the fruit is less subjected to friction than when placed in a bag. In all cases the receptacle is emptied by allowing the fruit to escape by means of an aperture at the bottom which is kept closed during the time picking is going on.

The oranges should be carefully emptied into "picking boxes" placed in the shade of the trees to receive them. Every orange grower should have a supply of such boxes; they should be as near the standard size as possible, but made without middle partition and with sides of half-inch wood and ends of one inch. Five of these boxes

with loose oranges should make four "packed" boxes. However it often happens that they are absent, and when this is the case the boxes in which it is intended to export the fruit may be used, care being taken not to fill them too full, as if this were done and the boxes piled one on the other the fruit would get bruised. Before use, each box should be carefully turned upside down and tapped smartly with the hand to dislodge any particles of soil or gravel which may have got inside and which, if left, would certainly cause punctures to the skins of the fruit.



THE SOMERS-HART CLIPPER.

It is important to remember that oranges for export should be picked dry. In the coastal districts especially is this necessary, where the air is heavily charged with atmospheric moisture. Under no circumstances should picking be done when there is dew or mist on the fruit. In the interior higher and drier portions of the country picking may usually commence in the early morning and continue to nightfall, but in the coastal districts all work of this kind should approximately be done between the hours of 10 a.m. and 4 p.m.

The boxes of oranges should be hauled with care to the packing-house, wherever that may be. The writer has seen many instances where fruit has been hauled to the pack-house loose in the bed of a wagon. Under circumstances such as these *it is impossible to make orange export pay*. The necessary care *must* be taken, details attended to, and each operation *must* receive the attention it demands and must be properly done if South African oranges are to attain that position in the world's markets which they should.

CURING.

It has been customary in the past to allow the fruit to remain in the boxes for sometimes four or five days before sorting. The

object of this was to allow the escape of surplus moisture from the skins by evaporation and thus to render them tougher and less liable to injury. Lately, experiments have been made which tend to show that it is not necessary to cure the fruit for so long a time. Two days are recognized as ample, and there are instances of fruit being picked, packed, and shipped the same day which has arrived on the other side in perfect order. It is certainly better to under than to over do the curing process.

SORTING.

As has been stated, the bulk of our oranges exported, so far, has consisted of two classes—Washington Navels and seedlings. Naturally the outside of the boxes is branded with the size and variety of the contents; thus there would appear to be but two classes of orange leaving our shores. Whilst this is really perfectly correct, each of these classes is capable of considerable sub-division. There are several types of navels and a very multitudinous assortment of seedlings. Efforts were made in the Transvaal in 1907 to classify these to some extent, and therefore the different grades were exported under the designations of “standard,” “choice,” and “fancy.” It is by no means certain that this effort was a success, for it was found that “standards” oftentimes fetched more than “choice”; possibly the sorting was at fault.

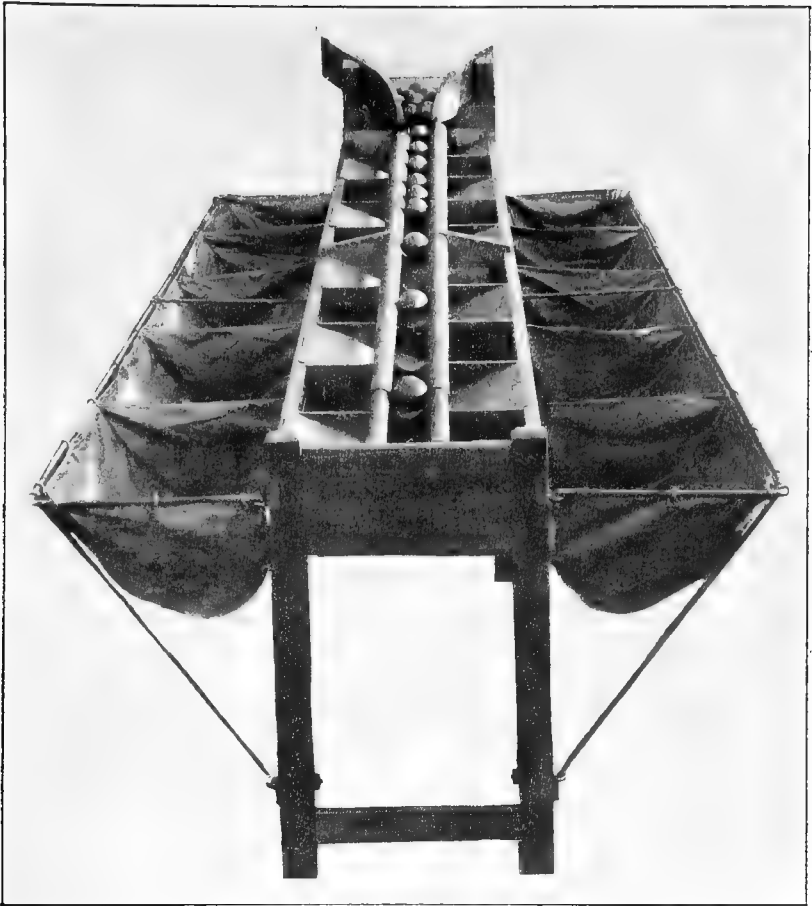
It is the writer’s opinion that the marking of the boxes with the names of the varieties they contain is sufficient for our needs at the present and, perhaps, for some time to come.

The tendency amongst buyers of citrus fruits is to purchase that which they see and prove to be good; therefore, if good fruit only goes forward the sorting for quality and varieties is but a secondary consideration. Sorting for the removal of blemished fruit, however, is another matter, and this should be done both as it passes through the sizing machine, commonly called the grader, and as it is wrapped prior to being placed in the boxes.

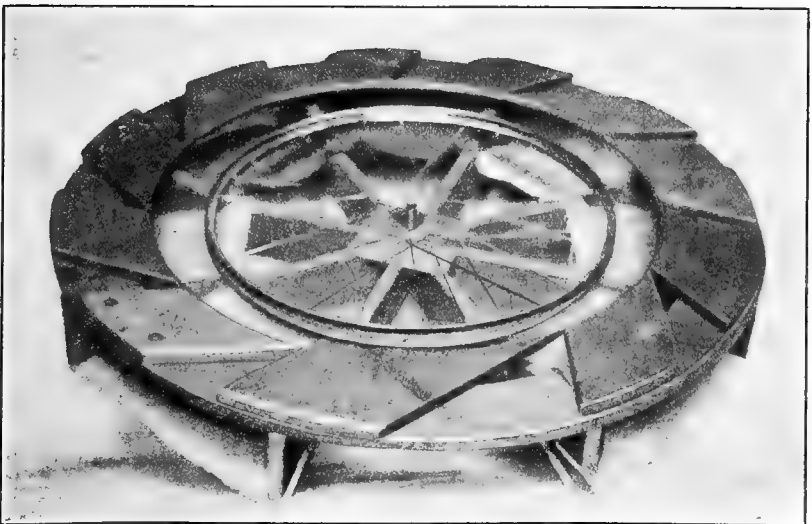
GRADING FOR SIZE.

This is one of the most important of all the details which go to make up a perfectly packed box of fruit. Unless oranges are perfectly graded for size they do not pack properly. On the other hand, when sizing has been carefully and well done, the packing of the standard box of oranges is simplicity itself. *It is not possible* to grade oranges perfectly by hand and eye. Recourse must, therefore, be had to some kind of machine which will attend to the work in a manner mechanically perfect. There are a few of these on the market in South Africa now which perform the operation in a satisfactory manner, and information can be obtained as to these on application to the Chief, Horticultural Division, Agricultural Department, Pretoria.

It is, however, quite possible for the farmer to make his own grader, which should do all that is required of it in a small way for, perhaps, the first year’s export, but a good grading machine is a guarantee that the fruit is correct as to size, and it pays to invest in the best article procurable. The accompanying illustrations show the class of machine which is now obtainable in South Africa.



No. 1.



No. 2.

No. 3 represents the interior of a packing-house in California, where the most modern machinery is in use. The picture is from the catalogue of the San Dimas Citrus Nurseries, California, as also are



No. 3.

the packed boxes of oranges and lemons—these have been published here so that our shippers may see how near perfection our American friends have arrived.

WRAPPING THE FRUIT.

For this purpose a thin, tough, white tissue paper should be used of size convenient for the fruit which it is desired to wrap. As a guide to purchasers, the following table is given:—

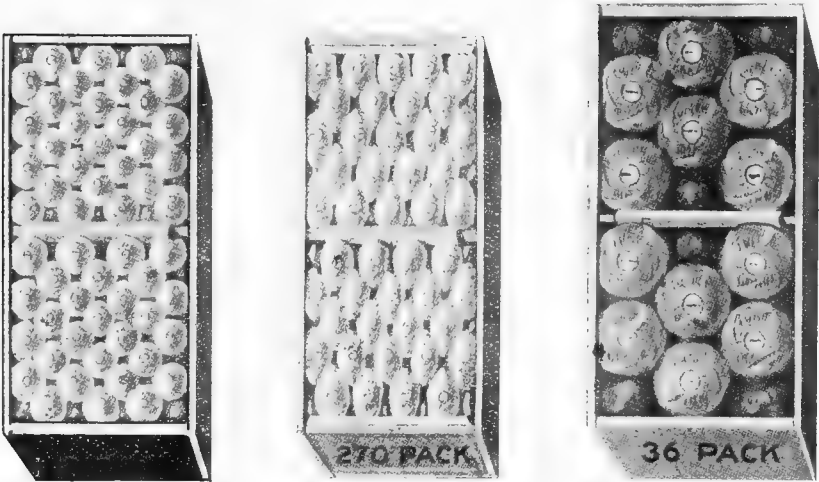
For standard box, 96 pack, 12 by 12 inches.

For standard box, 112, 126, 150 packs, 10 by 12 inches.

For standard box, 176, 200, 10 by 10 inches.

For standard box, 216, 226, 252, 9 by 9 inches.

The fruit should be perfectly wrapped, i.e. each orange completely surrounded with paper, which should be finished off with a twist, and, at the same time, be so placed round the fruit as to display the "brand" to the best advantage. All wrappers should bear the same distinctive mark as that which appears on the outside of the boxes containing the fruit. A neatly gotten up brand renders the appearance of the fruit more attractive, and the brands on the papers should all be placed in the same direction and not carelessly any how.



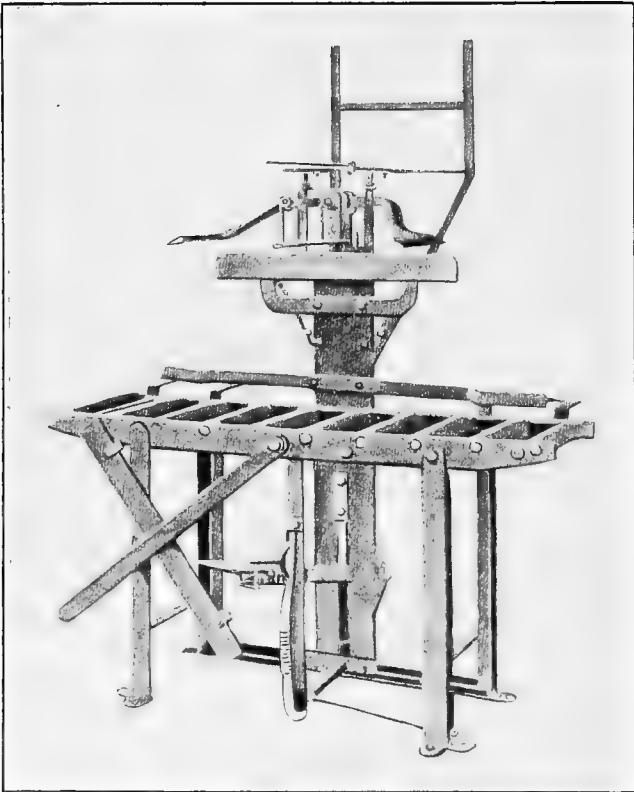
Girls and women handle, wrap, and pack oranges far better than youths and men. Their fingers are more supple and quick, and an inexperienced girl will become quite deft at the work in a few hours. Packers should wear gloves, or very special attention must be paid to keeping the finger nails short. Work in connection with packing oranges is clean, light, and pleasant, and should also be well paid in order to secure reliable and competent workers. When this is the case it often happens that one obtains the same packers year after year; in fact, the orange-packing season is looked forward to as a means of earning a few pounds for the purchase of some item perhaps otherwise unobtainable.

PACKING.

With oranges properly graded for size, packing in the export box is very simple and easy. In the standard packs shown in the diagram there is a place for every orange, always provided that the packing is

done as it should be—neatly and firmly. A well-packed box of oranges on arrival at its destination oversea should open up with a neat and attractive appearance; this can be secured by adopting the “packs” shown, and cannot be obtained should the fruit be placed loosely in the box.

Loose packing is the abomination of the fruit dealer. Wrapping and packing the fruit should be done by the same individual and form one operation. It can only be properly done when standing up. The erect position gives a command over the work not obtainable when one sits down to it; therefore there should be no chairs in the packing-



THE MODERN FRUIT BOX PRESS—NEW MODEL.

house. It will be found in nearly all the different “packs” shown that the fruit will rather more than fill up the boxes; in some instances it will stand an inch above the sides of the box. This necessitates further careful handling in the nailing up, and ensures that tightness which is indispensable for the safety of all fruits, of no matter what kind, when in transit.

In the up-to-date packing-houses of California a press is used (as shown), which forces the ends of the cover down so that the boxes are easily nailed up. If a press is used judgment is essential, as a quick

harsh movement is liable to cause the paper on those oranges next the sides of the box to be rubbed off. A gradual pressure is therefore needed. As there are very few presses in use in South Africa it may be as well to say that the next best way to nail up a box is to fasten the one end down first, driving the nails through cleat and cover; then bend the other end of the cover over and attend to that.

Over cleat and cover, at each end of the box, a thin iron strapping should be nailed to ensure the stability of the box during its 6000-mile journey.

Nailing up of boxes is a white man's work, as it needs to be done quickly, carefully, and well. The Trades Commissioner, in some of his reports from London, remarks on the weakness some people in South Africa have for driving nails into the oranges and not into their right places in the box. This is one more of the details which need care and which should only be placed in the hands of reliable workers. Boxes should not be nailed in the centre.

MARKING THE BOX.

This should be done in accordance with the requirements of the regulations. All boxes full of oranges should at all times stand on end; ventilation is in this way assured, and the liability to heat which occurs when they are placed one on the other on their sides is obviated. This applies to the cases when they are stacked in the packing-house awaiting shipment, in the railway truck en route for the coast, and in the cool chamber or hold of the steamer, as the case may be.

This arrangement further admits of the instant identification of all boxes, on arrival at their destination, by the oversea agents.

THE FUTURE OF THE CITRUS INDUSTRY IN SOUTH AFRICA.

It has been shown that during the few years which comprise the span of our export citrus history more or less satisfactory progress has been made. Had not the world war intervened, the probability is that in this present year of grace our exports would have reached 200,000 boxes, possibly more. This number would have been absorbed on the markets of England alone with ease. Past experience has shown us that difficulty in disposing of oranges has only arisen when the supply has become irregular—a few hundreds of cases by one ship, then possibly a break for a couple of weeks, and another few hundreds, and so on. As soon as the stream of supplies became steady there was no difficulty in disposing of our fruit. So far, practically the whole has been sent to England; the Continental markets were scarcely touched. It is true a few consignments were sent to Holland, but the circumstances were scarcely favourable.

North America has not yet sampled our citrus fruits. It is anticipated by the writer, when rapid and regular communication has been opened between South Africa and the new world, that an enormous development in our citrus business will take place—one thing is needful, and that is good fruit. The Americans are the one nation who eat fruit properly, as a food—or as a dietetic. Fruit is to them a necessity, and as long as it is good money is no object. They are the greatest connoisseurs of fruit on earth. Bearing that in mind we must realize that to send anything but really first-class stuff to America

would be sheer folly, and that shows how necessary it is to plant the best trees of those varieties which are likely to prove acceptable. What the world's economic conditions may be when the war is over the writer knows not; possibly money may be more widely distributed; but it is not at all likely that the taste for good oranges in the Northern Hemisphere will have been lost, and South Africa is the only country which counts to-day in the supply of citrus fruits in that direction. Competition may come; Australia and South America can both grow good oranges, but we are ahead of them, and with ordinary brains and energy should remain so.

CONCLUSIONS.

The markets of Europe and North America are open to the South African orange-grower. He can supply them with fresh citrus fruits during their hottest and most trying months. If he goes about his business in a business-like way he can develop and retain these markets indefinitely. If he is slack and careless his competitors will probably get the trade.

