leaves. In the dried material the leaves have 'scorched' spots or areas, spotted with black dots and surrounded by dark brown borders.

EUGENIA CARYOPHYLLATA, Thunb. (*Myrtaceae*). The Clove.

Irpex flavus, a yellow "toothed" fungus (*Hydnaceae*) is reported by Bancroft as causing a root disease. Ridley states that a red-spotting leaf fungus, probably a member of the *Peronosporaceae*, was responsible for abandoning the clove cultivation about 1860.

EUGENIA GRANDIS, Wt. (*Myrtaceae*). Jambu Ayer Laut.

Valsaria cinnamomi (*Sphaeriaceae*) on dead bark, collected by Baker at Singapore. The fructifications of the fungus appear as dark brown or black eruptions through fissures of the bark.

T. F. CHIPP.

(*To be continued*).

Some Trials of Food Plants in the Economic Gardens II.

Lima Beans (Phaseolus lunatus).

The Lima Beans, Small Siéva Pole, originally received from the firm of A. H. Dreer, Philadelphia, U. S. A., and which were reported upon at length in the Garden's Bulletin of 4th July 1919, have been kept under cultivation continually in the Economic Gardens since July 1918. It was shown, by the records of seed gathered up to, and inclusive of the fourth generation, that the crops had been well maintained and that the beans had not degenerated in weight, size or quality.

But the results since obtained do not confirm this; they in fact have disappointed the writer's expectations. It is not, however, yet time to ascribe the falling off in the subsequent crops to actual degeneration in the seed, for, in recent weighings taken in October 1919, it was found that the weight of the beans was well maintained, and the percentage of germinations on a plot of 1056 plants, sown on 28th October, the last of the season, was as high as 96 per cent. At the time of writing (22nd November) this plot shows the most vigorous and healthy growth, a fact which would exclude any tendency to degeneration.

To explain the discrepancy between this last statement and the disappointing results of the crop as a whole, it is necessary to refer to the locality where the trials were made. The area planted in Lima beans was a little over two acres consisting (all but a small part of 4000 square feet, or one eleventh of an acre) of a low strip of land skirting a hill, and made of drift soil, either washed from

Ragi, Eleusine Coracana.

the hill side, or brought by the floods which frequently occur. It is therefore of an alluvial character, of good depth and of a fine loamy texture, the very best medium one would think for a trial of this nature; actually however, it was not at all suitable.

To begin with, it had been for years under a rank, semi-aquatic vegetation of wild grasses and of Pandanus (Screw-pine), with a few stunted Rubber trees. The large sago-palms growing near-by, mark the land for what it really is namely an undrained, almost undrainable swamp: its structure, a peaty bottom overlaid with the rich silt brought by floods. Such is the land with the exception of the small plot of $\frac{1}{11}$ of an acre referred to above, a gentle slope at the foot hill, well above flood level. Here is no drift or alluvial soil but the ordinary coarse yellow sandy clay, characteristic of Singapore hill-sides. This small plot had been for some years under cultivation and sundry annual crops had been raised off it in 1917 by Professor Baker (see Gardens Bulletin July 4th 1918). Now, it is off this small plot of rather poor and thin material, that the crops of Lima beans were grown by the writer, the results of which were given in the Bulletin of 4th July 1919, and on it are still to be seen beds of Lima beans of healthy growth, with abundant crops on them. One bed, in particular, sown on 31st July 1918, shows at date of writing, quite a fair crop of young pods. What, then, is the explanation of the unsatisfactory return of the *ensemble* of the crop? How is it that the promising results previously obtained, as shown in Bulletin No. 4 of 1919, now fail?

In the writer's opinion, this failure is due to the host of diseases brought about by fungi and insect pests which are bound, in the natural course of things, sooner or later to attack and destroy plants grown under adverse conditions in an uncongenial soil. And here, for the sake of clearness, one may be permitted a slight digression. In some countries, Burmah for instance, we hear of the Lima bean being grown on alluvial deposits formed along the river banks, by the silt of periodical inundations, a condition resembling somewhat that under which the Economic Gardens are placed. But there is this difference between the case of periodical seasonal floods and the case of occasional floods which last only a few hours over undrained land. In the one case, the parasitic fauna and flora is killed by the prolonged sojourn of the waters on the land, moreover the steady withdrawal of the river water to a much lower level as the floods subside, allows of perfect drainage of the alluvial deposit left on the land. Thus a perfectly new soil is formed, perfect in nutritive elements for plant life, perfect in physical texture, and above all, a soil purged of fungoid and insect pests—a clean soil which, with a minimum of tillage, will bear such wonderful crops of tobacco and indigo as one sees, for instance, on the banks of the Mekong.

In the other case, new soil is brought on the land, carrying with it seeds of parasitic vegetation and spores of new fungi which find a congenial home in the rank vegetation, a vegetation which thrives all the more for a short immersion, and as the land drains

itself badly and slowly, the cleansing action of the withdrawal of the flood water is lost—result: a sloppy, acid land, infested with pests of every description—a foul land. That is precisely what this land is, which is now dealt with. A foul land, no matter how great its wealth of nutrient material, cannot be fit for intensive cultivation except after a period of repeated tillage and, even then, if the surrounding land is allowed to remain foul, the harvests will be precarious. It is said by people who know the country well, that it is very difficult to rear good dependable garden crops in the rich lowlands of the East Coast of Sumatra, because of the peristent attacks of pests; and this is explained by the fact that so much of the land, after the tobacco crops have been harvested, is allowed to revert to rank vegetation over which parasitic life runs riot.

This digression will serve to explain the failure of the Lima bean crop in the Economic Gardens to come up to expectations. The failure of a crop, however, does not necessarily imply the degeneration of the seed; but certain figures of weighings taken by the writer at different periods bear on this point and they are here given.

A. One handful of beans of the third generation put on one side of the scale numbered 55 beans: one handful of beans of the fourth generation put on the other side tilted the scale with 56 beans.

B. 100 seeds taken from a parcel of Lima bean seed received from the firm of A. H. Dreer, Philadelphia, on 19th June, 1919, were put on one side of the scale and it took 120 of our local selected seed, after one month's drying to tilt the scale. (The local seed were the offspring of seeds received from the same firm the year before).

C. One pound of beans picked on 23rd May 1919, and kept to dry for 8 days contained 916 beans, whereas,

D. one pound of beans picked on 20th October, (*i.e.* the following generation) and kept to dry for 12 days contained 1103 beans.

E. One pound of beans selected for sowing in October, contained, after one month drying, 910 beans.

As will be perceived, while some of these figures point to a decided falling-off of the beans in weight as shown in B and by comparing C and D, others, A, and a comparison between C and E do not point to the same conclusion.

In B, however, we have clear evidence, (several weighings were made with much the same results) that the local bean, after nearly twelve months cultivation in the Economic Gardens, has lost 20 per cent of its weight. Is that fact to be taken as a proof that the Lima Bean cannot establish itself in this country without degeneration? It must be remembered that the seeds sent out by the great seedsmen of Europe and America have been evolved by severe selection through successive generations under trained observers to produce a type of bean in this case suitable to a set of local conditions which may, or may not, be reproducible elsewhere,

Hill Paddy, Sown on 20th July, gathered on 10th December.

or only partially reproducible. The chances are that, in their ensemble, they are not reproducible, for the factors which enter into play are many, *e.g.* heat, moisture, constitution of the soil, pollinating insect life, and processes of cultivation are among the factors that work for divergences, and that affect the behaviour of the plant under altered conditions. There is, then, nothing surprising in the fact that the Lima bean, in its transfer from a temperate and relatively dry climate to a tropical and moist one, should suffer a decline from the parent seed. The question is whether, under successive generations of cultivation, the decline is continuous. If this were so, it would, of course, imply progressive degeneracy in the seed and the inadaptability of the Lima bean to our local conditions since reproduction of a seed true to type is the test of adaptability to surrounding conditions—of acclimatisation.

Now tests C and D seem to support the contention that the Lima bean does, in effect, lose in weight from one generation to the next. Here we have 2 lots of beans gathered off the same plot one belonging to one generation containing 916 beans to the pound —the second lot belonging to the following generation containing 1103 beans to the pound that is to say that the latter is 20% lighter than the first.

This may appear to clinch the matter and finally to settle the point of degeneration in the seed. But does it? The writer would be quite prepared to admit it, were it not for the adverse conditions under which the later crops have been reared—conditions which the above digression was meant to make clear.

As can be seen by visitors to the Economic Gardens, the cultivation of the various plots has been as thorough as it is possible to make it in this country and some of the standing crops, ragi, hill paddy, cholam (Sorghum vulgare), new to the land and, so far, immune or at least partly so, to the pests that infect the land, show quite adequate returns, birds notwithstanding. But in the sections where bean cultivation has been going on now for several months, the fight is all but hopeless, *Nematodes,* the *Agromyza* fly, *Bruchus rufimans,* also a black bug, round-bodied with shiny carapace, the name of which is not known to the writer, leaf fungi and root fungi have made a set-attack on these plots. Disinfection of seeds, sprayings with Bordeaux mixture and with insecticides, sulphur dustings, petroleum emulsion, neem oil emulsion, have been used without interruption, all with only very partial effect.

Referring again to the tests given above, the figures under A appear to negative the degeneration of the Lima bean from the third generation to the fourth generation: these weights were taken before the various above pests had taken such a hold of the land, but, unfortunately, it was found impossible to carry on these comparative tests with the later crops as the percentage of damaged beans was too great to make the tests of any use.

Test E was made from seeds obtained from the smaller plot previously referred to; but the test is inconclusive from the fact

that the seeds were selected for sowing, and were therefore plumper and, no doubt, heavier than average seeds would be.

As a conclusion to this paper, it may be stated:—

1st. That the Lima bean, Small Siéva, locally grown, shows a falling off in weight of 20 per cent. from the original parent seed received from Philadelphia.

2nd. That a falling-off in weight has taken place in the later crops, but that the adverse conditions under which the latter were grown, and probable loss of vitality from disease, make it unsafe to conclude that this falling-off would be continuous under normal conditions.

3rd. It may be pointed out that the Lima Bean is cultivated on a very extensive scale in the different countries surrounding us, and figures largely in their exports. Burmah has its Rangoon bean; Java its Java bean; Cochinchina its Haricot de Baria, the self—same "Small Siéva" which is under trial at the Economic Gardens, and all belonging to the species *lunatus*. In the face of this fact it will need very strong evidence to prove that it cannot be cultivated and acclimatised in this country, under normal conditions.

Roselle (Hibiscus Sabdariffa.)

The Roselle bush known also in the West Indies as "Jamaican" or "Red Sorrel," is a member of the Natural Order Malvaceae and is allied to the Bandikai or Lady's Fingers, and the Cotton plant. It was first planted in the Economic Gardens by Professor Baker who introduced it from the Philippines, and both the red, and the white "*Victor*" variety have been kept under cultivation there. Both plants develop into handsome bushes 5 to 6 feet in height with an abundance of almost horizontal branches spreading to a circumference of 4 to 5 feet in the lower part of the tree, which assumes a well defined pyramidal shape.

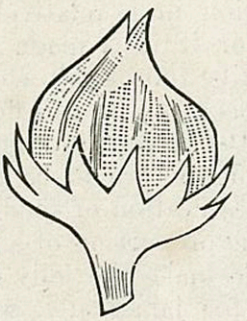
The so-called "*White*" Roselle is green in its wood, in its branches, and its leaves, but the calyces of the fruit are whitish green or straw coloured. The Red Roselle has a reddish bark and is quite distinguishable from the white type by the brilliant deep red colour of its calyces, which gives the jelly and jam made of it a very attractive red colour whereas the jelly made of the White Roselle takes the colour of amber.

This year, a consignment was received of seeds of the variety "*altissima*," new to the garden, and also of two distinct red and white types. Five beds were sown at the end of April, 1919, and on the 10th November, the first crop of fruit was plucked.

It is quite distinct in growth and habit from the Roselle of the "*Victor*" variety, the only one which had hitherto been cultivated in the Gardens. It is a much taller plant, attaining 10 to 12 feet in height, and the branches, instead of spreading horizontally as those of the "*Victor*" variety, grow at an acute angle to the stem, giving it a more slender appearance.

All its parts, even the calyces, are covered with short rough hair: the fruit, which is smaller than that of the "*Victor*" variety, is also rounder and the sepals, in the white type, are peculiarly streaked with faint lines of red spots. The fruit of the two varieties are here shown, side by side, in their natural size and shape.

Hibiscus Sabdariffa var: *Victor*
natural size
Colour—greenish white



Hibiscus Sabdariffa var: *Altissima*
natural size
White—spotted red

The "*altissima*" variety, although fairly prolific in fruiting, is less so than the "*Victor*" variety, and the smallness of its fruit, coupled with the more marked hairiness of the sepals make it a less desirable acquisition, for the purpose of making preserves, jams, jellies, or syrups.

Roselle has a long tap-root and it therefore requires a soil previously well dug to a depth of 10 inches. The writer, having planted it in varied kinds of soils, is of opinion that it thrives best in a fairly heavy clay soil, but being of rapid growth, it wants a soil well supplied with plant food. It is very grateful for a light application of well rotted cowdung. The land should be well drained, as the plant is somewhat subject, more particularly in low wet land, to the attacks of root-nematodes which dwarf it and render it unfruitful.

Roselle Jam or Jelly is well appreciated by all who know it, and, it is a great help to the housewife, in these times of costly and indifferent jams which figure in the market.

In making jam the sepals and calyces of the fruit alone are used, the seed-bag inside being cut-out and rejected. But the whole fruit can be used when making jelly, as in this case, the seed-bag is strained off.

The process for making jam is briefly as follows: Strip the calyces off and throw them in cold water to rinse them for 2 to 3 hours,—not longer—as, particularly in the case of red roselle, some of the pigment passes into the water and is so much loss in brilliancy of colour of the jam.

The calyces are then put in an earthenware pot or, if metal is used, it must be either a copper or enamelled pan. Boil in water sufficient to cover the fruit, for thirty minutes, more or less,

until the pulp is quite soft; add clean white sugar at the rate of ¾ pound to one pound of calyces; bring again to the boil for about 10 minutes, skimming meanwhile the scum that forms on top. The jam is then ready to put in bottles which must be previously heated; when cool, cover the mouth of the bottle with a round of paper previously moistened with white of egg, and applied to and overlapping the lips of the bottle.

This bottling is efficient if the jam is intended for home consumption in a relatively short time, but if it is intended to be kept, or if it is made for sale, then it is essential that the jam should be thoroughly sterilised. A very simple process of sterilisation was given in a leaflet of the "Board of Agriculture," (No. 250, May 1911) but thoroughly efficient processes, with quite simple implements, are to be found in many text-books which deal with the preservation of food-products. Also, if intended for long keeping, the proportion of sugar to fruit should be increased.

To make the jelly of Roselle, the same process is followed as given for jam; only, when the fruit has been sufficiently cooked to be quite tender, the whole is thrown on a fine sieve, and the calyces, after removal of the seed-bags, are mashed so as to extract the maximum of juice, which is collected below the sieve, and returned to the pot for a further boil, until it is found, on letting fall a few drops of the hot brew on a cool plate, that they jellify. The same proportion of sugar is used as for jam.

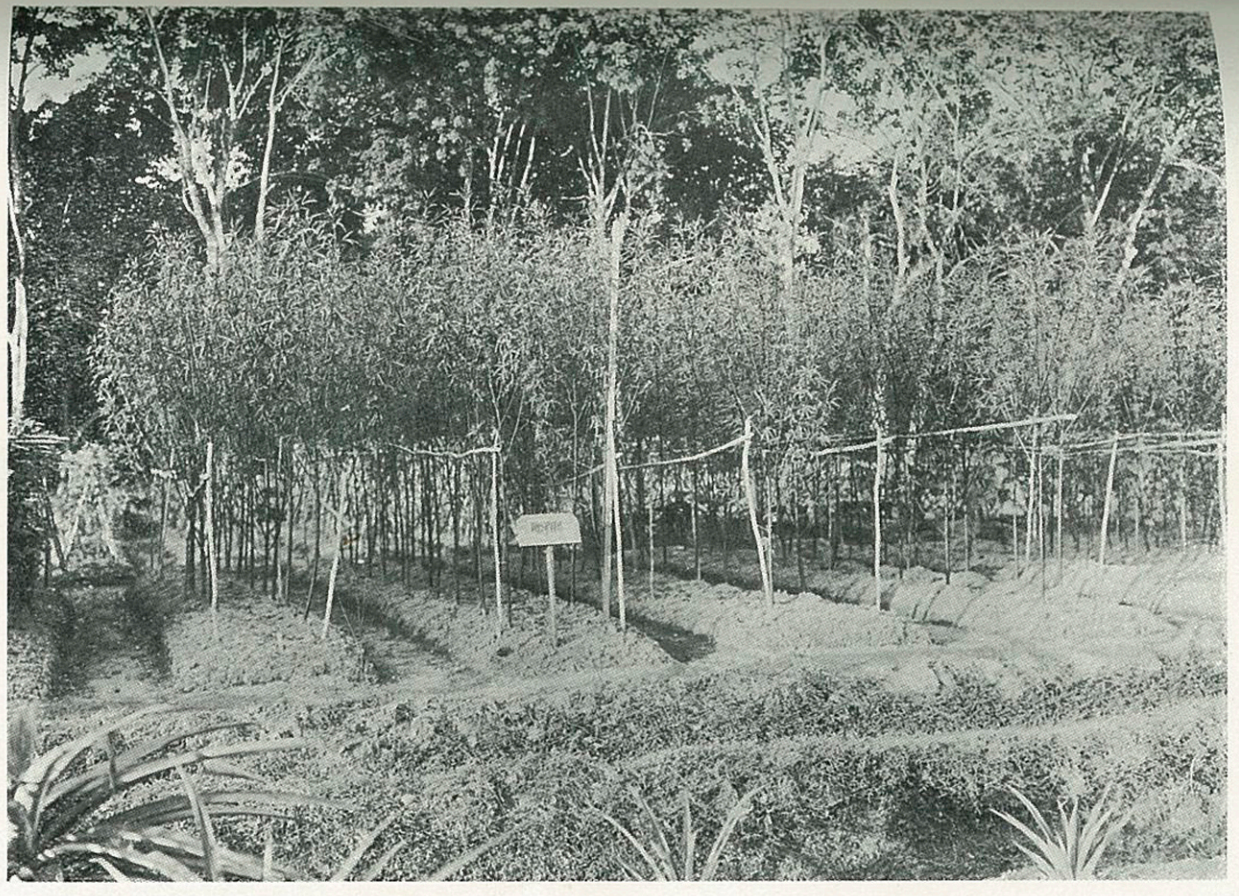
An excellent syrup can also be made of Roselle—and an equally excellent wine, somewhat of the nature of a very superior cider. This wine can be made without the addition of yeast and among the recipes given by sundry writers, the following taken from Quentin's "L' art de Conserver les fruits" is simple, and probably as efficient as any:—"In a barrel containing 15 gallons of water "dissolve 10 pounds of white sugar. Pour in the juice of 25 "pounds of calyces. Stirr well and leave to ferment for a couple "of days or until fermentation stops. Pour off the contents "through a filtering bag into another cask. If further fermenta- "tion occurs in the latter, the bung-hole should be covered with a "cloth only. If no fermentation takes place the bung may be "put in."

Wine made in this way is a still wine which improves on keeping.

A yet simpler method, by which the writer has himself obtained a strongly effervescing wine, is the following:—

Fill up a wooden cask or an earthenware jar with well-rinsed calyces after removal of the seed-bags. Press them well in to the brim and pour on top as much water as the cask or jar will take and let stand for 36 to 48 hours. Pour off the liquid over a filter-bag, put in clean white sugar, then bottle in strong champagne bottles, using well-fitting corks previously steeped in boiling water or in alcohol; secure them well with wire, lest the fermentation gases force them out.

The writer has seen in print some rather staggering accounts of the returns of Roselle cultivation. His own records are summed up in the following figures.



Roselle, Hibiscus sabdariffa var altissima also called Jamaica or Red Sorrel.

On a conservative basis, under average conditions, a crop of 120 fruit per bush may be looked forward to in 7 months.

6 whole fruit weigh one ounce; 9½ calyces (divested of seed-bags) weigh one ounce; 120 fruit, the crop off one bush, will therefore weigh 20 ounces.

There are 2,000 bushes in one acre planted 5 × 4 feet; the crop obtainable off one acre will therefore be 2,500 pounds of fruit.

In actual practice, the writer found that 8 pounds of fruit used in the making of jam, jelly, and syrup gave the following output:

2 bottles of Jelly—nett weight of jelly = 26 ounces
1 quart bottle of Syrup—nett weight of syrup = 33 ounces
4 large bottles of Jam—nett weight of jam = 93 ounces

Estimating the value of the jelly at	$0.70
„ „ of the syrup at	.60
„ „ of the jam at	1.80
we arrive at a gross return of	$3.10

for 8 pounds of fruit.

From this figure must be deducted:

5 pounds of sugar at 25 cents .. =	$1.25
Bottles .. .. =	.60
Cost of cultivation, work and firewood =	.20
	$2.05

The nett profit on 8 lbs. of fruit would therefore be $1.05, and on 2,500 lbs., the produce of one acre, $328.

Excepting for the nematodes mentioned above, the Roselle plant, appears to be singularly free from disease; but it is the host of the Red Cotton bug, a red bug with white and black abdominal stripes, which is very common on several of the Malvaceae, and particularly on the Cotton plant. It propagates very quickly and, unless it is kept in check by frequent sprayings and sulphur dustings, it is difficult to get rid of. Fortunately it only feeds on the leaves, not on the fruit; but it soils the latter by its excreta. It is the *Disdercus singulatus*.

The leaves of the Roselle are also quite a good substitute for sorrel, and as such, form a valuable addition to a vegetable menu.

E. Mathieu.

(*To be continued.*)