ZEA MAYS, Linn. (*Gramineae*). Indian Corn.

The smut *Ustilago Maydis* (*Ustilaginaceae*) is the only record for this crop. It destroys the cobs turning them into a sooty mass.

ZINGIBER, sp. (*Scitamineae*). Ginger.

Hypocrella zinziberis, Mass. (*Hypocreaceae*) was found by Ridley on the petioles of this plant. The fungus has a bright orange coloured stroma.

The above brings to a conclusion the summary of fungus diseases of plants in Malaya as hitherto definitely recorded. The list is small and many of our best known farm and garden plants have but a small record against them. This no doubt is due to the fact that the main crops, such as rubber, have hitherto engaged the attention of the few pathologists that have worked out here. As this work increases more attention will be able to be given to other plants quite important in themselves but not ranking with the main crops of the country. When the next revision of this list takes places it is certain to be considerably increased. In the meantime additions will be published in this Bulletin from time to time as they occur.

T. F. CHIPP.

Castor Oil as A Crop.

The Castor-oil plant (*Ricinus communis*), seems so far, to have attracted little notice in Malaya, and yet, when looked into its cultivation appears to offer fairly good prospects for the small planter, while the industry of mechanical expression of the oil offers a promising opening for the establishment of up-to-date mills.

It brings prompt returns to the cultivator and its product, whether in seed, or oil, or cake is in increasing demand from home at steadily advancing prices.

According to the Chemist and Druggist 28th February, 1920, the prices quoted by the pressers in Hull were £114 per ton for pharmaceutical oil—£111 for first pressing—£109, for second pressing. For medicinal French oil, the price was 120/- per cwt. in cases.

The present price (1st May, 1920) of Castor-oil in Singapore, obligingly supplied by the Secretaries of the Chamber of Commerce is quoted at $50 per case of 74 to 75 catties packed in 4 tins, or 0.66 per catty.

The Blue Book states that 861927 gallons of lubricating oils were imported into the Straits Settlements in 1918, the value being $1,036,943.

We cannot apportion the amount for which Castor-oil enters in this aggregate, but we know that being a heavy-bodied oil and the most viscous of all fatty oils, it occupies a large place among lubricants for machinery, especially for the oiling of fast moving machines.

The writer has not at hand the figures relating to Medicinal Castor-oil, but here, also, we know that the figure must be a large one, and judging by the price of 85 cents, which the writer recently paid for a 10 ounce bottle of Morton's Castor-oil, we may imagine that, in passing from the seed to the bottle and finally to the consumer, the oil gathers unto itself many little rivulets of handsome profits.

The Castor-oil plant, of which there are small plots in the Economic Gardens, does extremely well in light alluvial loams, well supplied with organic matter. Sown in such soil from seed on 5th November, 1919, several trees are now, at time of writing, 1st May, 1920, showing well-formed fruiting spikes. One panicle, off one of these trees has already given 120 ripe seeds, and the rest of the seed will require picking in a very few days. These trees are from 4 to 5 feet in height.

Next to this plot is another one sown on the 10th of January, *i.e.* exactly 110 days old at the time of writing, of a smaller variety, whose plants are already, at a height of 3 feet, flowering heavily; one tree with five spikes in different stages of development.

In thin clayey soils and in sandy soils the growth of the plant is slow and its seed production is small. Yet, in India it is said to do well on red laterite soils at the foot of hills, provided they are not too stiff and they keep moisture well: but if they are poor in organic matter, they must receive an application of cowdung well incorporated with the land, previous to sowing.

The plant roots deeply and the ground requires a good digging at least 8 inches deep.

There are many cultivated varieties of *Ricinus communis* distinguished by various characteristics, such as the colouring of the stem which may be almost white, or of a glaucous bluish-green, or of a red colour with or without a white frost-like dusting on the stems and branches. There are also marked differences in the sizes and colours of the seeds, between one variety and another. Some, of a flattish shape, with dull-grey markings, $\frac{5}{8}$ inch in length were shown to the writer as coming from East Africa. Others, gathered from a tree growing wild in the Economic Gardens, not quite half an inch long, are oval in shape and rounded in contour: their colour is a bright reddish-brown with well marked yellowish veinings; while still others, also found growing wild locally, are just over $\frac{1}{4}$ inch in length, purple brown, with faint markings.

In Madras the seeds are classed under two main types:

1° The Coast and Warangal, which are small.

2° The Salems, which are large.

The Coast-seed of Cocanada is said to be the best for oil.

Some varieties are annual; others are grown as perennial crops. Mukerji mentions a small-seeded variety from the Deccan, which goes on bearing for 5 years in succession, and producing an oil of superior quality. (Handbook of Indian Agriculture).

The seeds of the small annual varieties are sown 3 feet apart, or better still, (if a subsidiary crop of ground-nut is interplant-

ed) at distances of two feet on rows four feet apart. Sowing one seed at each stake, three or four pounds of seeds would be sufficient for one acre; but it is as well to provide for failures by sowing two or three seeds four inches apart to each stake, and thinning out one month after germination, in which case seven pounds will suffice for one acre. This quantity will allow for selection of the best seeds, *i.e.* those showing the whitest and best developed "caruncle," or the fleshy out-growth near the hilum. The seeds in which, after steeping in water, this out-growth is found shrunken or discoloured, should be rejected.

Ricinus breeds true; cases of cross fertilisation being very rare.

The seeds of perennial varieties are usually sown at distances of 6 feet each way; but in the case of large, branching plants, wider spacing is perhaps advisable, as it is said that under a plentiful supply of air, the yield of seed is very largely increased, as much as 20 pounds of seed being recorded from vigorous plants under such conditions. Distances of 10 feet each way would probably meet the case, which would give 400 plants to the acre, necessitating less than two pounds of seeds. The writer has not had occasion, so far, to adopt such wide-planting, but the crops one occasionally sees on isolated trees, point to its reasonableness.

The Castor-seedling bears transplantation badly; the seeds are therefore always planted straight away in the fields. But the writer found that, from a cause not yet ascertained (probably the presence of eel-worm in the soil) a proportion of as much as ten per cent of his plants died in the second month. Such infected soils should not be planted with *Ricinus;* but should the discovery be made too late, it is advisable to have a number of seedlings apart in bamboo baskets to fill the vacancies after creosoting the earth at the spot.

As previously stated, the ground must be brought to a fine state of tilth by a preliminary digging to a depth of 8 to 10 inches, followed by a harrowing or raking. The longer the land is allowed to lie broken and exposed to the air before sowing the better; as it gives a chance to the sun and the birds combined, to destroy the maggots and grubs, which, later on, in the shape of caterpillars, will, if the land remains foul, almost surely attack the plants, and, possibly, cause extensive damage by stripping them of their leaves. The writer has seen a handsome tree, 12 feet high, completely defoliated in a few days by a small black and red striped caterpillar. When the tree was shaken, myriads of the caterpillars fell to the ground. The Castor-seed caterpillar, *Dichocrocis punctiferalis,* which bores its way into the seeds is also a dangerous pest.

Although Castor-seeds preserve their germinative power a very long time if protected from damage by insects, immersion in water for a few hours is not a useless precaution as it softens them and facilitates germination. A preliminary short steeping in an insecticide solution such as a weak solution of copper sulphate, just strong enough to give the water a faint bluish tint, or in a maceration of tuba root, may also do much good.

Fresh seeds of healthy plants, selected with due care, need no such treatment: they germinate very readily, provided the soil is kept moist by rain or, in case of dry weather, by one or two waterings after sowing.

On a plot sown with quite fresh seeds on the 30th March last, all the plants showed their seminal leaves on the 6th of April and on the 10th April, the second pair of leaves was already out.

After germination, no more watering need be given, except in the case of actual drought. No further care is required except weeding, and keeping a good look-out for caterpillars which, if they are not kept down by hand-picking or by insecticide sprayings (kerosine and soap emulsion) are likely, as already stated, to cause great damage to the leaves, and, in the case of *Dichocrocis punctiferalis* to the young flowering spikes.

The Castor-plant can be cultivated with advantage with other annual crops. Of all such crops, the writer would give the preference to ground-nut, *Arachis hypogaea*, which, besides being in itself a very profitable crop, has the advantage of supplying to the soil some of the nitrogen which the Castor-oil plant, an exhausting plant, takes out of it.

The perennial Castor-oil plant often grows to a height of 15 feet, but such a height is a very great drawback and adds largely to the cost of harvesting, which may last for two months, in weekly pickings, as the crop ripens intermittently.

To check the growth in height, the trees should be topped at an early stage so as to maintain them at a height of 6 to 7 feet. This moreover induces the formation of lateral branches which, later on, will throw out flowering spikes.

It is generally admitted that the Castor-oil plant exhausts the soil, that it should not be cultivated twice in succession on the same ground and that a period of at least two years should be allowed between two crops. When annual varieties of *Ricinus* are cultivated, it is therefore necessary to devise a scheme of rotation embracing a series of quick-growing field crops to tide over the interval between one crop of the Castor-plant and the next.

Such a scheme should include crops adapted to similar physical conditions of soil, but belonging to different natural orders, so as to check any undue increase of insect-pests or the spreading of fungoid diseases.

Ricinus, Ground-nut, Gingelly, Sweet-potatoes offer such a rotation, which, moreover, has the advantage that the deep digging necessitated by the harvesting operations in the two cases of ground-nut and sweet-potatoes, exerts a beneficial effect on the mechanical condition of the soil, to the advantage of the following crop of *Ricinus*.

An interplanted crop of groundnut has already been suggested above. In this country, it is a four months crop, which accommodates itself well to the quality of soil suitable for the Castor-oil plant, and which under fair average conditions, especially if the land

has been limed, would give from 2,000 to 2,500 pounds of pods per acre. This is equivalent, at the ratio of 65% of their weight, in Kernels, to 1,300—1,625 pounds of shelled Kernels with an oil-content, from an ordinary country-mill, of 30% to 40% or say 35%, i.e. a final output of 450 to 560 pounds of oil per acre. In addition there is the very valuable oil-cake which can be used either as cattle food, or as manure, as it contains as much as 8% of nitrogen.

Although it is generally poor husbandry to grow the same crop twice successively in the same ground, the practice can be, and is largely, followed in India without harm, in the case of groundnut, provided the land receives between the two crops, a moderate dressing of lime and ashes. It is therefore quite feasible to obtain two crops in the course of one year, resulting in an output of 2,600 to 3,250 pounds of Kernels per acre or 900 to 1,120 pounds of oil and from 1,200 to 1,450 lbs. of cake, dry.

Followed by Gingelly (*Sesamum indicum*) which does exceedingly well after groundnut, a further crop of oil-seed would be obtained which could be treated for oil by the same extracting appliances as used for Castor-seed.

A last crop of sweet-potatoes could be put in, as in digging up the roots, a thorough breaking up and pulverizing of the soil takes place, which will make easy the preparation of the land for a new crop of *Ricinus*.

Manuring will be necessary at this stage. Manures are scarce and expensive—but in this case, they will cost nothing more than the cost of application; for the stock of groundnut and sesamum-cake will amply suffice for the requirements of the land in nitrogen; the deficiencies in potash and phosphoric acid (of which groundnut cake contains 1.2%) being made up by an addition of ashes from the stems of the Castor-tree itself and other refuse (shells and husks) and, if necessary, a modicum of bone meal. Nor must we lose sight of the Castor-pommace saved from the original crop, which is one of the best vegetable manures known—Castor-cake containing 5½ to 6% of nitrogen.

In February 1918 the price of the cake in London was £37 per ton, *i.e.* nearly 4 pence per pound. Considering that, by reason of its poisonous content, Castor-cake cannot be given to cattle for food, this price gives an idea of its high manurial value.

As a matter of fact, although the Castor-oil plant is considered to be an exhausting crop, it need not, under a careful system of husbandry, leave the land impoverished.

For, taking the plant as it stands, all of the plant food which has gone to form the roots, stems, leaves and seeds with their capsules and husks, can be restored to the land in the form of ashes, or better still, after passing through a chaff cutter or a root-cutter, in the form of a compost, so that nothing, except the oil, need leave the farm.

Now, Castor-oil, like other stable oils, contains only such elements *carbon, oxygen and hydrogen* as are drawn from the air, and by the sale of it, the land loses none of its fertilising agents.

Harvesting and Yield.

Having started planting in November, picking should begin about April for the earlier varieties and in May-June for the later ones. It is not a laborious operation and it can be done by women and children going over the fields once a week to pick the capsules when the calyces turn from green to brown and the yellow husks become visible. It may take over two months to finish the crop, but it often lasts less long if the weather, keeping hot and dry, hastens maturity. Harvesting is done by cutting the spikes, but where it is found that the capsules mature very unevenly on the spikes, a little hand picking of the capsules may be resorted to at first, to avoid loss of seeds, the spikes being cut later on when all the capsules present a more uniform degree of maturity. A less commendable method, but one which shortage of labour may excuse, is to let the capsules ripen and drop their seeds to the ground where they are gathered at leisure. This, of course, saves time, but it is admissible only where *Ricinus* is grown as a pure crop, and where the ground is clean and free from weeds. Where, *Ricinus* is grown with another oil-seed crop, especially groundnut the seed should be picked; the least admixture of Castor-seed with groundnuts would be fatal to the sale of the latter.

The capsules, collected in bags or baskets are brought to the store, and thrown in a heap on a clean concrete floor; a square enclosure is made to enclose the heap by putting up boards or iron sheets to a height of 3 feet—this to prevent the scattering of the seeds when the capsules open.

The heap which must be protected from the rain, is covered with gunny bags for 3 or 4 days and when, a beginning of fermentation having set in, the capsules have somewhat softened, the heap is opened, spread out and turned over in the sun. Most of the capsules will have shed their seeds in 5 to 6 days. Women are then put on to sort out by hand the broken pieces of shells which are taken to the compost heap or reserved for fuel. What capsules remain unopened are beaten with cudgels until all are disposed of. Small debris of shells remain mixed with the seeds after the bigger pieces have been removed, these are dealt with by means of the "*neeru*" a triangular tray, made of bamboo strips, with raised sides, or, if one is at hand, by passing the lot, seeds and debris, through a hand-winnowing machine.

The clean seeds, if they are to be made into oil on the farm, must be divested of their coats or husks. To this end, after two or three hours exposure to the sun to heat them, by which the husks are made more brittle, the seeds are passed between horizontal rolls set at a distance apart from each other, just sufficient to break the husks by slight pressure, without quashing the Kernels. The husks being very brittle crack easily, and with a very simple contrivance, to lead the seeds on to the rollers, a mangle such as used for the sheeting of rubber would do very well for this purpose. The husks, though cracked, may still adhere to the Kernels: a second passing between the rollers set a little closer will insure a further cracking,

and the seeds may then be put through the winnowing machine or shaken on the "*neeru.*" Some of the Kernels may still have small pieces of husk adhering to them but this is of no consequence in the further process of expressing the oil. It may be here mentioned that the husks impart neither colour nor taste to the oil, so that the quality of the oil is not affected by their presence with the seed.

As a matter of fact, present up-to-date oil-mills equipped with powerful presses, treat seeds in the husk without taking the trouble of husking them: but with presses of small power, such as would be used on small plantations, the husks would retain an undue proportion of oil in the cake: for this reason seeds must be husked in the latter case.

On the other hand, if it does not colour the oil, the presence of the husks in the cake gives it a dark colour, and, moreover, it detracts from its manurial value, in that the husks contain no nitrogen; the nitrogen percentage of the cake is thereby lessened, and its value correspondingly lowered.

Hand power Castor-seed decorticators are also made by makers of Oil machinery by which the outer husk is removed and the white Kernel turned out ready for the press but present prices put them beyond the reach of the small farmer.

Under fair average conditions a crop of 800 to 1,200 pounds of seeds with their husks can be obtained off one acre in a season.

According to Spon's "Industrial Arts" 1,400 lbs. of Calcutta Seeds gave 980 lbs. of Kernels from which the following quantities of oil were obtained:

1st Quality 324 lbs.
2nd „ 87½ „ } = 488 lbs. of oil.
3rd „ 76½ „

That is to say that the Kernels divested of husks gave almost exactly half their weight of oil, *i.e.* 100 lb. of seeds gave 70 lb. of

Kernels which in their turn gave of oil	35 lbs.
„ „ of cake	35 lbs.
the weight of the husks amounting to	30 lbs.
	100 lbs.

These figures vary according to the amount of pressure used: a powerful set of presses may give from 5% to 10% more oil than weaker ones and correspondingly less weight of cake.

Again some varieties yield more oil than others and lastly some also show a greater weight of shell than others.

The writer found 268 seeds weigh 1½ ounce and after husking them found:

268 kernels weigh 1 ounce
268 husks „ ½ „

These seeds were of a small variety in which the proportion of husk to kernel is likely to be higher than in the larger varieties.

The Bulletin of Imperial Institute 1911 gives a yield of oil of 55.41% of the weight of Kernels corresponding to 41.76% of the weight of the whole seeds containing:

kernels	75.37%
husks	24.63%

Oil Extraction.

The extraction of oil consists of three operations, namely:

1st. The grinding of the seed to a fine pulp in order to break the oil cells.

2nd. The heating of the ground seed to facilitate the flow of oil.

3rd. The pressing of the pulp, to force out the oil, leaving the cake as residue.

A fourth operation consists in submitting the meal to the action of a chemical solvent in which the oil is dissolved and from which it is separated afterwards, the final residue or cake containing only a very small percentage of oil. This process which is only practicable in specially equipped mills does not concern the planter.

Large modern mills, as already stated, treat the Castor-seed whole, with the husks on; but a hand power plant such as would be called for, to deal with the small crops contemplated in this paper, could not supply the pressure necessary for an adequate expression of the oil from seeds in their husks.

The small planter will therefore have either to sell his seeds to the oil-pressers, or to treat the seeds after husking them more or less completely. We have shown above how this part of the work can be done.

The husked seeds have thus to undergo the three operations of Grinding, Heating and Pressing.

Some makers of oil-mill machinery are now supplying hand-mills to meet the requirements of producers who do not use power.

The Firm of Rose, Downs and Thompson, Ltd. of Hull and Shanghai, supply such a mill catalogued as *"The Manual Oil-mill No. 359"* to crush 56 pounds of oil-seeds per hour, and worked by two men.

"The Mill consists of the following machinery: one set of Anglo-American Rolls 3′ high, 6 in. in diameter and 6 in. face, hand-driven with heavy fly-wheel; one wrought iron fire-heated pan or kettle, to be placed on a brick-foundation and worked by hand; one set of double hydraulic pumps, hand-driven, the large pump being arranged to give the first pressure rapidly, and the small pump to give the final or finishing pressure without a material increase of effort from the workman; one hydraulic press, to make five taper cakes 13″ x 6″ x 5″ fitted with corrugated metal plates bearing any desired brand; one 4 in. hydraulic gauge and pipes; a supply of woollen press bags, mending yarn and other needful sundries."

But even such a simple plant may be, in these times of extravagant prices, above the means of the Planter, and in this case he will have to fall back on such makeshifts as he may find at hand.

With ingenuity and the gift of contrivance, he will find that his case is not hopeless.

Grinding of the Seed. The Kernels of the Castor-seed are soft and do not require the elaborate process of shredding or pulverizing, in disintegrators which Copra, for instance, requires. They can be ground, by passing between the rollers of a strong mangle such as used for sheeting rubber, or by pounding in a wooden mortar made *ad hoc.*

Heating of the ground Kernels. The pulp is conveyed to a platform heated by means of a flue underneath. The heat should not be greater than what the hand can bear, or say 140° to 150° F, and such a flue as used on coffee estates to dry parchment would be suitable. Or it may be simply a barbecue in the open, dependent on the heat of the sun, provided a movable roof shelters it from rain and a flue underneath allows, in cases of insufficient sunshine, to supply the heat necessary (140-150° F) to penetrate the mass of meal and render the oil more fluid.

Pressing. A hand-power screw press will fulfill this purpose. Such screw-presses are made by makers of oil machinery, which are furnished with several steel plates and capable of dealing with 8 to 10 pounds of seed per charge, the meal of crushed seeds being enclosed, after heating on the flue, in woollen or canvas bags and inserted between the plates. On pressure being applied, the expressed oil flows down to a tray at the foot of the press, whence through a spout it falls into a suitable receptacle.

So far, then, the series of manipulations are as follows:

1. The crushed meal of seeds, on issuing from the rollers of the mangle, is laid on the heated table.

2. When sufficiently heated, the meal is taken up with a small hand-shovel in quantities sufficient to fill a square or oblong mould made of four small scantlings 4 to 5 inches high, without a bottom, and of the same size (inside measurement) as the steel plates mentioned above. Strips of canvas bagging—cloths of suitable size are disposed on the top of the hot table and the mould placed in the centre of these cloths, is filled with heated meal: the sides of the cloths are then folded round the meal following the contour of the mould, which is taken off and the slabs of meal are now wrapped up in the cloths. They are left on the hot table until the number of slabs, 5 or 6, is sufficient to fill the press for one pressing: they are then inserted in the press between the plates which, in the meantime have been kept immersed in a bucket of boiling water.

The pressure is now applied and a whitish oily fluid oozes out which is collected below and boiled with its volume of water, while all impurities, as they rise to the surface, are skimmed off with a

skimmer made of gauze. The mucilage and starch, contained in the meal are taken up by the water and the albumin, coagulated by the heat, forms a film below the oil between the oil and the water.

The oil is removed to another pan and boiled again with half its volume of water, until water vapour ceases to rise, when a small quantity of the oil put in a cup is found to be perfectly clear, transparent and colourless.

By this second boiling in a fresh supply of water, the oil is clarified and freed of acid matters.

The boiling may be done in a "dapur" such as used by the Chinese for the cooking of gambir or of pig-food; a 2 feet diameter pan will do for the purpose: its edges are let into the brick-wall of the oven, and the walls are continued, forming like a well to a height of 2 feet, thus giving a capacity, if we take into account the concavity of the pan, of about 6½ cubic feet or 40 gallons.

The boiling should be stopped as soon as the last drop of water has been expelled and no more bubbles appear.

Instead of a second boiling, the oil may be clarified by passing through charcoal in filtering bags, such as are used by distillers, or failing such, through a blanket.

The quantity of oil thus expressed would range from 30 to 35 per cent of the weight of the seeds with the husks on, leaving from 35 to 40 per cent of cake.

We may now bring our figures together and work out the produce of one acre of *Ricinus* interplanted with two successive crops of groundnut in one year.

An average crop of Castor-seed is computed to give from 800 to 1,200 pounds, or say, an average of 1,000 pounds of seeds which would result in 350 pounds of oil and 350 pounds of cake, yielding a gross revenue of:

350 lbs. of oil @ 45 = 157.50
350 lbs. of cake @ 5 = 17.50 } = $175.00

The produce of two crops of groundnuts was given above as between 2,600 and 3,250 lbs. or say, 2,900 pounds of shelled Kernels, a readily marketable product at the present rate of $25 per pikul; which will leave the planter a sufficient margin to cover not only all his costs of cultivation and of living but also the cost of manuring his fields for the following crop of his rotation, cost which need not be heavy for, it may be here noted, the leaves of *Arachis hypogaea* with the roots left after the nuts have been gathered, constitute, when dug under, a highly nitrogenous green-manure.

Given a land previously cleared, or under light blukar,—a land which could be made ready for cultivation at a cost say, of $20 per acre, the cost of a first Castor-oil crop (not including buildings and general farm equipment, ploughs and harrows, spraying apparatus or oil pressing appliances) would amount to about $100 per acre made up:—

by clearing, draining and cultivation	$50
Seed, planting, weeding, harvesting, insecticides	30
Oil extraction and tins	20

The 2 intercrops of groundnuts would cost per acre:

100 lbs. of seed (two sowings) at 25 cents	$25
two sowings	10
two harvestings and 2 shellings	25
Bagging and transport to market	25
Groundnuts, Cost of two crops ..	$85

The total aggregate cost of one crop of Castor-oil and two crops of groundnuts would therefore be $185.

The gross revenue of one acre of *Ricinus* has been already given as $175.

From the figures obligingly supplied us by the Manager of the Singapore Oil Mills the present prices of groundnut for which there is an excellent market, stand as follows:

Grade 1 unshelled $700 per koyan of 40 piculs.
„ 2 „ 650 „ „
„ 3 „ 600 „ „
Shelled nuts $25 per picul.
Oil cake 8.50 to 9 per picul.

The aggregate of the two crops of groundnut *i.e.* 2,900 lbs. (= 2,170 catties) of shelled nuts at 25 cents per catty would bring a gross revenue of $542.50

Making a total gross revenue of one acre (including the Castor-oil revenue $175)	717.50
Less expenditure	185.00
Leaving a nett profit per acre of	$532.50

If, however, making allowance for the vagaries of seasons, for undue prevalence of pests, and also for the fact that the groundnut, in this case is an interplanted crop,—not a pure crop—we cut down the returns from that source by one fourth and bring the amount of the two crops to 1,6527.50 catties of shelled nuts, the revenue from groundnuts would fall to (1627.50 x 25) $406.85
which added to the Castor-oil crop 175.00

would give a gross return of	581.85
and after deduction of all expenses	185.00
would leave a nett profit per acre of	$396.85

Uses of Castor-oil.

The many uses to which castor-oil is put make it one of the most important raw materials of industry.

As is well known it is used in preference to other oils for dressing hides and skins, morocco leather, and generally all kinds of leather goods, belting, boots, harness, etc. as it makes leather soft and pliable.

It fulfills particularly well the functions of a first-class lubricant as being a heavy bodied oil and very viscous, it forms an effective film between moving parts of machinery and keeps them free from friction, and for that reason, it is used in preference to other oils, in concerns—estates and mines—where internal combustion engines are employed.

It is said that, mixed with a soda-lye, Castor-oil has the property of imparting transparency to the resulting soap and it is used for that purpose by soap-makers.

It enters into the composition of unguents and pomatums in perfumery in Europe as well as in India, where it is used as an ointment to keep the skin cool and open. In Italy, the well known "Olio di Ricini a l'Inglese" is, or was, in common use.

Among the less known uses to which Castor-oil is put is that of binding agent for certain insulating compounds which enter in the composition of "Enamel Wire" which is very largely employed for cables. The Western Electric Company of New York import for their own works alone 30,000 gallons of Castor-oil used, in great part, for that one purpose.

Castor-oil imparts fastness and lustre to the dyes used for cotton and woollen goods—and made under the name of Turkey-Red oil, after treatment in concentrated sulphuric acid. It is preferred by dyers as fixing agent for all alizarine colours.

Castor-oil is in great demand as lubricant for aeroplane-motors, owing to the fact that it is unaffected by a wide range of temperature.

Cases did occur during the war when, travelling at great altitudes, the oil congealed and failed to run into the bearings of the engine which would then get red hot, and fatal accidents were traced to this cause: but, it would appear from the "Chemist and Druggist" of 20th February, 1920, that means have since been found to prevent Castor-oil from congealing while retaining its lubricating properties.

From the same source, we also learn that casein combined with Castor-oil is now manufactured into flakes which mixed with water produce a perfect emulsion with the taste of milk.

The value of castor-cake as a fertiliser is very high, and a market exists for every pound of it produced.

Its medicinal properties are well known to all.

As a last resource, it can be used like other oil-seed cakes to generate gas for lighting or for driving machinery. This conversion of cake into gas is in practice in several towns of India, and Dudgeon gives us in 'Agricultural and Forest Products of West Africa" an instance of Cotton-seed cake being put to the same use in an oil-mill at Ibadan (South Nigeria) where it was found that 6 hundredweight of such cake is sufficient to generate gas to drive a 30 h.p. engine for 9½ hours.

Before closing this paper, the writer would emphasize the fact that Castor-oil is not a crop for extensive cultivation as a pure crop on a large scale. One of the reasons for this is that it produces normal crops only under such conditions as are quite congenial to it, and one such condition is *shade* during at least, one part of the day not overhead shade, but side shade from large trees growing to the East or the West of the field.

A planter of very long experience, in a letter to the writer, says: "Castor-oil is a peculiar plant. I reared it in Africa. "Grown wild, it yields well; cultivated in plantations, it hardly "yields at all; moreover the oil is of irregular and inconstant "density."

The same is to some extent observable in the Economic Gardens for the plants growing in the full sun—their growth is backward, their flowering is poor—whilst the trees which receive, either in the morning or in the afternoon, the shade from large neighbouring trees are showing quite good crops.

E. Mathieu.

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Betel.

One of the first things noticed by the newcomer to the East is the red appearance of the lips and teeth of the natives together with their habit of chewing. He may also observe, particularly in country districts, that many of the natives carry a small tin or receptacle of some description about with them. A peep into this tin would bring to light various things but chief amongst them would be found some betel nut and betel leaves. These form the chief constituents of the mixture, known as "betel," which is chewed by many of the Eastern peoples. In towns the mixture may be seen ready made up for sale.

It is intended to give a brief outline of these two ingredients namely Betel Nut, the seeds of *Areca Catechu,* L., and Betel Leaf, the leaf of *Piper Betle,* L. The production of the former particularly, is essentially a native industry and is interesting on this account.