Indian Agriculture

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Pages up to 14 Missing

These form the chief cotton-producing plants; there may be others with which I am not acquainted, but they are not of sufficient importance to require notice here.

Cotton, from every one of the plants enumerated above, varying in quantity from one to five pounds, have been forwarded by me to the London Exhibition of 1862; and from the Gossypium family to the Manchester Cotton Association, through their Honorary Agents Messrs. Line and Co. of Madras.

III. Cultivation of the Plant.

Cotton is a soft downy material which envelopes the seeds of various plants, especially those of the different varieties of Gossypium from which also the cotton of Commerce is procured. It is known in Tamil as Paratee; in Hindustanee Kupas, or Roohie; in Teloogoo Thuthee, and is very extensively cultivated in India.

The foreign species, Gossypium Peruvianam, and Gossypium Barbadense, have been acclimated in India for nearly half a century, but owing to the indifference of the natives of India to exotics, their cultivation has not extended so far as one might have expected, from their being so much superior to the indigenous species.

Cotton belongs to the natural order Malvaceæ, or mallow order; which is indigenous to the tropical parts of Asia, Africa, and America. All the varieties of this order produce either herbs, shrubs, or trees, having palmately divided leaves, often stellate, hairs, and showy involucrate flowers on axillary peduncles; sepals five, rarely three, or four, united at the base, valvate, often having an epicalyx petals of the same number as the sepals, twisted. Stamens above twenty; monodelphous; united to the claws of the petals; anthers one celled, kidney-shaped, opening transversely on the side next the pistil; pollen covered with long very harsh hairs. A many celled ovary with placenta, in the axis, or several ovaries separate or separable, when ripe. [illegible] number to the carpels; distinct or united. [illegible] one or several seeded carpels, with [illegible]

combined or separate; seeds with little albumen, embryo curbed with folded seed lobes.

Gossypium is a shrub belonging to the mallow order, with showy flowers, and an erect branched stem, with stipulated palmately divided leaves which are alternate, large, lobulate, and more or less pubescent. The inflorescence solitary with axillary, pedunculated, involucrate flowers. The follicles large or small, and, more or less ovoid at the base, and accuminated at the apex, containing 3, 4 or 5 cells; seeds 7 to 15.

The plant is a perennial; flowering and yielding fruit for several years.

The foreign cotton has been cultivated in the Coimbatur, Tinnevelly, Bellary, Malabar, Mysore, Madras, and a few other districts.

The natives, to whom the cultivation is almost entirely confined, seem to have a prejudice in cultivating the exotic species, and this has been done only to a small extent by them and a few European Amateur planters.

Hitherto, the cultivation has been carried on in a rude, and indifferent manner, and that attention, which its importance demands, has not been paid to so valuable a product. For a much more productive and therefore a more remunerate result (by which I infer a high improvement in the staple), greater care and attention in the cultivation of the plant is necessary than has yet been bestowed upon it.

In the culture practised by the native planter, the soil selected is black, soft, and porous and is well known as the Regur or "*black cotton soil*," composed of decomposed basalt. The seed used is generally of the indigenous sort and the ground intended for its reception is prepared by being ploughed up a few times; manure is seldom used, but in some districts the usual dung heaps or wood ashes are lightly scattered over the ground, and should cattle not be allowed to enter the fields, the leaves and twigs of the previous year are frequently permitted to [illegible] ground to form manure.

As a general rule cotton fields are not irrigated,—the ryot has therefore to depend for the successful growth of his crops on the periodical rains.

The seed of his own growth or of the same district is sown over and over again, each successive year, and this appears to have continued for centuries. It is prepared for sowing by being steeped in a solution of cowdung and dried in the sun to prevent it sticking together, mixed with dry grain or pulse and sown broadcast; in some districts the seed is sown in parallel lines alternately with pulse by means of a drill.

The sowing takes place in some districts as early as June, but seldom later than September, depending to a great extent on the particular seasons.

The seedlings appear between the third and seventh day, and when they are three weeks old, the plantation is hand weeded, which process is repeated some two or three times during the growth of the plant. Frequently when the seedlings are but a fortnight old, a plough is run through the field to loosen the earth as well as to facilitate the removal of weeds.

The plants though generally considered to be herbaceous are found to be more or less woody and are full grown shrubs, varying slightly according to the particular kind of seed sown.

The plant generally begins to flower about the 4th and to ripen its fruit at about the 6th month of its growth, but in some rare instances, this does not take place until the eighth month.

The cotton wool of the several varieties in general cultivation in India, during a favourable season, is of a fair quality and the staple is even silky, and each fibre is strong; but in an unfavourable season those qualities are seriously deteriorated from the dearth of moisture.

The naturally rude and careless manner in which the native is known to conduct all his agricultural operations is here pre-eminently discerned in the cultivation of cotton,

and this at once accounts for its usual deficiency in quality and it is surprising to witness, even under these disadvantages what a large amount is turned out in a tolerably fair season.

The pods, as a rule, are not collected as they ripen, but are allowed to remain until the whole crop of the field is ready; and so little of importance is attached to the speedy collection of the harvest, that even then the ryot consults his own convenience rather than the importance of his duty. In many instances he is either unable to procure labour, or has not the means of doing so; often he is not permitted to gather in his produce in small quantities as the fruit ripens, but has to await the pleasure of the merchant from whom he has received an advance and frequently the crop has to be assessed, before he is permitted to gather it, during which delay, in most instances, two-thirds of the produce fall to the ground where it becomes mixed with dust and the debris of the standing plants, &c.—and should it happen to rain during this interval, 50 per cent. of the produce is irretrievably lost. In some districts the ryot gathers the early pods, so as to be enabled to come early into market. It is then cleanly gathered. But when the cotton season has fully set in, the price fluctuates, and the ryot being in no hurry to enter the market, thinks the produce may just as well lie in the field as in his house.

When the cotton at last is gathered, no care is evinced in removing the dried leaves, and other extraneous substances found attached to it, but it is generally taken off with all these impurities still clinging to it, and thrown into some receptacle, generally a large open bamboo basket, and carried to the stack yard, where it is heaped up amidst the dust or flue which necessarily abounds there. I have often witnessed heaps of cotton both cleaned and uncleaned lying exposed to wind and weather.

The produce thus collected is next freed from seed. This operation is, at the best, conducted by means of an Indian Churka. The cotton, as brought in from the field, is freed

to a certain extent of its capsules, stalks, leaves, &c., and then is submitted to the Churka; but in most districts the cotton is spread out on a common charpoy or country cot, and beaten with switches, when a portion of the minute particles of earthy or other extraneous matter still adhering falls through; but from the previous slovenly mode of gathering the cotton, no effort, however persevering, can now entirely free it from its impurities.

The beating or thrashing is more intended to loosen the wool from the seed, to which it adheres rather tenaciously, and in order to facilitate the operation of ginning by means of the Churka, which is a small primitive hand machine composed of two horizontal cylinders, the right end of which is constructed on the principle of the Archimedian screw. On the wool being slightly loosened from the seed, and held between the two cylinders, which are fixed in close contact and revolve in opposite directions to each other, a layer of cloth is fixed beneath the rollers, and fastened to the uprights of the stand, which is to separate the seed from the wool, as it passes through the cylinders.

This operation is generally performed by females, who hold the seed cotton in the left hand to feed the cylinders, and with the right simultaneously turn the Churka; the cotton is thus drawn between the cylinders, whilst the seeds are by the counter-revolution of the cylinder repelled back, as they are unable to pass through from their size, and fall to one side of the machine, the cotton falling off on the other compressed into a fine layer. A woman, by manual labour alone, can clean only about four pounds of cotton, whereas with the Churka, she can free from about *twenty-five*, to *thirty* pounds in a day of 10 hours. The cotton is next baled. This operation is thus managed.

To a strong, perpendicular, wooden post, a cross piece like the balance of a scale is suspended, the post being partly buried in the ground, and to the cross piece, a bag of gunny or gunny is attached, intended as a covering to the bale. From 5 to 6 maunds of cotton are now thrown

in, and pressed down by a few men who jump into the gunny and compress the cotton with their dirty feet. From six to ten men are sometimes thus employed, whilst others are engaged in bringing the sides of the covering together, and securing them by sewing. In some places the gunny bags are hung by three ropes from the roof of the house; a fourth being free in the centre, is also attached to the roof, to which the men stamping the cotton hold on; these bales vary in size and shape, being adapted to the mode by which they are conveyed to the nearest market for export, and which is either on pack bullocks, or carts. From the time the cotton is gathered to that of export it passes through several hands who, from interested motives, adulterate the wool in various ways.

The price of cotton varies according to the particular locality in which it is cultivated, and to the distance of export. The average price of a pound is about one anna.

Foreign cotton has been cultivated by the natives much in the way above described.

The American plan of ploughing the land and forming it into ridges varying in breadth from 2 to 5 feet, according to the nature of the soil, and the particular variety of cotton, was tried by Dr. Wight in the Coimbatur district, and is thus described by him. "The method of sowing in Coimbatur is to run a slight furrow from an inch and a half, to two inches deep, with a country plough along the centre of the ridge, in which the seed is pretty thickly scattered and covered by running over it a small triangular harrow." When the plant is three or four inches high, and beginning to put forth the third or fourth leaf, it is thinned out or "scraped" that is the greater part of the superfluous plants and weeds are scraped out with the hoe. This operation is repeated in 10 or 12 days, to complete the thinning and superficial cleaning of the land. About this time, or a few days later, the plant is sufficiently advanced to admit of the plough being used between the rows. The plough used is small and light, such as can be drawn by a single bullock

with it; a light furrow is run within 5 or 6 inches of the plants, turning the earth inwards towards the roots to supply the place of that previously removed by scraping. This operation of banking up the roots, is completed with the hoe. If the soil is foul, and at the same time soft enough to be easily worked, the ploughing may "be repeated several times the more effectually to destroy weeds."

We shall now consider the cost of culture by the ryot of one acre of dry or poonjay land with cotton, according to the native system, without the process of irrigation.

	Rs.	As.	P.
Ploughing (for four operations at 8 annas each),	2	0	0
For 10 seers of seed	0	4	0
Weeding	1	0	0
Sowing	0	4	0
Picking the cotton	0	4	0
Cleaning the cotton	0	8	0
Land tax to the State	2	0	0
Total Rs.	6	4	0

The average produce of one acre of land is 220 pounds of seed cotton, which when cleaned will produce 70 pounds of clean wool, which at the market rate of two annas per pound, will yield 8 rupees, 12 annas; from which deduct the foregoing outlay of 6 rupees, 4 annas, and we have a clear profit of Rupees 2¼ accruing to the ryot or cultivator.

The average produce of an acre of course fluctuates greatly, arising from the rude process which has been adopted throughout.

The cost to the merchant or exporter is as follows:—

	Rs.	As.	P.
Cost of 70 pounds of cotton	8	12	0
Expense of carriage to seaport	2	0	0
Freight at about 35 Rupees per ton ...	2	0	0
Th[illegible]ewing, baling, &c.	0	8	0
[illegible]mmission, brokerage, &c.	0	8	0
Total Rs.	13	12	0

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We see plainly by this that the produce of one acre of cotton costs Rs. 13-12-0 before it reaches England and to this must be added the profit anticipated by the merchant which in a great measure depends upon the state of the market at Home. The cost per pound will stand him at about 3 annas 1½ pie.

"Having briefly detailed the native, and American mode of cultivating cotton as well as showing the costs, and profits attendant on the former, we shall now proceed to suggest improvements, which if adopted, cotton of a superior quality will be obtained, and in sufficient quantity to remunerate both the ryot and the merchant, and thus instead of being the very poorly remunerative article, which at present it is considered to be, will prove a well paying investment to labour and capital."

Pursuing the original plan we shall consider first the improvement necessary in cultivating, regarding the selection of the soil, ploughing, kind of manure, choice of seed, sowing, and mode of irrigation, weeding, &c.—these being points of importance, we shall consider each separately.

Selection of soil.—Care should be taken in the selection of the soil in as much as it is of the greatest importance that it should be clean and in good condition, the land should be manured and well farmed. To carry this out more effectually the chemical elements necessary for the proper nourishment of the plant should be ascertained to exist in the soil, and this state maintained during its growth, and the manner in which the root descends should be kept in view.

Though it has been considered to possess a tap root, I have found it always to consist of a tap root surrounded at its base, or part connected with the stem, by many and large sized, branched roots, with rootlets attached, and these enter the soil in all directions penetrating dir[illegible]ming downwards as well as horizontally outwards.

Well drained land neither too stiff and clayey, [illegible], or a dry, firm and gravelly, neither too rich, nor too poor [illegible]dmit of [illegible]h used [illegible]ullock

be selected. A gravelly or red, loose, sandy soil, having a decaying granitic subsoil in its composition, is the one in which exotic cotton will thrive best.

When however the cotton grows too rapidly, as is the case when the soil abounds with humus "stimulating it into soft and sappy luxuriance" increasing the formation of wood, and leaves instead of flowers and fruit the plant is rendered either sterile, or much less fruitful.

In the selection of land for plantations it should be borne in mind that, for the success of the operator, a more or less moist soil is necessary, so that the land should not be too porous to admit of free evaporation. Soils too abundantly supplied with moisture, or wet lands, have been tried, and rendered productive by adopting the system of ridging, and during the rainy season, trenching, or subsoil drainage of the land to avoid swamping, which if it does not destroy the plant entirely by rotting the roots, the other ill consequence of sappy luxuriance, &c., will ensue.

When the soil is moderately loose, it facilitates the descent of the root. A fair crop may be grown on land known as the common black cotton soil, provided attention is paid to drainage and the lightening of the soil by the addition of sand, as the earthy parts of the soil are useful in retaining water, so as to supply the roots with the necessary proportion of moisture, as well as to the correct distribution of the animal, and vegetable matter, which by being thoroughly mixed with it prevent them from decomposing too rapidly. In selecting land, advantage should be taken of localities where facilities exist for sinking wells, so that in dry weather irrigation to a small extent might be brought into play to give moisture to the soil; more especially during the infancy of the plant, and when it is in blossom.

These are the only periods that it will require water. In infancy to give nourishment to the seedlings and enable them to take root, and when blossoming to give staple to the fibre and improve the quality of the cotton wool.

Land having been chosen, special care should be given to ploughing. The ground should be ploughed so that at least a foot of the soil is turned up, and care should be taken now that the grass and weeds are thoroughly eradicated, and carefully collected from the ground and burned; and when their ashes will serve as manure. Weeding therefore should be most carefully attended to, as if the roots be not thoroughly exterminated, they will certainly spring again, and be a source of never ending trouble subsequently. This being accomplished, every part of the earth should be exposed to the action of the sun and properly manured. Sufficient attention has not been given in this country to agricultural operations. We have already described the indifferent manner in which this plant in particular is cultivated; manure is seldom or ever supplied, the same rude process of manuring which has been in existence for centuries continues to be carried out in the present day.

The chief manure on which the ryot depends for his agricultural operations, is the dung heap, or wood ashes.

In the use of manure it is not the quantity, but the quality that requires attention, which principle is not appreciable by the native ryots. They therefore allow the manures to be exposed to the influence of the sun and air so long, in most instances, that their essential ingredients become exhausted, leaving nothing more than undecomposed rubbish behind. This satisfies the ryot, because he perceives no great loss in the quantity.

It is beyond dispute, that plants thrive only in certain soils which possess the necessary mineral, and vegetable products required for their structural formation, or such as are found to exist in their ashes, so that cotton from belonging to the family of malvaceæ, requires according to the analysis given in another part of this Essay by Dr. Mayer, a soil richly supplied with Potassa, Lime, Magnesia, &c. It therefore becomes incumbent on the agriculturalist to supply these to the soil with a view to enrich it should

it not already contain a sufficient quantity, and if this be carefully attended to, and the necessary supply of moisture added, almost any soil might be rendered productive and suitable.

All the necessary minerals can be readily obtained at little or no expense by the combination of wood ashes and farmyard manure, in about equal proportions, and by simply substituting a dung pit for a dung hill. For this purpose the pit may be faced with stone or metal, and brushwood, the refuse of the farm yard, straw, decayed leaves, &c., with which every Indian village abounds, should be thrown into the pit; the pit should be lined to the thickness of a foot at its bottom and sides. In addition, the washings of meat, fish, rice, dead animals, as dogs, cats, and other carrion, human urine, and ordure may be added.

"To deodorise the pit and prevent its becoming offensive, as well as to facilitate the decomposition of animal and vegetable matter, and to supply the chief elements in the structure of the plants, a small quantity of fresh lime should be occasionally thrown in, so that in a few months a valuable quantity of manure may be obtained, rich in fertilising properties and containing the necessary ingredients for the nourishment of the cotton plants." The pit thus prepared should be covered over with thatch, so as to protect it from the sun and rain. This subject only requires to be understood in its practical application to be generally adopted by planters who will thus realise double and even treble what is at present their usual crop. This is the kind of manure required for the cultivation of cotton, and by which a luxuriant crop with improved quality, quantity, and staple, will be obtained, for it is evident that the quality of the wool must depend upon the health and luxuriance of the plants.

"Manure prepared after the manner described will, in 12 months, be sufficiently disengaged from putrefaction to be distributed over the ground. It should then be carted away to the fields, in the cool of the afternoon, and on

being laid over the field it should be covered over, in order that the manure may at once become mixed with the soil, and thus prevent any of its volatile ingredients being dissipated by exposure to the atmosphere." But in subsequent dressings each plant should be carefully dug around to the depth of from 3 to 6 inches from the stem, and the excavatings thus made filled up with manure and then covered over with the soil.

In the cultivation of foreign cotton, after having decided on the particular variety to be tried, some care will be necessary in the choice of seed, which should be fresh, as it does not, in most instances, keep well, or maintain its vitality for any length of time. Instead of the seeds which are directly imported, preference should be given to that which has been acclimated—if even by only one sowing. Yet it would be advisable not to continue to plant the same seed within the same district beyond some 5 or 7 consecutive crops.

When freshly imported seeds are used, a number will fail to germinate, and for which allowance should be made, and in order to fill up blanks in a plantation, it would be a good plan to have nurseries prepared at the same time from whence the seedlings might be transplanted, as required on the plantation from time to time.

The cotton is a hardy plant, and if watered for the first week after its transplantation will get on. I have frequently pulled plants up by the roots at various ages, and on replanting them they readily established themselves in their new locality—by aid of a little watering.

The most hardy varieties are the Brazil: next to it the Bourbon; and lastly, the New Orleans. The last of these is rather delicate, and will require more care, but it is the best variety for cultivation.

There appears to be a want of vigour in the newly imported seeds, for they do not come up so well and readily as those that are acclimated, which might be accounted for by the long time which elapses before they reach this

country, and the atmospheric vicissitudes they must undergo in the course of their transit from their native country. There is invariably a loss of one-third, sometimes of one-half in the use of newly imported seeds.

The acclimated seeds in every instance exceed the foreign in growth, vigour, and luxuriance, appearing in from 3 to 5 days, while the foreign takes from 5 to 15 days to sprout up, but by attention to the plantation during the first two weeks, the loss of seed that takes place might to some extent be removed.

One peculiarity in the sowing of foreign seed is certainly strange, its germination appears to take place contrary to all physical laws in vegetable growth, for from some unexplainable cause the radicle, instead of the plumule, shoots up into the air, and when the seed lobes have exhausted their store of nourishment, the seedling withers away. In a few instances the radicle arches down towards the earth on reaching which it strikes root, and establishes itself successfully; advantage must therefore be taken of this latter fact; the plantation must be examined when the seedlings are springing up, and in every case where the radicle appears first it must be reversed by turning the seedling so as to place the radicle downwards, and this when once seen can never be mistaken, though to one unacquainted with the peculiarity, the radicle from its stumpy appearance is apt to be mistaken for a plumule deprived of its seed lobes, supposed to be destroyed by insects, &c.

It is also necessary to satisfy oneself as to the soundness of the seed, for if they have not been carefully preserved, rats are likely to have destroyed the cotyledons, and in those varieties which are covered with down, the opening made by the rats being very small is covered over and hid from view unless closely examined.

The larvæ of a small brown moth is very destructive to [illegible], and attacks them before the pod ripens, the opening [illegible] seed is in most instances so small that it is not [illegible] at all, but the cotyledons are destroyed, and the

cavity is supplied with the dung of the larvæ, which give consistency to the seed, and here also occasionally th opening is covered with the downy exterior of the seed and cannot be seen easily ; a few seeds must therefore be taken out and carefully examined to ascertain whether or not they be sound.

It should be made an invariable rule to collect seeds from those plants that are well grown, and from those pods which possess best and finest staple. In this country especially, too much stress cannot be laid on this subject ; for on it will depend the future success of cotton in India. The seed must be procured from the finest specimens obtainable.

The cultivation of cotton here being entirely dependent on the rains, seed is sown according to the different seasons. In those localities subject to the influence of the N. E. monsoon the seeds should be sown early in September, should facilities exist for irrigation, thus to advance the plant and give it the full benefit of the approaching seasons. But should such not exist, advantage should be taken of the first shower of rain to put down the seeds.

In the Brazil cotton, the plants should be from 6 to 8 feet apart, and in the other American varieties, 6 feet apart from each other. They should be sown in lines, each being about 4 feet distant from the other, and in no instance should the plants be nearer than from 3 to 4 feet. Into each hole from 3 to 5 seeds should be placed, within a depth of one inch. If the seed is placed deeper it does not generally germinate, from not receiving the necessary supply of air, and in most instances it becomes rotten. In large plantations, either the native or the American method may be practised with advantage, although they entail a great loss of seed. That is, after the soil has been prepared, light and straight furrows in parallel lines from 3 to 4 ft. apart are run through, with a common plough, varying in depth from 1 to 2 inches. Into these, the seed is scattered pretty freely and then earthed over with the plough, and as

plants make their appearance and attain a height m about 4 to 6 inches they are gradually thinned out, aving a single healthy plant at the regulated dis- nce. In no instance, should the Brazil cotton plant be ore than 4, and the other American varieties, than 3 feet part. Even for the Indigenous species, this distance ou d always be allowed between each plant, so as to encour- ge free branching.

The quantity, and quality of the produce will greatly epend on the healthiness and vigour of the plant.

Another advantage to be obtained by a due and correct gulation of the distances is that a free circulation of air ill be allowed among the plants, which will be preserved a healthy and vigorous condition ; and as they grow up, heir branches will entwine with each other, and the leaves eing fully developed the ground will be shaded and the jurious influence of a tropical sun, if not entirely over- ome, will be considerably modified, and the rapid evapora- on, which must otherwise occur, will be prevented. At he same time it will be necessary to keep the roots and tems free and clear of weeds, to maintain circulation of ir by giving passage or leaving openings for currents of air o pass through.

If the soil was thoroughly cleared of all foulness before he seeds were sown, there will not be much difficulty in eeping the plantation free of weeds now ; but the few that nay show themselves must be rooted out immediately. The eedlings will begin to appear from between the 3rd and 5th day, and occasionally even later. Those that come up irst will in 3 weeks have attained from 4 to 6 inches in for ht, and thrown out from 5 to 7 leaves, during which eriod the whole plantation should be preserved scrupulously ree from weeds and irrigated if necessary. The soil must now be loosened, not only around each plant but through- out the plantation. This may be accomplished by women with a hand hoe, any remaining weeds being carefully exterminated, and the plantation dressed with a fair propor-

tion of manure, equal to three tons the acre. It sho then be irrigated unless there are indications of a fall of rai

A cheaper and easier mode of loosening the soil on a larg plantation could be effected by running a common plou between the rows of plants, taking care that the ploughin cattle do not either eat the young plants, or trample the under foot; a little care will prevent these destructiv mishaps.

The plough will loosen the soil sufficiently, after whic women and boys may be sent into the plantation to pick ou the weeds. When the dressing with the manure and irriga tion can be practised, acclimated seeds will be found t come up much quicker than foreign, and will be muc healthier and more vigorous. Foreign seeds, even when they do show themselves, appear to sprout out prematurely; and although the plumule continues vigorous for a short time attaining from 6 to 8 inches in height at the end of a fort night, they become weak and sickly, remain stationary in growth, and frequently take on a light green, sickly hue, with the leaves curled up. Thus they continue for another week, by which time, they either thoroughly recover themselves, or continue to die away. Occasionally they continue sickly for some time, then die, seldom recovering if this has lasted more than a week or ten days. They are found less vigorous in their growth than those sprouts which have appeared at the proper time, for it seems natural that rapid growth, and premature decay should go together in organized structure. When the plants are three to four weeks old, is the time to see to the plantation having its proper complement of plants: should any of the seeds have failed to grow, or have been destroyed from accidents, &c., places should be filled by plants from the nursery. Whe the plants are 6 weeks or two months old, they will have attained from about 16 to 20 inches in height, and now the soil should be loosened and the earth manured, and if necessary, irrigated.

The growth of the plant will depend upon the quantity

quality of the sap that passes into its organs, and its odifications to the requirements of the plant by the princi- es of the atmosphere. All weeds should at the same time e carefully removed, and this should be repeated a third ime when the plants are three months old. After this all gricultural operations should to a certain extent cease, hough the plants will require to be carefully looked after, n order that nothing may go wrong, and should the season ail in supplying the required moisture, the plantation must e irrigated.

Irrigation in cotton plantations does not appear ever to ave been adopted except perhaps in amateur experiments carried out on a small scale. The plantation depending on the rains for success accounts not only for the fluctuation of the crops, but in many instances for its failure.

The cotton plant requires rather a moist climate for its successful growth, and when cultivated on the scorching plains of India, will require partial irrigation to supply the moisture artificially to the soil, to render the speculation successful. There are no doubt many hill stations in India where the cotton plant will find a congenial climate. In the plains, if the seasons prove fair, the plants will only require partial irrigation, that is during infancy; so as to advance them sufficiently to profit by the succeeding monsoon, which if fair, will bring them to such a vigorous state of maturity as will enable them to bear with little injury any drought, should such a thing happen. The irrigation should also be used when the plants are in blossom, (if the rains have partially or entirely failed) as it will be necessary at this time to give them a sufficiency of moisture to enable the plant to secrete the necessary materials required for the formation of the cotton wool. For all the different substances found in plants are derived from water, which incorporating itself with the decomposed elements of the vegetable and animal substances in the soil itself, or that derived from the manure introduced into the soil, from the true nourishment of the plant.

Cotton plants will require to be irrigated only parti and but once a week during dry weather, and once a fo night if the season be fair.

The advantage of irrigation is not to supply the necessar moisture to the plants, but also to convey nourishment, dis solved in it, to the roots, and defend them from the effects of the heat; should water be too strongly attracted by the earth, the spongioles will be unable to absorb it; if in excess, or too loosely combined with the soil, it is likely to injure the fibrous parts of the roots.

"The usual method by which land is irrigated throughout India is either by a Picota or by the Moth. A Picota requires 3 men to work it, and a boy to distribute the water through the grounds. These will water about one acre of ground daily, and on an average cost 10 Rupees a month. The cost of erecting a Picota is about 16 Rupees."

"The Moth requires a pair of bullocks with a driver and a boy; these will water about 3 acres of land daily and will cost about 13 Rupees per month. The cost for erecting Moth and purchasing bullocks will be 64 Rupees." The preference should invariably be given to the Moth, as the bullocks will prove of double advantage in the conveyance of manure, and can also be used in ploughing, whilst the boy and man, when the moth is not at work, can be employed in clearing from 4 to 10 acres of land from weeds and insects. The plants having been brought forward, it will be necessary to make the plantation snug in anticipation of the monsoon; if this is not done, much damage is likely to occur from the rains, should they prove heavy; the plants should have their stems earthed up to the extent of 8 or 12 inches, and well laid out drains should be cut to carry away excess of water; and if the plants have attained 3 to 4 feet in height and appear very shrubby, their crowns should be thinned out as soon as an immediate indication of rain takes place; if not, from the size and extent of foliage, they retain a large quantity of water, the weight of which bears down the branches, and tearing them away

consistent with the necessity of its being conducted under conditions not more favourable than could be obtained by any ordinary ryot bearing the payment of assessment.

II. This need not be insisted on though the item must be included in the eventual valuation of the results.

(A true copy)

(Signed) W. HUDLESTON,
Secretary.

Order thereon, 7th October 1861, No. 1934.

I. The Government are precluded from acting on the Board's recommendation by the orders contained in the Despatch of the Secretary of State to the Governor-General, dated 24th July 1860 printed in G. O., 24th September 1860, No. 1696.

(True extract.)

(Signed) J. D. SIM,
Secretary to Government.

Pages 33-36 Missing

Meteorological Observations for 1861.

Exhibiting the monthly mean of the Barometer, Thermometer, Direction of the Wind, and Depth of Rain in the Carnatic prepared from the Tables in Madras Quarterly Journal of Medical Science.

1861.	Barometer reduced to 32° Faht.		Thermometer corrected to the New Observatory's Standard.				Direction of the Wind.		Depth of	
	A. M. h. m. 9. 41.	P. M. h. m. 3. 41.	A. M. h. m. 9. 41.	P. M. h. m. 3. 41.	Maxim.	Minim.	A. M. h. m. 9. 41.	P. M. h. m. 3. 41.	Rain.	Evaporation.
January	29.82931	29.072699	79.197	80.0235	81.8439	69.677	E.	E. N. E.	,,	.316
February	29.8095	29.8934	79.111	82.1468	83.3625	67.1111	N. E.	E.	,,	.281
March	29.16911	29.8336	84.6747	85.6487	87.812	72.7784	S.	S.	.332	.343
April	29.78551	92.737	75.5051	86.07069	78.80467	,,	S.	S.	,,	,,
May	29.6697	97.29454	75.7141	83.1659	79.262	,,	W. S. W.	S.	.411	,,
June	29.7117	97.565	80.0905	87.60047	77.4714	,,	W	W.	.215	,,
July	29.7098	94.4876	79.8112	86.2945	76.8434	,,	W.	W. S. W.	.39261	,,
August	29.7448	90.7786	77.101	82.971	78.165	,,	W.	S. W.	.11252	,,
September	29.7664	90.604	77.5042	82.5711	77.4712	,,	W. S. W.	N W.W.	.11678	,,
October	29.843	87.00387	76.618	83.1982	76.424	,,	N. N. E.	,,	497	,,
November	29.206881	76.938	66.676	76.2886	73.037	,,	N. N. E.	,,	.2811	,,
December	27.42564	76.4885	64.5528	70.529	67.3268	,,	N. E.	,,	.12	,,

IV. A DESCRIPTION OF THE DISEASES, INSECTS AND OTHER INJURIOUS INFLUENCES WHICH ARE DESTRUCTIVE TO THE COTTON PLANT.

The liability of these plants to suffer from heavy rains, &c., and the measures necessary to protect them on such occasions have already been pointed out. It now becomes necessary to notice the diseases to which they are subject, but before doing so, it will be requisite to premise what their healthy condition is, or ought to be, in order to describe their diseased state; as this is a difficult subject for analysis, it will suffice here, merely to notice the various conditions under which health may be said to exist. For it is almost impossible to draw a line of demarcation as to where health ceases, and disease begins.

To endeavour to make the subject clearer, we may be justified in stating that a cotton plant, when in a perfect state of health, is of a deep, or dark green colour, the leaves being shiny, and complete in formation, and every other part of the plant indicating health, and vigor, as it passes through its successive stages of growth. The fruit ripening between the 6th and 8th month; the latter occurring a little earlier in some and later in other varieties. Excess of moisture renders the plant dropsical, and favours the formation of soft sappy wood with a luxuriance of foliage, and this excess of moisture dilutes the sap, and diverts it towards the wood and leaves, rendering the plant sterile or very scantily fruitful from a tendency to succulence. Should this occur when the plant is in flower the fruit becomes abortive, or does not ripen, but drops from the plant in an immature state, from the sap-bearing vessels getting gorged with the diluted secretion, they become ruptured, and the nutrition to the plant is thus cut off. The same abortive result may arise from an opposite state, viz., from the want of a due proportion of moisture in the sap to maintain the integrity of the plant, and thus a shrinking of the sap vessel occurs. In other words cultivated plants are subject to an invariable tendency to disease, from two

opposite causes. The excessive development of any particular structure is liable to destroy the equilibrium of the *whole plant*, with reference to its secretions, and this may be the result of physical causes existing either in the climate or soil of the locality in which it is grown. On the other hand it may arise from starvation, or from a state of semi-starvation, from the plant being wholly or partially deprived of the necessary ingredients required for its nourishment. In the one case starving the plant into dwarfishness, in the other developing it into sappy luxuriance. These states require only to be understood and they can readily be corrected by modifying the effects of the climate to a certain extent, and gradually acclimatizing the plant to its new situation, or by supplying the soil with the necessary ingredients in the way of water, manure, &c.

The Exotic species require a moist atmosphere in addition to such ingredients as may be required for their nourishment, to enable them to maintain a healthy and vigorous existence, and render the plant fruitful.

Moisture in the soil influences its temperature, and the manner in which it is distributed through, and its combinations with the various earthly materials is of importance with reference to the nourishment of plants.

The scorching sun on the plains of India produces rapid evaporation of moisture from the soil, the continuance of which soon interferes with the health of the plant unless artificial means are resorted to in order to prevent this.

When the cotton plant becomes sickly, the first indication is a stoppage of the growth of the plant followed by the decay of the stipules. The leaves then change colour and become lighter and tinged with yellow, the lamina contracts and gets depressed in the middle, and the leaf becomes like a cup from contraction of the margin. In other instances the leaves curl up and the young leaves as well as the succeeding ones become dwarfed. The discoloured spots ultimately acquire a brown colour and as it were slough away, leaving circular and irregular holes in the lamina. Sometimes the stem

itself becomes cankered though frequently the plant continues to show a few flowers and even to ripen its pods. This is no doubt owing to the rapid and constant evaporation going on much beyond what either the climate, or soil can afford to replace, the sap is thickened from the loss of water, and immaturely favors the formation of flower buds, on its return to the stem.

That these results are produced by the climate there can be no doubt; even when sufficient moisture is given to the soil, the young shoots and tender leaves become scorched by the intense heat of a tropical sun; and as evaporation is more rapid in proportion as the temperature is higher, so the plant loses not only its superfluous amount of sap, but that which is really necessary is rendered less deliquescent at the time its ascent is quicker.

In proof of this I may adduce that these effects are visible in those plants only that grow in the open air; when sheltered by a tree, house, or other object, it flourishes well, and none of the effects above detailed are visible. The remedy is obvious, the plants should be slightly protected from the midday sun. But in doing so, too much shade should not be given, for then the plant shoots up tall and slender, without branches, and produces only sparingly. The way in which the plant should be subject to shade and protection, has already been explained.

Vegetables like animals are subject to ravages from parasites. I have found two kinds principally to infest the cotton plant, and from the examinations I have made under the microscope, they evidently belong to what are termed "*thallogens*," or "fungi." They appear in the form of rounded fibres or thallus shooting up in the air, having the lamina of the leaf as a base and feeling villous to the touch. The small fibrillæ that form the nap appear shooting up as sharp projections when seen by the naked eye; under the microscope they are found to consist of pointed tubes interspersed here and there with minute granular cells. It first attacks either the upper surface of petioles, or the

margins of the leaf, gradually extending over the lamina, and matting together the whole leaf into a greyish white, felty, mass. At first it attacks the young shoots and tender leaves, preventing them from expanding. The extension of the parasite deprives the plant of its juices and eventually either destroys or renders it sterile. The spores seem to be derived from the atmosphere, and finding the plant in a state fit to receive them, from either the result of excessive cultivation, or from the effects of heat and want of moisture, rendering it unhealthy and thus favouring the reception of the spores of the fungi. Another variety speckles the leaves with whitish dots. These remain separate, but the lamina is covered with them and in time the leaf changes colour, becomes yellowish, and eventually dies away. This is evidently the disease called Bunt or some variety of it, as it is seated beneath the epidermis and eventually the spores escape. Under the microscope, they seem to consist of small dark cells or spots attached to a thread like Mycelium.

The only effectual remedy to destroy these parasites is to watch the plantation carefully and to remove every affected leaf the moment it shows itself and have them destroyed. In the early stages, ere the spores have become matured, simply removing them will suffice. Several remedies have been tried, such as solution of blue stone, common salt, &c. but such will only be required in special cases.

Blight is more frequently the result of plant-lice, which will be noticed in connection with insects.

Insects and Animals destructive to Cotton.

Cotton plants are subject to ravages from caterpillars and other varieties of insects which frequently eat away the whole of the lamina, leaving only the midribs attached, and thus giving the plant a singular appearance and sometimes completely injuring it. Not only the leaves but the tender stems, petioles, peduncles, flowers, and fruit are destroyed in turn by different insects. Considering the importance which the subject of cotton culture in India has now obtained, it

will be necessary to enter fully into the consideration of these destructive insects, in order that they may be accurately described. This will not only tend to the advancement of science, but will also lead to some rational method of prevention.

Those only who have witnessed the ravages made by them can clearly understand how fields may be laid bare, and for the most part destroyed, perhaps in a single night.

Class VIII. Insecta.

Order IV. Rhynchota.

Sub-Order I. *Homoptera.*—The first of this group is a small oval insect which appears active in all its stages and is covered with a white cottony mass which is found to swarm with the ovas and young larva. On examination under the microscope, they are found to possess 6 short feet, and are seen to move pretty actively; the eyes are small, dark, and prominent. The larger ones are streaked with greyish white, having a pair of filaments proceeding from their posterior extremity. This parasite evidently belongs to the Coccidæ, and is extremely destructive, for from the moment it settles on the cotton plant, the latter never thrives but soon sickens and dies away.

The stem, branches, twigs and in some instances even the under part of the leaves, are covered with cottony substance, swarming with a colony of these parasites.

I submitted some to Captain Mitchell* for his opinion. He says, "The Coccidæ, Gall insecta, mealy bugs, for by all these names are they known. These like all the Hemoptera have a Rostrum. In the coccis, our present subject, it is very long and contains three minute or rather delicate seta, with which it punctures the plant. The ova of the insect are found in considerable numbers, they were of a pyriform shape and measured $\frac{1}{136}$ of an inch."

The second tribe of this Sub-Order is the Phytophthiria, or Plant lice.

* Superintendent of the Government Museum, Madras.

The amount of damage done by this insect is almost incredible; the plant swarms with it, and the juices from the shoots, leaves, and stems are extracted in such a way as entirely destroy them. The leaves are frequently rendered sessile by their laminæ being fringed, from a shortening of the midrib and veins, whilst in some instances little gall like excrescences are produced on the young shoots; or they are distorted into a hundred fantastic forms, and sometimes entire plants are blighted by them.

There are a great many species, some of which are wingless. It is not necessary here to enter into minute detail of the natural history of the insect as it is well known, but it may casually be mentioned that by the saccharine secretion it possesses (known as honey dew) ants of many varieties are attracted to the cotton plant, and I have myself counted upwards of 30. But these are in some measure beneficial as they devour the larva of other noxious insects in their search after the honey dew.

Division III.—Group II. *Membracina.*—Of this section a small insect with three horns, two arched on either side and the third over its back, is also found to infest the cotton plant and living on its juice. These also attract ants from a saccharine substance they secrete. The young of these crowd in millions over the young shoots.

Sub-Order II. *Heteroptera.*—Of this class are the Geocores or land bugs; some of them known as green bugs. Many species of the last group of this order (Scutata) are found on the cotton plant feeding on its juices.

Order VI.—*Orthoptera.*

Several insects of this well-known order are very destructive. Of these the chief are the *Locustina;* and *Gryllina;* the larva of these crowd in thousands over a single leaf, through which they eat in a few seconds; and then descend to the adjoining leaf, and so continue their destruction. Some full grown locusts I have taken off the plant measuring nearly four inches in length, and the great green grasshopper (Gryllus Viridissimus) nearly 2 inches in length,

and to this group belong the most destructive tribes, particularly when they make their appearance in large numbers.

Of the Locustina the Locusta Migritoria and the Locusta Cristata I have found. Of the insects composing the 2nd tribe, the *Gryllus Viridissimus* is common, and their larva commit a great deal of mischief among cotton plants.

Order VII.—*Neuroptera.*

Sub-Order I. *Dichatopetra.*—Of this order the *Termitida,* or white ants, and of these especially the *Termis Tatalis,* commit a great deal of mischief. They are attracted by the dried leaves, &c., which drop from the plants and subsequently making their way to the plant itself devour every plant that comes in their way.

Order IX.—*Diptera.*

Sub-Order II. *Brachycera.*—Of this Sub-Order the group *Musidæ* or fly family. Several species of this genus infest the cotton plant, and deposit their ova on every part where decay is going on whilst the larva is much more frequently found in the young pod, eating through the seeds, and materially affecting, even if it does not entirely destroy the cotton. Some of these are of different colours, the larva are soft, footless grubs well known by the popular designation of maggots.

Order X.—*Lepidoptera.*

Sub-Order I. *Heterocera.*—The *Tineina,* or second tribe of this Sub-Order, are small moths, some brown, others dark brown, and a third variety striated, having bristle-shaped slender Antennæ, with a long and slender body, the wings being entire are long and narrow, the larva naked; some are slightly hairy, provided with eight or ten prolegs in addition to the thoracic members.

The ova appears at first to be laid at the base of the flower, but the larva, soon penetrating the young pod, feeds on the tender seed and wool, and by the time the pod becomes mature, the larva form their cocoons with a white

downy cotton like substance, and escape in the form of the moth described above. By these a variable quantity, from two to three-fourths, of the cotton wool is not only completely destroyed, but the remainder left more or less soiled; another variety of this tribe form for themselves shelter in the young shoots, which they fret so as to cause them to dry, and in this they form for themselves a case in which they carry on their ravages; the larva is small, about 6 lines in length, of a light green colour, with a black head, and hairy, having 8 prolegs in addition to those of the thorax.

A third variety mixes itself within the young shoots, where it continues to exist extending its ravages some 4 to 6 inches, and in most cases to the destruction of the shoot. The larva are about 8 lines in length, slightly hairy, brown in colour, spotted with white, and as they enlarge, they taper slightly towards each extremity. These have 10 prolegs in addition to the thoracic members. Their cocoons are formed of a white cotton-like substance, in which they enclose themselves.

The moth is brown with longitudinal green stripes. This tribe is extremely destructive to the cotton plant.. The young shoots with flower buds soon exhibit signs of its ravages, and begin quickly to wither and die away when once this insect settles on the plant.

The *Tortricina*, or third tribe, of insects, better known as "leaf rollers," are extremely destructive to the cotton plant, particularly when they occur in great numbers.

The larva measures about an inch in length, slightly tapering at both extremities, divided transversely into 10 segments, and scattered over with short white bristles, generally of a dull white colour through which the dark green of the leaves it has fed on can be seen. The head is formed of a black cap or hood, and in some a second pair of hoods is visible posterior to the first, and the mouth armed with strong jaws; the three following or thoracic legs are black and curved like claws. About the middle are four pairs of fleshy tubercles, which look like stumps

and constitute the prolegs, whilst a fifth pair proceeds at right angles from the last segment of the body. The ova are laid on the leaves, and the larva (on its exit from the ovum) is very minute, and threadlike: in a short time after this it begins to weave a light web over itself, and as it increases in size, draws the sides of the leaves and glues them together with its secretion. It then ascends to the upper part of the leaf and bores through as much of the lamina as is required. Having completed this, it now rolls the leaf into the shape of a cone or a cylinder, by folding one part over the other. Each larva forms a separate habitation for itself, and as the leaf is required to be doubled over, the insect has to cut through a considerable portion of the lamina. The bottom of the cylinder or cone is floored with a web, and strewed with its excrement in the form of minute black pellets.

The plants thus present rather a singular appearance with these cylinders or cones, three, four, or even five are sometimes seen suspended from the same leaf.

When the larva attains its full size it becomes somewhat transparent, and the dorsal vessel is seen pulsating at the posterior extremity propelling its contents onwards. This larva is extremely active; can move with rapidity, either forwards or backwards; and when danger threatens it escapes from its habitation by forming its body into an arch, and by suddenly straitening throws itself off the leaf to the ground, and in some instances it continues suspended by a fine thread in its descent to the ground.

Having attained maturity it selects for itself a spot in the cylinder where it forms a web over itself and remains quiescent for from 24 to 48 hours, and about the end of that time the substance of its body shrinks, and then it assumes an opaque, light green, appearance, and then it is found enveloped in a membrane of brown colour, exhibiting no other symptom of life than a slight motion of its upper pointed portion; and in 3 or 4 days after this, it emerges in the form of a moth, which is of a light brown colour, with

dark stripes. This moth appears more partial to the Brazil cotton than to the other varieties though I have occasionally found them on some of the latter.

The *Geometrina* or *Loupers*, as they are popularly termed, are also destructive to the cotton plant. The larva measures from ¼ to 1½ inches in length, is of a cylindrical form, composed of 10 segments having 14 feet, three pairs, somewhat of a brownish colour, and slightly clawed next to the head, 3 pairs of prolegs, and to the last segment another pair placed somewhat at right angles to the body.

The larva is green in appearance with a light buff coloured head having three longitudinal stripes along the back and sides; and intermediately to these 3 other stripes of a lighter colour and dotted white. It moves in one direction only by measuring the space it moves over by doubling or bending its body, and progresses by a succession of springs or jumps, and from which peculiarity it received its name. The moth is almost the same size as the last described, but of a brown colour, the upper half being dappled, of a very light, and the lower half of a dark brown.

In another variety of *Geometrina* or *Loupers*, the larva has 6 pairs or 12 feet, only about one inch in length, larger about the thorax, having 10 segments, and the back having prominent little tubercles; the larvæ are of two or three colours. Some of them resemble in colour and texture a piece of dry twig, others are of a mottled yellow and brown; the moth from which this variety springs is white and prettily striped with black.

Of the tribe *Nocturna* the caterpillars are generally naked, or rather having a short velvety down, and slightly variegated in colour; the body thick, having 16 strong feet. The pupa is inclosed in a loose downy cocoon. The moth is dappled brown and white and is of a larger size than any of the others.

The *Catocolæ*, or tribe of hairy caterpillars, having 16 feet from 1½ inch in length. They congregate in numbers and are extremely voracious in their habits, feeding on each other in the absence of vegetable food. Their pupa is inclosed in a loose cocoon made of hair and other materials of its own secretion. The moth is of a larger size than the last named. The wings are of a dark dappled colour, having their posterior or under wings of a bright red and orange colour.

Order XI. *Hymenoptera.*

Sub-Order I. *Securifera.*—The *Phyllophaga*, or saw-flies do a great deal of damage to the cotton plants either by attacking the petiole of the leaf, or the young shoot is perforated and ova deposited in it, and the young larva burrows in this, feeding on the pith and other tissues. By the time it has attained maturity the parts begin to wither, for the destruction has reached the alburnum, thus committing much mischief.

In the second tribe, *Xylophaga*, or tailed-wasp, the larva is small, having only six small thoracic legs. It burrows in the wood of the shoots and occasions extensive mischief.

Order XIII. *Coleoptera;*

Section II. Tetramera.

In the first tribe of this section are the Phytophaga. It is of a brown colour, striped with black all round and interspersed with white. They commit a vast amount of injury to flowers on which they feed.

Section IV. Pentamera.

The sixth tribe of this section is the *Necrophorus*, or burying beetle, these are chiefly destructive to the flower of the cotton plant, every part of which is greedily devoured by it.

It belongs to the family *Silphidæ*.

Class V. Mammalia.

Order III. *Rodentia.*

The *Murida* or rat family are extremely destructive to the pods which they greedily devour in search of the tender

seed to which they are particularly partial. Their depredations are generally committed at night, when they climb up the plants, and creep along the stem in search of the pods. This is particularly applicable to the *Mus Sylvestris* or long-tailed field mouse. The amount of mischief committed by these animals is almost incredible. They take the pods and devour them at their leisure and frequently carry them off to their retreats.

Scuiridæ.

The Scuirus cinerus, or common grey squirrel of Southern India, is a very destructive little animal to the cotton plantation, which it infests at all seasons of the year, and destroys not only young shoots, but the green as well as the mature pods, in search of the seed of which it is very fond, as well as of the cotton which it carries off in large quantities, with which to furnish its retreat.

Of Ruminants.

Sheep or deer will not touch the cotton plant, goats occasionally do, and buffaloes and cows are very fond of it. More particularly when the plants are in flower, cattle are attracted by the smell, and if permitted to enter a plantation, commit extensive depredations in a very short space of time.

Thus it will be seen that every part of the cotton plant is subject to ravages from insects, every one of which I have endeavoured to describe briefly, giving their class, and order. It is however more difficult to recommend remedies for their destruction. But I have found lime, and wood ashes dusted on the plant, very efficacious in keeping away caterpillars. When infested with aphides, I have found it a good plan to smoke the plants. It is readily effected with an earthen chatty. The chatty is stuffed with damp straw and any kind of dry combustible substance, to which may be added with the greatest advantage, tobacco stalks, sulphur, &c. A hole is knocked into the bottom of the chatty, through which a piece of live coal is insinuated, and on

being blown into, a cloud of smoke issues or is driven through the mouth of the chatty, and if this is done to the windward of the plant, the chatty being shifted from place to place, or several chatties being used at the same time, it is very effectual. Early in the morning is the best time for the operation. Dried chillies are a good substitute for tobacco stalks, or dusting the infested parts with finely powdered tobacco or black peppers is extremely effectual.

Sprinkling, or dusting the plant with a solution of tar, or creosote, will sometimes prove useful in destroying all kinds of insects; or sulphur in the proportion of one part mixed with two or three of quick lime, and boiled in a sufficient quantity of water to dilute it well, and sprinkled on the plants, is very efficient in keeping away insects. Worms and caterpillars may be easily got rid of by picking them off the plants morning and evening, and destroying them immediately. I have found it an advantageous plan to keep poultry on the plantation after the plants have attained from 2 to 2½ months old, as they devour white ants, grasshoppers, and other kinds of insects. For this purpose the common guinea fowl, *(Numida Meleagris)* are the best; they are fond of roving about in search of food.

"Some knowledge of the habits of an insect is often required to enable us to check its ravages completely. When we are aware of the particular moths whose caterpillars commit the greatest depredations (by ascertaining the moth that proceeds from each), we must seek the most successful mode of preventing their propagation, and that is by destroying the female before she has deposited her ova."

I have often succeeded by taking one or more moths alive, and confining them in either a gauze or net cage, and placing it in some part of the plantation at night. It will frequently attract others, which can be readily taken and destroyed; even if left till morning, a few are generally found sitting on the cage which contains the decoy moth.

To destroy rats the usual traps with tempting baits answer sometimes; at others, thin slices of cork fried in

ghee should be thrown about the plantation; this they devour greedily and are soon killed by it.

I have found different kinds of common grain, saturated in a week solution of strychnine, very effectual in their destruction; but the most deadly poison, as well as the most efficacious, is made by dissolving 2 drachms of Phosphorous in a bottle of ghee: a portion of which should be mixed with boiled rice, and placed under large tiles, hollow bamboos, or in boxes made for the purpose. Crows, poultry, or any creature partaking of either of these two poisons will surely die. The bottle containing the ghee must be placed in the sun till the Phosphorous dissolves. Keeping cats on the plantation, which should only be allowed to run loose at night, to prevent their destroying or frightening away birds,—which ought to be encouraged, for they contribute largely to the destruction of caterpillars, and other insects.

The common Mongoose, or *Herpestus Grisens*, is a capital rat catcher, but it is destructive to poultry. The planter will, of course, select his aid for the destruction of vermin and insects according to the locality of his plantation and other attendant circumstances.

The most successful way of destroying squirrels is by enclosing a square foot of ground with four stakes driven into the earth and connected on all sides with pieces of twine, and on every side of the square some half dozen or more nooses made of horse hair should be tied to the twine and the bait of a plantain or a little sweet rice placed in the centre of square, surrounded by the nooses. This soon attracts the squirrels.

Several of these traps having been set, an attendant with a stick, about 2 feet long, and 1½ inch in diameter, should be set to watch the traps at some little distance. The moment one gets caught in the noose, before it has had time to bite through, he should run up and strike the squirrel a

smart blow on the head, and withdraw it, and adjust the noose ere he returns to his watch.

A whole community of squirrels might thus be destroyed in an incredibly short space of time. The same plan might be tried successfully with rats, if a trustworthy attendant could be got to watch for them at night.

V. Experiments with

A. Indigenous Cotton.

I conceive that an account of the cultivation of the different species of cotton as grown for experimental purposes, under my own immediate supervision may prove interesting; especially as their whole progress from the time of sowing the seed to the ultimate gathering of the crop was carefully watched and noted by myself; and I have been the more exact in detailing them, as they are in general neglected in India.

A. Indigenous Species.

1. *Gossypium Herbaceum*, or Indian Cotton. Tamil, *Oopum Paratie.*

On the 31st of May 1861, a piece of land at Chingleput, 95 square yards, was well prepared by free delving, and some seeds of the above named species from Bellary, which had been previously acclimated in the district, were sown in parallel rows 4 feet apart, and which germinated between the 3rd and 7th days after sowing. They were irrigated on 9th of June, and the seedlings well thinned out to the distance of about 18 inches apart, leaving 150 to grow; these had attained about 4 inches in height, and had each thrown out between 3 and 5 leaves. On the 14th and 16th they were again irrigated, and on the 3rd of July they had attained between 6 and 7 inches in height. On the 3rd of August they were clear of weeds, and the earth loosened around them; but they were not irrigated, as a few light showers had fallen in the interval. They were now lightly manured with the common farm yard manure. Average height of plants 18 to 20 inches; descent of root, 7 inches; and lateral shoots are making their appearance.

3rd September. The plants are kept free from weeds, and the earth around them loosened. Average height of plants 4 feet and lateral branching proceeding freely; a few have put out flowers.

3rd October. The plants have attained 6 feet in height, are looking shrubby and very healthy. A few flowers appeared, but were thrown down by some heavy rain. The ground has been kept scrupulously clean.

November 3rd. Fearing that the plants were likely to run into excess of wood and leaf, as some have nearly attained the height of 7 feet, they were checked by pinching off their tops. The N. E. Monsoon having commenced with heavy rain, during the 7th and 8th of November some of the plants were thrown down, and to prevent a repetition of this, their branches were thinned out, and earth ridged up against the root stems nearly the height of a foot.

3rd December. The plants are in full blossom and are forming fruit.

3rd January. The plants are covered with bolls, which on the 3rd February commenced ripening.

23rd March. Gathered the produce amounting to 30lb. of seed cotton, giving when cleaned 10lb. of clean cotton wool.

The expense of cultivating the above plot of ground.

	RS.	AS.	P.
For preparing soil	0	2	0
Seed	0	0	3
Watering	0	2	0
Weeding	0	1	0
Picking	0	0	5
Cleaning	0	1	1
Land rent	0	2	0
Total...	0	8	9

At the above rate one acre will contain about 7,650 plants; and the average cost will be 27 rupees, 9 annas, 6 pie. The produce will amount to 500 lb. of a superior quality of cotton, which even at the usual low rate of the ordinary cotton of

1 anna per lb. will yield 31 rupees, 14 annas per acre. From which, if we deduct the cost of culture 27 rupees, 9 annas and 6 pie, a clear profit of 4 Rs. accrues to the ryot. But were such operations conducted on a larger scale, the outlay would, of course, be much less, and the produce greater in proportion to that given above.

2. *Gossypium Arboreum*, or religious cotton of the natives, Tamil "*Shemparatie.*" A plot of ground measuring 30 square yards was well prepared, manured lightly with the ordinary manure, and on the 18th of June 1861, was sown with seeds from the above named species, which had been produced in the district. The seedlings began to show themselves between the 3rd and 6th days, and on the 18th July had attained from six to eight inches, when they were weeded, the earth loosened, and the roots watered. On the 18th August about 40 plants were left on the land, each 18 inches apart, and they had attained a height of from 12 to 15 inches, when they were again weeded, the soil loosened, and watered. These plants were on the 18th September three feet high with a few short lateral branches, which within the succeeding thirty days had become considerably extended, and a few exhibited flower buds, which however were knocked off by a heavy shower of rain.

The plants are 4 feet in height, and covered with flowers, and bolls. They appear somewhat tall and spindle-shaped, each having from 6 to 10 branches.

10th December. The plants continue to look well; bolls are forming, and will soon ripen.

Height of plant 5½ feet, slightly shrubby and losing their lank appearance.

18th January 1862. The pods are bursting their cells, and the cotton is in course of being gathered.

18th February, the plants continue to flower and fruit. The produce has been collected which yielded 20 lb. of seed cotton, which when freed from seed returned 5 lbs. clean cotton wool.

The expense of cultivating this plot of ground was as follows:—

	RS.	AS.	P.
For digging manuring, &c.	0	0	8
Weeding, &c....	0	0	4
Seed	0	0	1
Watering	0	0	8
Picking	0	0	1
Cleaning	0	0	4
Land rent	0	0	8
Total...	0	2	10

An acre of land similarly managed, will contain 8,066 plants; the average cost will be 16 rupees, 2 annas, 3 pie, and the produce of an acre at the foregoing estimate will be about 806½ lbs. of clean cotton wool, which at the low rate of 6 pie per lb. will yield 25 rupees, 3 annas, 4 pie per acre, from which if we deduct Rs. 16-2-3 as the cost of culture, there will be a balance in favour of the ryot as clear profit 9 rupees, 1 anna, 1 pie. With this as with the former variety, the profits will be larger in comparison to expense, according to the magnitude of the operation.

2. A single plant of this species being three years old, growing at the back of a dwelling-house, and receiving neither manure, water nor other care, yielded during 1861, 18 oz. of seed cotton, which when freed from seed, and clean picked, produced 4½ oz. of clean cotton wool. The plant was about 6 feet in height, and rather shrubby, and continues without intermission to be productive throughout the whole year. The soil on which it grows is gravelly.

Allowing them one plant to every square yard, an acre will contain 4,840 plants, and taking not 4½ oz., but 1¼ only, as the average of single plant, an acre will accordingly, produce about 453¾ lbs. of clean cotton wool, which taken at 400 lbs. per acre will at the lowest rate, *viz.*, 6 pie per lb., yield 12 rupees, 8 annas.

Here, it must be understood, the plant has had no culture; but with care, and moderate cultivation, the quality, and

quantity will both increase; and as the plants are perennial, they will continue to fruit for several consecutive years, the produce increasing with the age of the plant.

3. A plant 8 years old, growing at the back of a native dwelling-house, receiving no water, except that obtained from the people of the house in the course of their ordinary ablutions, no manure, or care of any kind, about 12 feet in height having upwards of 13 lateral branches; vigorous and healthy in appearance, and producing flowers and fruit for the greater part of the year.

The produce for the last year (1861) was 3 lbs., 10 oz. of seed cotton, and this when freed of seed, yielded 1 lb., 6 oz. of fine cotton wool, silky, rather short in the staple, and of a fine white colour.

The soil on which it grew was a sandy loam. Thus, taking an acre with 8 year old plants, allowing only 4,000 plants to an acre, and taking the produce at only 4 oz. per plant instead of 1 lb., 6 oz. as above, the produce of one year will be 1,000 lbs. of cotton per acre, which at 6 pie per lb. will return 31 rupees, 4 annas.

Judging then by the foregoing results, we may venture to predict the most favourable conclusions were a certain amount of careful culture, and attention extended to the plant. The quantity will not only increase, but the quality will also improve.

I wish to draw particular attention to this hitherto totally neglected species of cotton plant. The results given above are all from actual experience. The natives of the district express their belief that the plant will thrive and fruit well for upwards of 20 years, with moderate culture, and occasional pruning, &c., and I have no doubt of the result, should it only be given a fair trial by those interested in the cotton question.

B Foreign Species, Garden Culture.

Gossypium Accuminatum, or Brazil Cotton.

The plot of ground selected for this purpose was 96

square yards, 18 miles distant from the sea, and about 12 feet above sea level. The soil was chiefly composed of gravel and sand; the former predominating. The earth was thoroughly loosened and turned up freely, to the depth of one foot. It was then manured, at the rate of 3 tons per acre. The soil was levelled, the clods were crushed, and parallel trenches were formed each 4 feet apart, into which the seeds were put down in holes at a distance of 4 feet from each other, each hole receiving from 3 to 5 seeds.

These were put down on the 10th of May 1861; the seeds were of two kinds, some recently imported and others long acclimated in this district. On the 13th a few seeds sprouted up, and by the 20th they had all made their appearance. On the 21st the seedlings were between four and five inches in height and the leaves were covered with dark dots, there being but two obovate leaves on each seedling. On the 24th they were 6½ inches in height, and on the 26th a second pair of entire accuminated leaves were found, and on the 31st a third pair of leaves.

On the 3rd of June a very light shower of rain fell. On the 5th each seedling was found to have thrown out from 4 to 5 leaves. On the 6th another light shower of rain fell, and on the 9th the seedlings were hand weeded and watered, and this was repeated on the 14th. On the 24th a heavy shower of rain fell, between 4 and 5 P.M., followed on the 28th by some light drizzling showers. The seedlings were advancing nicely.

The 5th pair of leaves were found slightly trilobed, and in all the succeeding ones the divisions were deeper. On the 30th, insects of the caterpillar kind were found infesting the plants. To destroy these the plants were dusted with quick lime early in the morning, before the moisture deposited on the leaves by the dew at night evaporated.

On the 15th July a slight drizzling shower fell, and on the 20th the soil around each plant was freely loosened and the weeds removed. On the 21st at 7½ A.M. a heavy fall of rain. On the 22nd the plants stood about 24 inches in

height, and had begun to show lateral shoots, one in the axilla of each leaf. 2nd August, a fair shower of rain fell followed by another on the 3rd and some light drizzling rain on the 4th.

The plants are now about 2½ feet in height. On the 8th, 9th, and 13th some smart showers. On the 23rd the soil was well loosened by a hand hoe, freely weeded and manured, and on two following evenings there was light drizzling rain. 26th, after the setting in of the North East wind, the plants looked sickly, the stipules first began to decay; this was soon followed by change of colour in the leaves, from a dark to a light green. The margins contracted and the blade assumed a hollow or concave appearance. The contracted margins soon began to grow brown, and the blade of the leaf became studded with yellow spots, and these in their turn became brown and fell through, leaving irregular and circular apertures in the leaves.

10th September. In some plants the entire blades were destroyed, leaving nothing but portions of the naked midribs of the leaves sticking out, giving to the plant a singular appearance. Nevertheless, a few plants were showing flowers, and those plants that received shelter from the adjoining hedge were looking perfectly healthy. The natives attribute this state of things to the "Evil eye."

22nd. A few light showers of rain fell since last report, and some of the plants which had slightly recovered themselves were forming flowers.

1st October 1861. A few of the plants continued to show flowers. The ground was freely weeded on this day.

1st November. Most of the plants are in flower, and those that were sickly began to recover after the wind changed to the South. 6th and 7th, most of the plants were blown down and nearly uprooted; to prevent further injury, their crowns were thinned out and the earth ridged up against the root stems to the height of one foot. Most of the flowers and young pods were blown away.

1st December. The plants were now between 4 and 5 feet in height, and looked healthy after the wind changed to South.

1st January 1862. The plants were looking remarkably healthy, and flowered freely; some of the early pods that escaped injury from the rains now began to ripen and burst their capsules. The plants were irrigated twice during the month.

1st February. The wool was in course of collection whilst the plants continued in flower. They were irrigated three times during the month.

1st March. The wool was still being collected. Much of it is soiled by insects.

The plants were irrigated once a week. On the 1st of April the produce of plants was 10 lbs. of seed cotton, this when cleared of the seed yielded 3½ lbs. of lint, 1lb. of refuse, and 5½ lbs. of seed.

The cost of cultivating this plot of ground was as follows:—

	RS.	AS.	P.
For preparing soil	0	4	0
Seed	0	1	0
Watering	0	8	6
Weeding	0	4	0
Picking	0	0	6
Cleaning	0	0	8
Land rent at 10 Rs. per acre	1	0	8
Total ...	2	3	4

As the plants still continue to produce it is impossible as yet to estimate the full value of their yield. But even taking it as above given, then that of an acre will amount to 176½ lbs. of clean cotton wool.

I was now desirous of determining the produce of the Brazil variety, according to the actual age, and, with this view, I took under my immediate supervision every plant in

the place varying from 1 to 5 years of age; and the results are as follows.

1. The produce of a plant one year old was 1 to 2 ounces of lint per plant. Taking an acre at 1,000 plants, and the produce of each plant at 10 oz. that of an acre will amount to 178½ lbs. of seed cotton, and allowing for seed and refuse will produce 62½ lbs. of clean wool.

2. The produce of a 2nd year's plant averages from 1½ to 2 ounces. Take the first of these rates, and allow 1½ oz. to each plant. The produce of an acre, making abatement for seed, and refuse, will amount to 93¾ lbs. of clean lint.

3. The produce of a third year's plant was from 2 to 3 oz.; taking the lowest rate of produce per plant, the produce of an acre will amount to 125 lbs. of cotton wool.

4. The produce of a 4th year's plant was from 2½ to 4 oz. Taking the produce per plant at 2½ oz., the yield of an acre, deducting refuse and seed, will amount to 156 lbs.

5. The produce of a 5th year's plant was from 3 oz. to 4 oz. and taking it at 3 oz. per plant, an acre will yield, free of refuse and seed, 187½ lbs. of clean wool.

These plants were cultivated in the usual way. The calculations are from actual experiments. In some instances carried out on a single plant, and in others from half a dozen or more. Of course, it will be necessary to make allowances for unfavourable seasons, unforeseen accidents, &c. In connection with the foregoing experiments, I, at the same time, planted, about the middle of each succeeding month, a few seeds of each of the varieties, and the results of these experiments satisfy me, that from September to November is the best time for putting down seeds in soils subject to the influence of the N. E. monsoon, and from analogy I should say that in localities subject to the influence of the S. W. monsoon, from May to July would be the best time for sowing.

In these, my last calculations, it will be seen that I have allowed for only 1,000 plants to each acre, whereas an acre should, properly speaking, contain from 2 to 3,000 plants.

But allowing for accidents and failures, I have considered 1,000 plants as the safest data to work upon.

Some plants will fruit abundantly others again yield scantily, so that I have restricted my calculations to 1,000 plants per acre, and in estimating the produce, I have taken up the lowest figure, so as to keep within safe bounds.

Field Culture.

To test the Brazil cotton as a field culture, a piece of fallow land, of a sandy loam, measuring 20 square yards, was ploughed, weeded, and trenched.

On the 2nd June 1861, seed which had been acclimated was sown three feet apart in parallel rows, most of which germinated between the 5th and 9th days. Some did not appear till so late as the 25th of the month, whilst others had altogether lost their vitality, and those which had first sprung up were now nearly 4 inches high. All these were dependent wholly on the rains. In dibbling the seeds, several had been put into each hole; but on the 1st July the seedlings were thinned out, leaving but one in each. On the 12th fresh seeds were planted in the room of those which had failed. On the 3rd August the young plants were thriving. On the 15th the soil was lightly loosened by the hand hoe and weeds removed. 22nd. Most of the plants began to assume a sickly appearance similar to those of the garden culture previously noticed, whilst a few were showing flowers. The soil was again slightly loosened, and weeds removed.

15th September. Most of the plants still continued their sickly appearance though each plant displayed one or more flowers.

15th December. The plants were about 4 feet in height, shrubby, and improved in appearance.

15th February 1862. The plants had improved very much, and were coming into bloom. 20th February, some of the early pods are ripened.

1st April. At present 5 lbs. of cotton had been gathered, and the plants are still in flower and fruit.

The cost of culture was as follows.

	RS.	AS.	P.
Ploughing	0	1	8
Seed	0	0	2
Weeding	0	0	4
Picking	0	0	2
Cleaning	0	0	3
Land rent 2 Rs. the acre	0	3	1
Total...	0	5	8

Garden Culture.

Gossypium Barbadense.

1st. Variety—Bourbon Cotton. The seeds were once acclimated at Bangalore, and have been reproduced in this district for the last seven years. A plot of garden land consisting of 18 square yards, the soil a sandy loam, was freely turned up by the mahamety, all weeds removed, clods crushed, levelled and drawn out into parallel trenches 3 feet apart, and from 3 to 5 seeds were planted in each on the 30th May 1861, at a distance of 3 feet from each other.

3rd June, the land was irrigated—8th, most of the seedlings had come up, and were about one inch in height, having but the two seed lobes. 9th, weeded. 10th, watered; most of the seedlings were out. 22nd, the earth was loosened, and weeds extirpated. The seedlings were looking well, were between 4 and 6 inches in height, and were much refreshed by a fall of rain on the previous evening. The lower part of the stems and the inner part of petioles are tinged red. 28th, a light shower of rain. 30th, the plants were lightly dusted with quick lime to keep off insects.

8th July. The plants are throwing out lateral shoots, 22nd, height of plants from 12 to 15 inches, and branching freely, the earth loosened with a hand hoe and weeds removed.

30th. The plants were looking well and a few were forming buds. 4th August, two days rain. The plants are progressing; height from 15 to 20 inches. 14th, the

branches were found to outspread much. 17th, the soil was loosened, and weeded with hand hoe.

19th, rain. The whole of the early blossoms were blown away. 22nd September. The plants were going on well bushy below, and tapering upwards, and were again beginning to bloom.

October 5th. The soil loosened and freely weeded. The plants were now from 4 to 5 feet high, and covered with blossoms, and young pods. Insects were troublesome, consequently the plantation was smoked in the manner detailed in another part of this Essay.

November 5th. A few of the earlier pods have ripened and burst their cells.

December 5th. Cotton was being gathered in small quantities and the plants irrigated. January, 1862. The gathering of cotton in small quantities was still continued. The plants were watered once a week.

1st April. The produce up to this time was 10 lbs., 8 oz. of seed cotton, which when picked yielded 3 lbs., 8 oz. of cotton wool, 1 lb., 8 oz. of refuse, and 6 lbs. of seed.

The cost of culture was as follows:

	RS.	AS.	P.
For preparing soil	0	4	0
Seed	0	0	6
Watering	0	3	0
Weeding	0	1	0
Picking	0	0	3
Cleaning	0	0	6
Land rent	0	0	6
Total ...	0	9	9

The plants are still bearing fruit, but taking the produce of an acre as above, the result will be upwards of 800 lbs. of clean cotton wool.

1. The produce of a first year's plant was from 1½ to 3 oz. per plant, but taking the acre at 1,000 plants and the produce at 1½ oz. per plant, that of an acre will amount to upwards of 300 lbs. of seed cotton, which allowing for seed and refuse will produce upwards of 93 lbs., 12 oz. of clean wool.

2. The produce of a third year's plant was from 2 to 6 oz. of cotton; taking the produce of plant at 2 oz. an acre will yield 136 lbs. of cotton wool.

Field Culture.

This cotton was tried as a field culture, for which purpose a spot of ground consisting of 277 square yards was freely ploughed up, weeds removed, and on the 10th June 1861, seeds were sown in parallel lines, 4 feet apart, each plant 3 feet distant from the other. Each hole received from 3 to 5 seeds. The soil was a sandy loam containing some gravel. In July the seedlings had come up without many failures. In August they were thriving, and in weeding were thinned out.

In September, a few plants began to show flower. They were weeded.

In December, the plants were flowering freely and a few of the earlier bolls were bursting their cells, and the plants were 3½ feet in height and looking very bushy. In January commenced gathering the cotton, and as the plants were still in fruit, the cotton continued to be gathered as the bolls opened.

April, up to this time 14 lbs. of cotton wool has been gathered.

The cost of culture was as follows:

	RS.	AS.	P.
Ploughing	2	0	0
Seed	0	4	0
Weeding	0	8	0
Picking	0	2	0
Cleaning	0	2	0
Land Rent	0	8	0
Total ...	3	8	0
	9		

Variety 2, New Orleans cotton. In the same locality a plot of ground measuring 27 square yards, was prepared in the same way as that for the other varieties, and the seeds were some recently imported by Messrs. Line and Co. of Madras, and were put down on the 6th of June 1861. On the 18th they were irrigated. On the 25th about one-half of the seeds had germinated. On the 28th they were between 2 and 3 inches in height and looking very well; a few seeds were only now pushing through the soil. 29th, fresh seeds were put down where it had failed previously.

Some showers of rain fell during the week ending 8th July. On the 16th and 22nd it rained again and the plants, in general, were not looking so healthy. Those that shewed themselves first were now between 3 and 6 inches in height. All were lightly dressed with the usual manure (wood ashes, and dung heap rubbish) and watered. 1st August, most of the plants were showing flower buds, and some few blossomed. The plants were only about 8 inches in height and were throwing out-side shoots, although they were still looking delicate with the leaves curled up.

12th. The plants were now between 12 and 15 inches in height, and still looking sickly. 14th, they benefited from rain and were improved in appearance, and almost all were in flower. On the 16th and 17th the soil was loosened with a hand hoe, and the weeds removed, plants looking well; the bolls were large and fine. 19th, light rain. 22nd, dressed with manure; about 4 oz. was put around each plant. 28th, the entire piece of ground dressed with manure, and weeds removed. Some drizzling rain fell, which threw down the flowers, and immature pods.

9th September. 4 pods that had burst their cells were taken off; irrigated plants. 22nd, some plants were thrown down by rain, and most of the pods had rotted, these had their stems earthed up.

1st October. Weeded, and watered. 1st November, watered three times during the month. The pods were picked off as they ripened.

December. Bolls continued to ripen. Insects were very destructive. The plants were irrigated once a week. January, cotton continued to be gathered; plants were watered once a week.

February. Plants were watered once a week; they look withered; most of the leaves are dry; nevertheless they continue to shew flowers.

15th March. Up to this time 24 lbs. of seed cotton had been collected whilst the plants continued to be in bearing.

The cost of culture was as follows:

	RS.	AS.	P.
For preparing soil	0	1	0
Seed	0	1	0
Watering	0	0	2
Weeding	0	0	2
Picking	0	0	1
Cleaning	0	0	2
Land rent	0	1	6
Total...	0	4	1

Field Culture.

At the same place and in the same soil, as the other varieties were cultivated, 162 square yards of ground was prepared in the same way, and seeds put down on the 16th of August 1861. Beyond that of exterminating weeds, no other care was given; about the middle of September a few plants began to show flower, and by the end of that month, a few bolls had ripened and they then continued to produce, and up to 1st April 30 lbs. of cotton had been collected; and although most of the plants were looking dry and withered, they still continued to be productive:

Costs of culture of the above plot—

	RS.	AS.	P.
For preparing soil	0	6	0
Seed	0	1	0
Weeding	0	1	0
Picking, ...	0	1	0
Cleaning	0	1	0
Land rent	2	0	0
Total ...	2	10	0

It will be observed that though the early sowing was attended by successful results, I have notwithstanding advocated late sowing. I have already detailed the experiments of May and June. But I must in explanation add that I continued to plant seeds about the middle of every month, up to the month of February 1862 inclusive, and taking all things into consideration, it is my firm belief that from September to November is the best time for planting in land subject to the influence of the N. E. monsoon, and that from May to June for localities subject to the S. W. monsoon. For the success, however, of those experiments, I was indebted to two favourable incidents.

First.—The season was irregular, and rain fell only in small quantities, from June to October, which enabled the plants fully to establish themselves, by the aid of partial irrigation, in the garden culture; but without that aid in the field culture.

Secondly.—The rains of the N. E. monsoon, which set in early in November lasted for only a week, consequently the plants were enabled to advance rapidly and favourably. Had the N. E. monsoon been heavy, as is usually the case, and continued, as it generally does, to the end of December and sometimes till January, then the experiment would doubtless have failed, either from the plants having been injured by the heavy rain, or by the destruction of a large portion of the flowers and pods, as well as by the serious deterioration of the product.

C. Observations on both.

The cultivation of cotton first attracted my attention in the year 1851 and 1852, in the Ceded or Bellary district of the Madras Presidency, but I did not give the subject close attention till 1855. In the years 1855-56 and 57 I traversed the length and breadth of the cotton districts of Orissa, Nagpore, and parts of Behar. In a report written in 1856, I casually alluded to the extensive culture of cotton in Orissa, and the large return in produce of fine staple cotton with the great amount exported from these parts, as well as the quantity consumed in the localities themselves.

At the time I collected extensive information not only about cotton, but on other produce of these provinces, with an object which I had then in view, but which circumstances unfortunately prevented me from carrying into effect at the time. However, much of the information I then obtained on the subject of indigenous cotton I have now embodied in this Essay.

With reference to exotic or foreign cotton, my attention was drawn to the subject in June 1857; and as my mind was stored with information regarding the culture of indigenous cotton, I felt no difficulty in giving to the foreign species the attention they deserved; more especially as I had terminated my travels, and settled down in a station where I had every opportunity of giving scope to my wishes in this and other matters. My notice was first attracted to the subject of Brazil cotton by the gentleman who showed me a few plants raised from seed procured direct from Cairo.

When I saw these plants they were between three and four months old, and were about 3 feet in height, having an inclination to become shrubby. Not long after this my attention was directed to the acclimated Brazil cotton, which was, I may say, naturalized in the district, where it has been in cultivation upwards of half a century. On close examination, and comparison of the living plants, I found it to be the same as that cultivated by the gentleman above

alluded to, from seeds which were imported from Cairo: the only difference being, that one was raised from recently imported seeds, and the other naturalized in the district.

Gossypium Accuminatum, or Brazil Cotton.

1. This cotton has been grown by natives in betel gardens for upwards of 60 years, but it is made subservient to the culture of the betel vine, and which it is intended to support for training the vine. The seeds are planted with other trees close together and somewhat crowded. The plant does not fruit before the second year, and continues to do so for about two years. The garden is then abandoned and the cotton and other trees uprooted.

This cultivation is carried out on wet lands, where the soil is a deep sandy loam. It participates in the culture given to the betel, which is manured with cow-dung and woodashes twice a year, and irrigated every second day.

The plants with the betel are grown on ridges 3 feet wide, and on either side of the ridge on which they are planted there is a trench three feet deep and two feet wide, which always contains at least the depth of a foot of water, except in very dry weather.

The water is taken up by shallow, oval, wooden dishes from the trench, and thrown on the vine bearing ridges. In dry weather water from adjoining wells is conveyed to the trenches and from thence to the ridges.

The cotton plant being completely shaded by the others closely surrounding it, does not grow much during the first year; but in the second, when the quick growing trees on the ridges are arched and tied intermediately over the trenches, the cotton plant receives a larger amount of light and air, and shoots straight up to 15 or 20 feet in height, free of branches, until it outtops the others, and then throws out a few branches, and begins to fruit.

The betel gardener now lops off most of the branches, for fear it should become top heavy and be blown down by a gale of wind.

The one or two remaining branches now freely produce flowers, and fruit; the pods are large, completely formed, and contain from three to four cells. The wool is of a fine white colour, has a good staple, and is free from harshness; although not silky, soft. When the plants are not much multiplied, they yield about one pound of seed cotton per plant per annum; this when ginned, and cleaned produces from 5½ to 6 ounces of clean cotton wool.

The average contents of an ordinary pod, were 20 grains of wool and 40 of seed.

2. The plants produced from the seeds that were procured direct from Cairo, and cultivated by the gentleman previously alluded to, began to show flowers in the sixth, and to ripen their fruit in the seventh and eighth months.

The soil on which they were grown was chiefly rocky, and composed of decaying granite. They were occasionally watered, but received no manure or other care.

When these plants were 2½ years old, the produce was submitted to the local Agricultural Exhibition held at Chingleput in February 1859, and a prize of 100 rupees was awarded for the specimen.

The remarks of the Committee on the exhibition were as follows: "This cotton was described as Egyptian, and bearing crops for 5 or 6 years, while it stood the heat very well."

I frequently examined these plants; they were shrubby, well grown, and had from 12 to 15 lateral branches, and were about 4 feet in height. At an average there were from 150 to 200 hundred pods, on each plant, and the capsule contained 20 grains of wool free from seed. A 1st class medal was awarded to this gentleman at the Madras Exhibition of raw products for the same cotton.

3. Seeds, once acclimated, were sown in a small garden adjoining the above, belonging to the road department; the soil is high dry and gravelly. The plants were occasionally watered but received no manure or other care. In April 1861, I found 6 plants growing here, they were about 3½

years old and were 4½ feet in height, shrubby, and having many branches. The stem at the ground gave a circumference of 2 inches. In some the branching took place immediately above the root, and in others 6 inches above it. I counted the empty capsules on two of these trees, and found 150 on one and 170 on the other.

The officer in charge of the place kindly handed over to me the produce of the season of the 6 plants, which was 3 lbs. 6 oz. of seed cotton; this when picked clean and freed from seed, yielded 18 ounces of lint or cotton wool.

Four of the 6 plants were the chief producers, the other two were injured by cattle and produced but a few pods.

The average weight of the contents of a pod were the same, 20 grains of wool and 40 seed.

On the 1st June 1861 I had these plants cut down to within a foot of the ground. The first shower of rain brought out numerous shoots, the plants became extremely vigorous, and are now about 4½ feet in height. The earth around their roots was dug up and some refuse straw and grass were buried around each plant to form manure, and they were occasionally watered. They began to flower early in September, and the cotton began to be collected in December. The produce from 4 of these plants, in March 1862, was four pounds of seed cotton, which after being ginned yielded 1 lb., 12 oz. of wool, and 2 lbs. 4 oz. of seed. The plants are still producing fruit.

4. A native procured a few seeds from the last mentioned place, and planted them in a piece of ground adjoining that belonging to the road department. This land is part of a garden where the soil is high, dry, and gravelly.

The seeds were put down about 3 years ago which may be said to be the age of the plants. Here I found, in May 1861, as many as 50 plants growing wild, and the place overrun with spear grass, and weeds.

They received no water, manure, or any other care. The plants appeared stunted, were about three feet in height,

having each only three or four thin branches, and a few scattered leaves. The produce was never gathered, but I found on some of them from 30 to 60 empty capsules; the cotton from a few pods I found gave an average of 16 grains to each, with 40 of seed. The wool was white, the staple very ordinary and fibrous to the touch and appearing crispy.

5. In the garden of an officer here, there are two plants which were raised from acclimated seed in 1857, these are now about 5 years old and were grown on a garden soil. The plants have grown out luxuriantly and were in April 1861, 9½ feet in height. Circumference of stem at the ground 7¾ of an inch and at the height of 14 inches, it branched into 3 divisions; a little higher up it gave off 25 or 30 smaller divisions or branches. At this time I collected off these plants one pound of seed cotton, which was only a part of the crop, the gardener having made away with the rest. This pound of seed cotton, when ginned, yielded 5 oz. of clean cotton wool of a beautiful white colour and good staple, soft, and free from all harshness. No particular attention was given to these plants, but as they were grown in the vicinity of some vegetable beds, they came in for an occasional share of water, but no manure or other care was bestowed on them.

These plants were cut to 9½ inches above the ground in June 1861; in a very short time after numerous shoots began to appear. One of them was greatly sheltered in a corner, and the shoots were entirely eaten up by caterpillars; it did not thrive but continues with only two small branches. The other threw out about 30 shoots and became quite luxuriant; it is now about 4½ feet in height and the produce this season, from this single plant, was 1 lb. of cotton, which when ginned gave 6 ounces of wool and 10 of seed, but the plant still continues to fruit.

6. The late Collector of the district, J. Shubrick, Esq., procured Brazil cotton seed from Chingleput which he planted in January 1859 at Roshim Bag in Sydapet near

the banks of the river, where there are at present nearly 200 plants. Each plant is 9 feet apart, the ground being about 8 chains. In 1860 they produced 15 pounds of cotton wool for the year. The plants were, I believe, watered, at first twice a week; subsequently once a week, and lastly once in 10 days. But during 1861 they received no water, or other care.*

The place was wild, overrun with couch and spear grass, and they were cut down in a very careless manner. When visited by me on the 17th September 1861, I found that from the careless manner in which cutting had been practised, the stems were injured, and some of the wool slit up. The consequence was that a few of the plants were dead, and the others had thrown out short shoots, but these were sickly, and the plantation was nothing more than a corpse.

I again visited the garden on the 11th of December, the plants were still looking sickly, though some had a few flowers.

7. In 1859, the late Civil and Sessions Judge † planted about an acre of land, with the Brazil cotton, but unfortunately he selected his ground immediately under the bund of a large tank, and put down the seeds at a wrong time; so that they began to ripen their pods, about the time the rains commenced (in October) and much of the cotton was not only injured but a large portion completely lost. Directly the tank filled, the plantation was swamped, from the water in the tank oozing through and under the bund, so that whilst the tank continued to be thus filled, the plantation remained a swamp; the effect of this was that the plants degenerated into soft wood and succulent foliage and they attained a great size, becoming more like trees than shrubs: although some of them flowered pretty well, these did not all produce fruit, and the fruit which did form did not ripen, but fell off in an immature state, so that on the whole the crop of cotton gathered was between 30 and 40

* I am indebted to V. Vurdacharloo, Esqr., Sheristadar, for this information.

† W. Dowdswell, Esqr.

lbs.: the experiment proved a failure, but I have no doubt had the plants been cut down during the dry weather, a fair crop might have gathered. Unfortunately I was out of the country at the time, and the gentleman on leaving the place returned the land to the native from whom he had farmed it for 5 years: as soon as the natives took charge of the land, every cotton plant was extirpated and used as firewood. On my return, therefore, I found not a vestige of the cotton plant remaining.

8. On the 18th September I visited the People's Park, Madras, where there are about 100 Brazil cotton plants, which were found growing wild, choked up with couch and other grass. The plants were small and sickly looking, the largest was not above 3 feet in height; most of the leaves were decayed, nevertheless a few have flowers, and are likely to have benefited from the rains that were then impending. 11th December, visited People's Park and examined the whole of the Brazil plants. Excepting a few next to the Superintendent's quarters, they have not grown at all; since my last inspection, they have dropped the few flowers they had, and the plants are looking sick and withered, and the soil is overrun with rank grass, &c.

Some of the Bourbon plants on the western side are looking tolerably well, and are in flower and fruit. Here also the soil is overrun with grass, and the plants, in general, are not very healthy; they require to be kept free at least of weeds, even if no other culture be given them.

9. Visited the Horticultural gardens at Madras on the 18th September 1861, examined 100 plants of the Brazil cotton nicely grown. These plants were forming blossoms, have attained nearly 6 feet in height, and the stems were 6 or 8 inches in circumference. They appeared to have formed much wood and leaves, as they were then only 6 months old. Said to have been cultivated since April last.

The plants appear to have received ordinary care.

11th December. The plants appear to have run into wood and sap; they are upwards of 8 feet in height, and are

not quite so healthy in appearance; have a few flowers and pods on each, but nothing commensurate to their size.

10. I visited a village on the coast 19 miles distant from this, on the 23rd February 1862: here I found, growing uncultivated in a garden hedge, 3 Brazil cotton plants; they were about 200 yards distant from the beach, and from the account of the owner of the garden, 2 were about 5, and the third about 3 years old. These plants were covered with flower and fruit. They stood nearly 7 feet in height, and the stems, at the ground level of the 2 older ones, were in the one 9, and in the other 8¾ inches in circumference. They had branched freely, and the cotton I then collected from them was 1½ oz. of clean cotton wool, which was soft, free from harshness, and of a white colour; but nearly one half was soiled by insects, as I took off several larvæ from the pods. The gardener told me that each plant yielded about 1½ lb. of seed cotton, which, taking at an average, the produce of each plant would have been about 8 oz. of clean cotton wool per annum.

Gossypium Barbadense. Variety, Bourbon cotton. Some acclimated seeds were brought from Bangalore in 1856 by a Mr. Haydon and planted at a village about 30 miles from this. The plants were intended to form a hedge on either side of a walk in his garden. In 1856 he submitted some of the produce of these plants at the local Agricultural Exhibition, held at Chingleput in that year, for which he received a prize of 50 Rupees. The Committee of the Exhibition report as follows: "The specimen of American cotton, (Bourbon) very fair, and though the quantity sent was small, being the produce of only a few plants, yet the Committee consider that a reward would show that a value was attached to the article and might conduce to a further introduction of it in the district." Thus encouraged, Mr. Haydon put down and raised about 100 plants at the same place.

Following his example, a Mr. Wakefield of the road department planted 100 trees in a garden adjoining the above.

Some time after this Mr. H. was obliged, in consequence of the failure of his health, to leave the place. He left this garden to the care of a native, who not only unceremoniously cut down the cotton plants for firewood, but allowed free ingress to cattle, which devoured those that had escaped the axe. The plan of sowing adopted by Mr. H. was that of sowing in furrows, the plants being about 6 inches apart from each other. They were watered, whilst plantlings, for about three months; after that time they received no care whatever. They thrived well, and from his account used to flower and fruit throughout the year, and the average produce of cotton wool was said to be 3 oz. per plant. I visited this place in June 1861 to examine some plants which were said to be still there. I found a few of them alive, and these were flowering and bearing. There were also a great number of the stumpy remains of those that were cut down. But in the garden adjoining, belonging to the road department, about 150 plants were planted around a "parterre" as a hedge, and were in a fair state of preservation. I counted, on most of them from 70 to 100 pods; these were very small, but the staple of the wool, although soft and silky, appeared to be weak. The wool of a single pod averaged from 8 to 10 grains, and the seed 25 to 30 grains.

A single plant attracted my attention; it was growing close to a bed of greens and appeared to have been blown down; and as it laid on the ground it covered a space of about 5 feet in diameter. The girth of the stem on the ground was 9 inches. It was covered with flowers and young pods to the extent I should think of 500 and more. From this it was evident that the cotton plant benefited by the water given to the bed of greens, and this accounts for its flourishing condition. The cotton from most of these plants was not collected, and even the little gathered was carelessly thrown in a corner where it was partly eaten up by white ants and rats. I found young plants growing all about the place, some upwards of a 100 yards distant; these were evidently blown over there from the parent

plant, and the seeds grew spontaneously without any care. The soil all about here is of strong binding gravel, very hard to turn up. Mr. Haydon stated that during his time the native weavers about the place readily purchased the cotton from him at 4 As. per pound.

Gossypium Barbadense. Variety, New Orleans Cotton. In June 1861 I supplied the Revd. Mr. Ramanoojum at Wallajahbad with a small quantity of the above named seed recently imported by Messrs. Line & Co. of Madras, which that gentleman put down in his garden among some country vegetables. The seeds sprung up and fruited freely. When I visited the place in December 1861, I found some half dozen plants about 2½ feet in height, thriving well and loaded with fruit; the pods were unusually large, and the seed well covered with wool; sometime after Mr. Ramanoojum sent me a part of the produce which was one pound of seed cotton, although the plants had not then ceased to fruit. The cotton wool when freed from seed amounted to 6½ oz. and the seed to 9½ oz.

In July 1861, I sent to Major Mitchell, who was temporarily residing at Sadras in the Chingleput District, a few seeds of each of the New Orleans, Brazil, Bourbon and country cotton which he planted in a garden near the beach. The country cotton seeds grew up on the 4th day, and those of the varieties between the 8th and 10th days. They continued to be very healthy and vigorous for the first six weeks, when from the continued heat of the weather and the absence of rain they appeared to stop in their growth. But the fall of rain revived them, and they sprung up quickly to the height of some two feet, when they were again checked by some goats having trespassed into the garden. One of the New Orleans plants was but slightly injured, and from this plant the Major shewed me, on my having visited Sadras in February 1862, about 8 oz. of seed cotton, which, though a pretty fair sample, was not so fine, nor so long in the staple as that produced at Chingleput. He has since however obtained a few larger bolls of a finer

sample. The other varieties were much more vigorous but had not yet produced. The soil was little better than bare sand, and the plants had the disadvantage of no manure and a scanty supply of water. There seems however evidence sufficient to prove that the Exotic plant will thrive even at Sadras with care and attention, and that the New Orleans is the earliest variety.

VI. The collection and preservation of the Cotton Wool, &c.

The fibres of the cotton wool come under the same category as woody fibres, and are found surrounding the seed; and although the resisting power of the cotton fibre is much below that of other fibres, yet its great usefulness has rendered it an important article of commerce.

It will be necessary before entering at once on this part of the subject of the Essay, to consider briefly the Physiological uses of the wool to the plant itself; as well as into its microscopical and chemical structure.

The physiology of the wool is at present ill understood, but, as far as we can learn from experiments, the wool seems to perform no important function until the fruit has ripened and burst its capsules by the separation of its valves, when the wool then becomes at once exposed to the rays of the sun, which absorbs its moisture. So that the wool, which up to this time had closely encased the seed, is loosened by degrees, and by the time the seed itself is completely dry, it, with its attached wool, is separated, and being rendered light and buoyant by its downy spreading envelope, is carried by the wind to some distance from its parent plant, and as I have seen it sometimes, to the distance of a hundred yards or more, when unobstructed by trees, &c. The analogue of this exists in the tribes of the Sterculaceæ and Asclepiadaceæ, but more particularly in the latter, and better illustrates the peculiarity from the seeds being smaller, flatter, and lighter. I have watched these feathered seeds, carried out of sight as they floated along in the air, like miniature balloons, descrying one of the innumerable

instances of the power and wisdom of the Creator, in dispersing and covering the land with fruitfulness.

Structure of the Cotton Wool.

On examining a cotton pod soon after the ovary has been impregnated (which is known by the change in colour and the fading of the petals, or flower leaves, or corolla) it is found to contain a number of seeds according to its particular variety. If a single seed be separated and examined by the naked eye, nothing is visible; but when seen through the microscope, it is found covered with a villous coat, formed apparently of elongated cells joined end to end. These are filled with sap. The young seed itself is somewhat pear-shaped, and resembles, in miniature, some of the China candied fruits with the frosted crystals of sugar covering it. On letting out the contents of a single cell, it is found to consist of granular cells, containing a centro-lateral nucleus. On examining a pod between 3 and 4 weeks old, the seed still retains somewhat of its pyriform shape and appears quite shaggy. The fibres, tapering to a point at their free end, resemble hollow cylindrical tubes filled with fluid, and vary in length; and on submitting a single fibre, compressed between pieces of glass, to the microscope, the flattened surfaces become distinctly visible. Again, on substituting a mature fibre before it gets dried, the filament is found to consist of tubular hairs, which are now quite cylindrical. After the dehiscence of the mature capsule, by the contraction and separation of its valves, the wool becomes dry from exposure. A filament now placed under the microscope is found to resemble a flattened piece of tape twisted upon itself, and apparently formed of an extremely thin and transparent membrane, interspersed with dark granular matter, which, after a certain time, disappears in some of the varieties.

Composition of Cotton. The wool of the cotton is but a slight modification of woody fibre, and is composed of Carbon, Hydrogen and Oxygen; their exact proportions have not been ascertained, but in all its essential chemical properties

it agrees with ordinary woody fibre. The filaments when of superior quality are of a fine texture and silky softness.

If of inferior quality, the texture is harsh and feels somewhat crisp.

Chemical Characteristics.

The specific gravity of cotton wool is 1·188,—the wool is tasteless, and destitute of smell. The fibre is insoluble in water, Alcohol, æther, fixed and volatile oils, and vegetable acids: dilute Alkaline leys have no perceptible action on cotton, but when very strong, and assisted by a sufficient degree of heat, they dissolve it. In combination with Nitric and Sulphuric Acids, it forms the explosive material known as "gun cotton" which is employed in the manufacture of Collodion. Cotton has a strong affinity for some of the earths, especially Alumina. Hence this substance is used as a mordant to fix colours on cotton. Iron stains cotton a yellow colour, and the stain, unless recent, cannot be removed by Alkalies or soap. Oxide of tin also combines with cotton; consequently it is frequently used as a mordant.

Brazil Cotton, Sp. Gr. 1·188.
New Orleans, Sp. Gr. 1·165.
Bourbon Cotton, Sp Gr. 1·110.

Cotton wool readily unites with Tannic acid and forms a yellow or brown compound. Nitric acid, when assisted by heat, decomposes cotton wool, forming Oxalic acid. Sulphuric acid chars it; Chlorine gas bleaches it, and probably alters and dissolves it when applied in a concentrated state. Cotton wool is extremely combustible and burns with a clear, lively flame. When distilled, it yields a small quantity of oil but no Ammonia.

Composition of the Cotton plant.

On the 16th June 1861, with the view of ascertaining the composition of a cotton plant, a five year old plant of the

Brazil variety, was selected for experiment. It was grown in a garden soil, but had received no particular culture, the height of the plant was 9 feet 2½ inches. It was cut 9½ inches above the soil, girth of stem 7¾ inches. The stem divided into 3 branches at the height of 2 feet from the ground. Circumference of each division of the plant 6 inches.

Weight of the Plant.

	lbs.	oz.
Woody part of the stem...	9	8¾
Twigs, leaves, flowers, and pods... ...	7	6½
Total...	16	15¼

The plant was cut up after this, and the leaves, twigs, &c., were enclosed in a calico bag, and the wood tied into a bundle and dried in the sun thoroughly, and on the 30th July 1861 again weighed, when their weight was found to be

	lbs.	oz.
Woody parts of stem	4	8
Twigs, leaves, flowers, and pods	3	1
Total...	7	9

The dried wood, leaves, &c., were now placed in a new clean earthen pot and thoroughly incinerated on the same day, and the ash that remained weighed 8 *ounces*.

Percentage of Composition of Plant.

	lbs.	zo.
Water	9	6¼
Organic matter	7	1
Ash	0	8
Total...	16	15¼

Specific gravity of the ash at a temperature of 80° was 4.242. Not having the necessary Chemical apparatus, &c., I engaged the services of J. Mayer, Esq., Professor of Chemistry at the Medical College, Madras, to conduct the analysis of the cotton plants, whose report I append to this Essay.

Another experiment was made with the following plants which I have here tabulated.

Variety of Cotton.	Date of Experiment.	Age of plants.	Height of plants.	Branches.	Length of roots.	Girth of stem at base.	Weight of green plant.	When re-weighed.	Weight of dried plant.	Weight of ash.	Remarks.
		Months.	Inches	No.	Inches.	Inches.	Oz.	Months.	Oz.	Oz.	
1. Brazil, ...	28th Decr. 1861	8	66	8	42	3¾	54	4th Feby.61	19	1½	
2. Bourbon, ..	do. ...	8	84	25	54	3	58	5th do.	21	1	
3. New Orleans,	29th do. 1861	6½	51	20	30	2½	19	6th do.	5½	¾	
4. Indian, ...	2nd Feby. 1862	9	84	8	42	3	48	27th do.	20	6½	
5. Religious...	9th do. 1862	8	96	12	36	3¼	30	27th do.	14	2	

These plants were in flower and fruit when taken up, and were grown in a gravelly soil.

The experiment was carefully conducted in the manner detailed above.

Percentage of Composition of Plants.

Variety of Cotton Plants.	Water.		Organic matter.		Ash.		Total.		Remarks
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	
1. Brazil	2	3	1	1¼	0	1½	3	6	The ash of these plants were placed in glass-stoppered bottles and sent to Professor Mayer for analysis.
2. Bourbon	2	5	1	4	0	1	3	10	
3. New Orleans ...	0	13¼	0	5	0	¾	1	3	
4. Indian	1	12	0	13½	0	6½	3	0	
5. Religious	1	0	0	12	0	2	1	14	

Collection of the Cotton Wool.

Some care is necessary in passing between the different rows of plants when the cotton is being collected. As soon as the fruit begins to ripen and burst, and exposing the cotton in its cells, a few women should be engaged to gather it, and from three to five acres is a fair days work for one woman. The cotton should be picked, either by drawing out the woolly seed from the open capsules with the thumb and forefinger, and it readily separates from each cell, or by cutting the capsule off the plant, and leaving the extraction of the wool to be performed subsequently.

In extracting the wool from the capsule, the soiled cotton can at once be separated, and it will perhaps save trouble subsequently and prevent the necessity of going over the wool again; but by the former mode of gathering, empty husks or capsules, are left on the plant, the result of which is that the twigs generally die away with the husk, and by

its remaining so prevent the plant from forming other flower buds. This is, of course, a great disadvantage. On the other hand, the capsules are cut away with a good pruning knife, at the time the pods are collected, and the plant is left unincommoded, whilst at the same time by this moderate pruning, if I may so term it, the plant is much benefited. New flower shoots begin to push close to the extremities which have thus been cut off. When the cotton has been brought into the house, the wool can be drawn from the capsules, removing the soiled from the clean portion; and if, at the same time, the wool be opened out, it will favour its drying and render easy the subsequent operation of ginning, or using the Churka, to separate the wool from the seed.

Whilst the wool is being loosened out, it will not take much time to rid it of any extraneous matter. I have found that a woman will extract the wool from the cut capsules, separate that which is soiled, loosen the wool generally, and free it of foreign matter, at the rate of nearly 100 pounds of seed cotton in a day of 10 hours; and I have also found the plan of cutting the pods off the plant the best. A few trained women should alone enter the plantation for this purpose, and made strictly aware that they are to use every caution whilst working, and that the plants on either side be not wantonly injured as they pass onward; and that those which have become interwoven are to be carefully disentangled to enable them to pass by without any injury to the plant.

Each woman should have bags made of some coarse cloth, or what is better a wide basket carried on the head of another, into which the pods should be thrown as they are taken off, and as the basket becomes full, it should be emptied into the storehouse, or other suitable place.

Should the plan of removing the cotton from the cells of the pod be adopted, bags made of cloth would be the best. Each woman should have two bags, one slung on each shoulder; the one to receive the clean, and the other the soiled cotton.

As soon as the capsules begin to burst, arrangements should be made for collection. The best time to do so would be the afternoon, the later the better. About the same hour every day parties should be sent into the plantation to bring away all the open pods; if this be not done, the heavy dews at night are likely to injure and soil the wool; and especially when there are indications of rain, this should never be neglected for a single day, as the dry wool is apt to absorb moisture, and is thus not only likely to become soiled, but also weakened from tendency to disorganization of the fibre.

As soon as the pods are brought into the storehouse, which should be a large clean and airy building, they should be spread out, and either then, or when less work is on hand, a few children should be engaged to separate the wool from the capsules, in doing which, clean should be separated from the soiled. The wool must be well opened out from the seed, and any foreign matter that may be present should be removed, and the cotton, thus cleaned, set loosely aside on a loft, which should be erected all round the inner part of the house. The empty shells should be thrown into the dung pit to form manure.

Should the plan of only extracting the wool from the capsules on the plant be adopted; whilst the operation of separating the clean from the soiled wool is being practised, the wool on each seed should be loosened out to favour its drying the sooner, as well as to facilitate the subsequent ginning; these, when brought into the house, should be spread on the lofts to dry.

The cotton wool in the lofts should be turned over every two or three days, or if the weather should not be windy it might be laid out to dry in the sun by spreading it on some of the ordinary country mats, or in the absence of such, if the ground is well swept and covered over with a thick mixture of cow-dung which is generally used by the natives, it will answer very well.

Ginning or freeing the Cotton of Seeds.

I have no experience in any of the patent cotton cleaning machines. The Indian Churka is what I have used myself and seen used elsewhere. The cost of one I had constructed at Chingleput was two rupees, and with this instrument a woman will clean from 30 to 40 pounds of seed cotton in a day of 10 hours, whereas she can only pick from 4 to 5 pounds with the hand during that time. I find no difficulty in cleaning any of the varieties of cotton with the Churka; when New Orleans or any other particular kind is used the only requisite is to see that the seeds are thoroughly dry, so as to crack between the teeth before being submitted to the Churka.

Some of the lately introduced cotton gins would, no doubt, be the best, but these should be of so simple a construction that any native blacksmith might be able to repair them when out of order; otherwise the natives will not bring it into general use.

The ginning should be carried out in a place protected from currents of wind. A good large room, well aired, would be the best, and the cotton that has been ginned should be placed on lofts erected for the purpose.

By having a good airy room for a storehouse, the cotton wool will be preserved, and the fibres will dry thoroughly. If this be not attended to some portions of the cotton wool, is apt to become discoloured.

Packing. With reference to packing the cotton, a screw-press would, no doubt, be the best, and one of these should be introduced into every cotton district; or in the absence of such, the present mode of compressing the wool by the weight of a few coolies might be practised. But attention to cleanliness must be strictly adopted. The coolies should not be allowed to enter the store without having previously dusted their feet.

But the packages should be made up into neat square bales of 350 lbs. each, and the weight of the bale should invariably be fixed at this rate: at present I believe the bale

constitutes in Calcutta 300 lbs., in Madras 300 lbs., and in Bombay 392 lbs.

The bagging should well cover the bale, and the seams should be properly closed, so that no part of the cotton be left exposed. The cotton will now be ready for export to the coast, and from thence to the English or other market to which it is intended to be sent.

In estimating the value of a cotton plantation, purely as a commercial speculation, it becomes necessary that the other products which it is capable of yielding should not be lost sight of.

With this object I shall now briefly consider the value of cotton seed, oil, fibre and wool.

Cotton seed. The seeds, from the Indian variety in particular, are largely used in India to feed cattle, more especially draught bullocks and milch cows, in quantities varying from 2 to 5 lbs. once a day. The seeds are merely steeped in water and placed before the animals.

In the foreign variety the seed, owing to the testa or covering of the seed being leathery, and when thoroughly dry becoming very hard, cattle refuse to eat it, and it does not possess the saccharine flavour of the Indian varieties; consequently cattle do not relish it at first, but when they become accustomed to its use, they partake of it equally as well as of the indigenous varieties. But the Exotic seed requires to be bruised in either a grinding or pounding mill previous to being steeped in water. This plan should be invariably adopted with every variety of the foreign cotton seed when intended as fodder for cattle.

Oil. Cotton seed is known to produce oil. The process of extraction consists in first cleaning the seeds, and freeing them as much as possible of the wool and Fuzz that are still found adhering to them. They are then dried in the sun for a couple of days; afterwards pounded in a mill; formed into cakes: passed into canvass bags prepared for the purpose, and then submitted to the pressure of a powerful screw-press.

The following are the results:—

20 lbs. of Brazil cotton seed produced 2 ounces of oil, which was of a very dark brown colour, neither acrid nor viscid, having a smell rather similar to the common lamp oil, with a slight oily taste. Specific gravity 0·9237. Half an ounce of this oil, with a cotton wick one inch long, weighing one grain, was burned in a wine-glass. It gave out a good bright yellow flame, but was slightly smoky, and continued to burn for 30 minutes. I believe that if the oil was clarified it would be entirely free of smoke, and it would make it as clear as the best Gingeelie oil.

10 lbs. of Bourbon cotton seed produced 2 ounces of oil, which was a shade lighter in colour, but in other respects the same as that of the Brazil; specific gravity 0·9237; when burned in the quantity and way detailed above it lasted one hour. The smoke, if any, was scarcely perceptible, and the flame was bright and luminous.

10 lbs. of the New Orleans cotton seed produced 4 ounces of oil, which was of a light, brown colour, limpid, and clearer than either of the others; specific gravity 0·9237, and when burned in exactly the same way as the other two kinds of oil, it lasted one hour and six minutes, giving a good bright flame and entirely free from smoke, &c. Thus it will be seen that the oil, from the New Orleans cotton seed, is the best in every respect; yielding double the quantity of oil to that produced by the Bourbon, and nearly six times as much as that of the Brazil.

It may be safely calculated that the produce of each of these oils might have been ⅓rds greater than the result obtained, which has been absorbed by the canvass bags; but when expressed in large quantities, the product would doubtless be much more abundant was the process to be tried on a more extensive scale; whereas in the experiment with small quantities the pressure is not so great, and consequently much wastage occurs.

I am indebted to Messrs. Gay and Co., of Madras, for carrying out these experiments for me at my expense.

I fully believe that oil of the kind described above, from either of the varieties of cotton seed, would bring from 250 to 300 Rs. the ton in the English market. I find in the Juries Reports of the Madras Exhibition for 1855, that 8,090 hundred weights of Indian cotton seed oil was exported from Madras in 1852 and 53. In the Northern circars the average price of the seer, which is equivalent to 2 lbs., sells at 2½ annas.

Medical Properties. The young shoots and pods of the cotton plants are used as Demulcents and Emollients. From their mucilaginous nature they are very soothing in their effects.

A Decoction of the plant is in great repute among the natives as a fomentation in wounds and bruises. The wool has long been employed with good effect in surgical dressings, more especially in burns of the skin; the principal use being that of protecting the injured part from the irritation caused by the action of the air when it is applied in thin layers, one over the other, and retained by the application of bandages.

Cotton wool impregnated with nitre or chlorate of potash has been employed as a Moxa. Cotton cloth is well suited for clothing in an Indian climate from its preserving an uniformity of the temperature and readily absorbing moisture from the skin.

The oil, which is both nutrient and emollient, is extremely useful in frictions and embrocations; its effects are great in softening and relaxing the skin, and it would make a capital application for the hair. It is also recommended for freckles.

Cotton fibre. The fibre of the cotton plant is prepared by gathering the plants, when cutting down has been practised on a plantation, after the fruiting season is over, and tying them in proportionate sized bundles for steeping in water from 3 to 5 days; after which time, they should be taken out, untied, and each plant beaten on a piece of board with a wooden mallet, so as to loosen the bark from the wood;

care should be taken that, whilst beating, the bark is not broken through, as that is likely to injure the fibres.

After being beaten, the plants should again be put under water for another 3 or 5 days, according to circumstances, when the fibre will be found loose enough to be easily separated by the fingers. The fibres should then be gathered, washed in clean water, tied up into sheaves, and dried in the shade; but they should be placed out in the dew for a few nights to bleach or to improve the colour. The fibres are now found to be of a light brown colour, though this in a great measure will depend on the time the plant has been under water; as should it have been kept longer than was really necessary, the colour will have become dark brown and even approaching to blackness. The fibre would be extremely serviceable as cordage, and when prepared with care might with advantage be used for textile fabrics. Half an ounce of the fibres, twisted into a cord $\frac{13}{16}$ of an inch in thickness and 2 feet in length, bore a strain of 69 lbs., 2 oz. ere it broke

Dr. Royle gives the comparative strength of cotton fibre and coir as follows:

Coir	224
Cotton	346

Cotton wood. From the experiments which have already been explained in another part of this Essay, it will be seen that a single plant produces 8 ounces and upwards of wood, according to its age. Although the wood never attains any very great size for useful or ornamental purposes, it is found to be tolerably tough and close grained, but very light. As common firewood it burns remarkably well. In an experiment conducted by me, I find that ¾ pound of the dried wood of the Brazil cotton was sufficient to raise 2 lbs. of water to boiling point 212° F. and 1½ lbs. of wood was sufficient to cook 1 lb. of the ordinary rice with 3 lbs. of water, so as to fit it for food.

Oil cake. The cake obtained from the cotton seed is of a light brown colour, and contains large portions of the testa,

or covering of the seed. It does not cake well, crumbling into powder by pressure of the fingers. It has an insipid, mawkish taste, and will make good fodder for cattle, or may be converted into excellent manure. For animals unaccustomed to its use it should be slightly sweetened for the first few days, after which it will be relished by them as food. I find that my milch cows and buffaloes require no coaxing, they greedily eat the oil cake from the foreign seed when placed before them. As manure it is a first rate article; in some countries the cotton seed itself is used as such, but in this case it takes a long time for the seeds to rot and get incorporated with the soil. Whereas the oil cake is a better preparation, as it is better fitted to combine with the soil at once, supplying it to a great extent with a part of the organic matter that had been withdrawn from the soil by the cotton plant itself. I could not do better than give here the analysis of the oil cake which Dr. Royle gives in his work on Cotton Culture in India at page 157, said to be by Dr. Anderson, Chemist to the Highland Society.

Water	11·19
Oil	9·08
Sugar	10·70
Albuminous compounds. (Nitrogen—3·95)	24·69
Ash	5·64
The ash is said to contain,	
Silica	1·32
Phosphates	2·19
Excess of Phosphoric acid	0·15

Dr. Royle states that by comparing these results with those of the linseed cake, he finds that the cotton cake possesses very considerable nourishing or alimentary properties.

APPENDIX.

To the Acting Secretary Agricultural and Horticultural Society of Bengal.

Dear Sir,—I have much pleasure in sending you the accompanying papers as supplemental to the Cotton Essay in which I have briefly detailed the produce of cotton per acre, also the state of my experimental plants up to the present time.

I also send copies of correspondence between myself, the Madras Chamber of Commerce, and the Manchester Cotton Supply Association, in which the quality and value of the cotton grown by me are given.

I regret much to state that Professor Mayer has not been able to complete the analysis for me, although he stipulated with me and undertook the analysis which he hoped to finish in a month or six weeks, but unforeseen events having taken up his time, he has not been able to do so. I am sorry for this, however I sent duplicate samples to the Manchester Cotton Supply Association who have promised to try and get the analysis effected if possible. Here also accidental delay was occasioned, in consequence of an oversight on the part of the Conicapaly of the Honorary Agents (through whom I sent the soils, &c., for transmission) not having forwarded the ashes and soils with the sample cottons in May last; but I believe they have since been forwarded, and it is possible an early analysis may be thus obtained.

The gentleman I wrote to on the subject of insects was Dr. Baird of the British Museum. Unfortunately that gentleman, in consequence of family bereavements, was long out of London, and only in June last I received a reply which

was not satisfactory, nor did it contain the needed information.

Government have purchased the seeds offered them and have had them distributed.

I have since May last distributed nearly another hundred pounds of seed. Several natives have applied to me for seed and information, which I have freely given, and I am using my best efforts to encourage and extend the cultivation as much as possible.

I have also received several applications for seed and information on the subject of cotton from the Mysore country, with all of which I have readily complied.

In submitting the whole correspondence on the quality and value of cotton, I leave it to your Society to decide as to what portions of it should be published with the Essay as an Appendix, and how much of it should be omitted.

Dr. Hunter has furnished the drawing of the cotton plants, but having submitted them for the inspection of His Excellency the Governor they have not been returned as yet; they are in the possession of Mr. Sim, the Secretary to Government who is just now away on leave to the Neilgherries and will not return until the 2nd Instant. As soon as he returns Dr. Hunter promises to get the drawings and send them to me for transmission to you. The drawings have been elaborately finished and are the size of this pencil sketch, which I now submit, of the Religious cotton.

They are very nicely colored, and I hope will prove acceptable as an addition to the Essay. With reference to my letter of the 29th October 1862, should you think it would be safer to do so, please send the medal, &c., awarded to me through the medium of the Madras Government.

I am, Sir,

yours very truly,

JOHN SHORTT.

MADRAS,
6th. October 1862.

Supplemental to the Cotton Essay.

The Cotton Essay was closed on the 1st of April 1862, when, in consequence of all the varieties continuing in fruit, I was unable to determine the produce per acre. I am now desirous of continuing such information as I can give up to the present time, as also the results of the experiments, not confining myself to those detailed in the Essay, but going over the several plots. On taking a general average from these, I find that the produce of the Brazil cotton as a garden culture was 185 lbs. of clean cotton wool per acre, and 130 lbs. as a field culture.

The produce of the Bourbon is much larger 215 lbs. as a garden culture and 170 as a field culture.

The produce of the New Orleans was 150 lbs. as a garden and 100 lbs. as a field culture.

From this it will be observed that the Bourbon variety is the greatest producer, accounted for, in a great measure, by the plants continuing to produce throughout the year.

Although the Brazil appears the most hardy plant in some respects, yet it seems to suffer most from change of seasons and the ravages of insects.

The New Orleans stands next in its liability to suffer from atmospheric vicissitudes and the ravages of insects, and the Bourbon is the least affected by the causes that injure the other varieties.

Since February last I have given up irrigating the garden culture of the different varieties, and have done nothing beyond keeping them free from weeds, &c., and although the monsoon failed and a severe drought was experienced in the station, nearly all the wells in the place having run dry and great scarcity of water being felt, the Brazil and Bourbon varieties continued to look extremely well and were covered with dark green foliage.

The Brazil ceased to fruit very early, but the Bourbon continued to do so, whilst the New Orleans, although looking dry and withered, continued to put forth occasional

flowers and to ripen their fruit, the wool of which was short in staple and rather harsh.

Two full grown cocoanut trees in their immediate vicinity died in consequence of the drought, but none of the cotton plants seem to have suffered in this way; their evergreen and healthful appearance contrasted pleasantly with the dry and faded aspect of the various shrubs and trees around, and their dark green glossy foliage was quite refreshing to the eye in the midst of the surrounding aridity.

I took advantage of the first shower of rain that fell in the beginning of August and had the plants pruned. As the Brazil was the largest shrub and the plants were greater in number than the others, I divided them into three batches, the first I cut down to within one foot of the soil, the 2nd to within 3 feet, and the third I merely stopped their growth by pinching away their tops and removing straggling branches. The Bourbon were covered with blossoms and fruit, so I merely stopped their growth and removed straggling branches.

The New Orleans I topped at the height of 2 feet from the soil and cut their branches around at about 6 inches from the main stem, and the earth around each variety was loosened, weeds exterminated, and they were dressed with rotten stable manure.

In the course of a fortnight the plants were quite bushy with shoots. The 3rd division of the Brazil that were stopped are shewing flower buds here and there.

The Bourbon are now ripening their fruit which is in course of being collected, whilst fresh flowers are appearing.

The New Orleans are loaded with flower and fruit.

It is possible that should the rains set in heavily, some damage may be done, nevertheless I am in hopes of gathering in an early winter crop as I have made the plants as snug as possible.

CHINGLEPUT, *Oct.*, 1862.

JOHN SHORTT, M.D., F.L.S., M.R.C.P.L, &c., &c., *Zillah Surgeon.*

EXPLANATION OF ABBREVIATIONS USED IN THE COTTON ESSAY.

Part II, Cotton yielding plants, under head Gossypium Accuminatum, the Invalid officer alluded to is Captain Templer of the Madras Invalids.

Under the head "Observations" wherever C comes means "Chingleput."

Para. No. 3. The Engineer officer alluded to is Lieut. Hasted, Asst. District Engineer, D. P. W.*

Para. No. 5. Alludes to the garden of W. Dowdeswell, Esq., late Civil and Sessions Judge, Chingleput.

Para. 7. Late Civil and Sessions Judge means W. Dowdeswell, Esqr.

Gossypium Barbadense.

Para. 1. Where comes Mr. H—means Mr. Haydon, a pensioned Drummer. The village alluded to is "Terupagooly" in the taluq of Conjeveram, Chingleput District.

* Now Colonel, Secretary to Government, Public Works Department.

INDIGO.*

The consideration of this subject may be divided into two parts, viz. :—

I. The cultivation of the plant.

II. The manufacture of the dye.

It may not, however, be out of place, before entering minutely into these divisions, to give a very brief general history of Indigo, as also a short account of the plants from which the dye may be obtained.

History.

Indigo, as a blue dye, was long known in India. It was first imported into Europe by the Dutch in the year 1660, and subsequently by Portuguese, French and British traders. Notwithstanding the many objections against its introduction into Europe, it became in course of time an article of extensive commercial value; so much so, as to interfere seriously with the Home trade in Woad.

The export of Indigo from India declined considerably at the commencement of the 18th century; but, under the patronage of the late East India Company, it has since increased. The quantity at present, exported from the Madras Presidency alone, is about seven thousand chests annually: the quality of such Indigo being considered second only to that produced in Java.

Indigo-yielding plants, may be classed under three genera, viz., 1, *Indigofera*; 2, *Isatis*; and 3, *Nerium*.

1. Indigofera.

Of this genus there are several varieties, viz. :—

1. *Indigofera Tinctoria.* This is the cultivated species

* A prize Essay, by Dr. John Shortt, to which was awarded eight hundred rupees by the Madras Government.

Genus Indigofera.

of this Presidency and of Bengal, and furnishes the chief article of commerce in the Madras Presidency. It is also to be found in Madagascar, the Isle of France and St. Domingo.

2. *Indigofera Anil.* This is a wild species, commonly found at Phillips's Island in Spain and in the West Indies; as also along the Gambia in Africa. It is characterized by an erect, under shrubby stem, deflexed, curved, with both sutures thickened and prominent—ten to twelve-seeded. The Spaniards were the first who seem to have manufactured Indigo from this species in Mexico and other parts of America, and the Portuguese in Brazil. It is cultivated in some of the Provinces of the Punjaub for the purpose of manufacturing the dye. It is doubtful whether this belongs to the same species as the *Indigofera Tinctoria* or to a distinct one.

3. *Indigofera Argentea* is the wild, or silvery-leafed Indigo: its growth in India, while admitted by some, is disputed by others. It is shrubby, with round branches of a silky whiteness, from oppressed pubescence; leaves pinnate, eight to twelve-paired, leaflets opposite, obovate, silky, pubescent; racemes shorter than the leaf; legumes pendulous, much compressed, knotted, canescent, two to four-seeded. It is the species cultivated in Africa and America for the sake of its dye, which it yields in small quantities, but of superior quality.

"Karoo-eti," or Black Indigo.

4. *Indigofera Cœrulea.* This species is known as the Karoo-eti, or Black Indigo, of the natives of India. It is an erect-shrub, growing in dry, barren, uncultivated ground, to the height of three feet; and higher when cultivated in good garden soil. It flowers during the wet and cold seasons; the leaves are pinnate, four-paired, obovate, emarginate; racemes rather shorter than the leaves; legumes deflexed, curved, contracted between the seeds, being from three to four-seeded. From the leaves of this plant, Indigo of a light color has been obtained by

Dr. Roxburgh; lighter, it would appear, than that obtained from Indigofera Tinctoriâ, or Wrightia Tinctoria, and in larger proportion. The Indigo from this species is obtained by the scalding process.

5. *Indigofera Disperma* is the plant cultivated in Spain, America, and in some parts of the East Indies. The stem is herbaceous, weak; branches, round; leaves, pinnate, four to six-paired; leaflets, elliptico-oblong, smooth; racemes, slender, larger than the leaf; legumes, round, subtorulose, mucronate, two-seeded. It furnishes a superior dye stuff. The Guatemala Indigo comes from this species.

6. *Indigofera Glauca* is the Egyptian and Arabian species.

7. *Indigofera Pseudo-Tinctoria.* This species is cultivated in some parts of the East Indies, and is said to furnish the best kind of Indigo.

8. *Baptisia Tinctoria* is the wild Indigo of the United States, and furnishes a blue dye.

9. *Cinerea* and *Erecta.* The latter is a native of Guinea. There are several other varieties common to the coast of Guinea, such as Indigofera Hirsuta, and Indigofera Glabra.

10. *Tephrosia Apollinea* and *Toxicaria* are plants which yield a species of Indigo; the former is found in Nubia, and the latter on the banks of the Nile.

2. Isatis.

Genus Isatis.

1. *Isatis Tinctoria* or *Woad*, is the species cultivated in Europe and China. It may perhaps with advantage be introduced into India.

2. *Isatis Indigotica* is found in Shanghae and Chusan, and is largely cultivated in the Re-Wang-Meon district.

(These two varieties belong to the natural order Crucifera.)

3. *Polygomen Tinctorium* is a native of China. It has recently been introduced into Belgium for the manufacture of Indigo. It belongs to the natural order Polygonacea, or Buck-wheat family.

4. *Ruellia Indigotica* belongs to the natural order Acanthaceæ. In Assam this plant is known under the name "Room," and is there largely cultivated. It is also cultivated in India and at Che-king in China. The dye from this plant does not appear to be known to commerce, though the plant is easily cultivated, grows most luxuriantly, and is believed to be productive. The dye is obtained from the leaves of the plant much in the same way as that manufactured by the natives of this Presidency from Indigofera Tinctoria, viz., by steeping the plant, beating the liquor and precipitating the fecula by lime-water. It is known to the Chinese by the name "Tien-ching." The odour it emits during preparation renders it very offensive.

5. *Gymnema Tingens*, or *Asclepias Tingens*, has been made to yield Indigo in the east of an excellent quality. It is a climbing plant, and belongs to the natural order Asclepiadacæa, or Milk-weed family.

6. *Marsdenia Tinctoria* (of the same order as the preceding). This also supplies a blue dye resembling Indigo.

3. Nerium.

Genus Nerium.

1. *Wrightia Tinctoria* (named after Dr. Wright) belongs to the natural order Apocynacæa, or Dog-bane family. Characters of this order—calyx, five-parted; corolla, salver-shaped, having at its throat ten divided scales, with the stamens exserted and attached to the same part; anthers, sagital, cohering by their middle to the stigma; ovaries, two, cohering; style single, filiform, dilated at the top; scales five to ten, situated at the base of the calyx, outside the corolla; follicles distinct or combined, with adnate placentæ. It is a large wild tree, with pale green, soft leaves, which are deciduous in the cold weather, and on being bruised, yield a kind of Indigo. It flowers in March and April, with white follicles in pairs, from twelve to eighteen inches long, the lower extremities of which unite as they ripen. It is a tree common in the low jungles of Coimbatore, Salem and Orissa, where it attains considerable size. Its wood is white and close-grain-

ed, somewhat resembling ivory, whence it receives the common Indian name of "Paulay Murrum," or "Vep-paulay," from its milk-white appearance. From this plant, Indigo has been manufactured in this Presidency. Dr. Roxburgh first drew attention to the Indigo-yielding properties of this plant, and from its leaves he extracted Indigo by a shorter process than that in use: it is termed the "scalding process," or "European method;" but the method when applied to this plant does not seem to have been carried out with the same amount of success by subsequent manufacturers.

"Paulay."

A few other plants with which we are not sufficiently acquainted, are known to yield a blue dye, or coarse sort of Indigo—such as Galega Tinctoria, Spilanthes Tinctoria, Scabiosa Succisa, Cheiranthus Fenestralis, Bigmonia, and Tabernæmontana; and on the African coast, Amorpha Fruticosa, and Saphora Tinctoria.

I. Cultivation of the Plant.

Indigofera Tinctori (Tamil, அவரி *Avarie;* Hindoostanee, نيل *Neel*; Teloogoo, నీలి *Neelie*) is very extensively cultivated in this Presidency as well as in other parts of India. It belongs to the natural order Leguminosæ, or Pea-tribe, which is indigenous to the tropical parts of Asia, Africa and America. All the varieties of this order are small, herbaceous, shrubby plants, having pinnate leaves, small and papilionaceous flowers, appearing in axillary clusters of a purple hue; the calyx is cleft; segments, acute; standard, roundish and notched at the upper extremity; keel furnished with a sub-acute spur on both sides; stamens, arranged in two distinct bundles—nine and one; legume, continuous, one or more seeded; seeds, truncated, separated by spurious cellular partitions.

Natural order of plant. Characters of the order.

Indigofera Tinctoria is an under shrub belonging to the sub-order Papilionacæa, or Pulse section, and has the butterfly form of corolla. It has an erect, branched stem with stipulated pinnate leaves, the leaflets being in pairs of five and six, long, obovate, scarcely pubescent. The inflorescence is a raceme, with axillary flowers shorter than the leaves; the legumes are approximated towards the base of the rachis, being nearly cylindrical, and presenting rounded swellings, which are successively bent downwards and upwards in continuous curves; the sutures thickened, seeds about ten, cylindrical and truncated at both ends. The plant is a biennial, as it passes through all the phases of its existence in two years. It is cultivated to some extent in India by native ryots on their own account, as also for a few leading mercantile firms, which have large factories for manufacturing the dye. Some of these may be seen at North and South Arcot, Cuddapah, Nellore, Rajahmundry, Salem, Tinnevelly, Trippassore, Vellore, &c.

Characters of the Indigofera plant.

Natives cultivate on their own account to a small extent.

The natives have small factories of their own in the various districts in which Indigo is cultivated. In general, the dye has hitherto been manufactured by them in a rude and indifferent manner; and they have not paid that attention to the culture of this valuable dye which its importance demands. It requires much care and attention in the cultivation of the plant to increase the quantity and improve the quality of the dye.

Native Factories.

The mode of culture followed by the native cultivator is that of freely ploughing up dry or garden land, and manuring the ground in one or other of the following methods:—

The mode of cultivation by natives.

A flock of sheep or goats is sometimes enclosed on the ground intended to be sown with Indigo for a few nights previously, at an average of 200 head per cawnie. At other times the ground is lightly scattered with wood-ashes, cow-dung, &c.; and at others, the refuse of the Indigo plant from the steeping vat, or its ashes, is scattered over the fields. The first method is no doubt the best, for both the dung and urine of the

Ploughing and manuring.

animals are secured; but the advantage thus gained is partly lost by the subsequent exposure to the heat of the sun, which dissipates the most essential or volatile ingredients contained in them, leaving nothing but the undecomposable rubbish on the fields.

Irrigation not practised.

As a general rule Indigo fields are not irrigated—the native cultivator depending for the success of his crop upon the periodical rains.

Sowing.
Weeding.
Cutting.
Gathering.
Market value of plant.

The seed is generally broad cast, and when the seedlings attain the height of two or three inches, the fields are weeded; this is sometimes done a second and a third time. The sickle is brought into play at the end of the third month after sowing, when the plants bloom. It is soon made up into bundles about seven feet in girth and sold to the manufacturer, usually at the rate of seven bundles per rupee.

Stacking.

On the arrival of the bundles at the factory, which by previous arrangement take place about 10 a.m., they are stacked into what is termed the "steeping vat," and pressed down by large beams which are firmly bolted to upright iron rods or stone posts, buried partly in the ground.

Steeping.

Water is then let into the vat so as to stand a couple of inches above the plant. In this manner it is allowed to macerate from eighteen to twenty hours, by which time a kind of mucous fermentation will have taken place: the fluid is then let out by the removal of certain plugs into the beating vat, where it is beaten with oars or paddles for a couple of hours. Lime water in proportionate quantity is then thrown in, and the fluid allowed to settle for a couple of hours. During this time the fecula precipitates to the bottom of the vat; the plugs or now opened and the supernatant fluid let out. The fecula is then taken up with flat copper pans and strained through a layer of coarse cloth. It is next placed in a copper boiler with a sufficient quantity of fresh water, and boiled till ebullition freely occurs. The fire is then put out and the contents allowed to cool.

Beating.

Collection of fecula.

Boiling.

Pressing.

The pulpy mass is next collected in bags made of dungary cloth; these are placed in a wooden box having a till, in which it is submitted to pressure by means of a screw in order to expel the whole of the fluid contained in the mass. This is repeated for two or three days; and when the mass has been completely drained, it is cut into square cakes and placed in the shade, and the moisture allowed gradually to evaporate.

Cutting.

Cleaning.

In about a month the cakes are cleaned or brushed to remove a whitish efflorescence which forms on their surface, and also to give them a glossy appearance. The article is now ready for the market and is styled *fresh-leaf Indigo*, and is considered superior to that manufactured from the dry leaf.

Only slight variation between fresh and dry-leaf processes.

The dry-leaf process is carried out in the same way, except that the plant is cut, dried and threshed to collect the leaves, which are sold to the manufacturer by weight, at 90 seers; or by measure, at 350 cubic feet per rupee. The dry leaf is submitted to the action of water in the vat to undergo the process already described as the fresh-leaf process. The fresh-leaf process is that by which the native at present manufactures his Indigo; and the plant chiefly used is the Indigofera Tinctoria; but at some of the large factories under European superintendence, this process is somewhat modified: more care is taken in the several steps of the manufacture, and greater importance attached to cleanliness.

We shall now consider the cost of cultivating one cawnie

of dry poonjay land with Indigo by the native cultivator who does not irrigate :—

	RS.	AS.	P.
Ploughing (at 8 annas a time for) eight times...	4	0	0
For eight measures of seed.....	1	4	0
Sowing and covering, weeding, &c.....	4	4	0
Cutting and cost of carriage to factory.....	5	0	0
Land tax to the Collector.....	2	0	0
Total...	16	8	0

The average quantity of plant obtained in three crops from the one cawnie of land is 250 bundles, each having a girth of seven feet, and at the market rate of seven such bundles per rupee, returns, as the whole produce of one cawnie, rupees 35-12-0, from which deduct the cost of culture, &c., viz., rupees 16-8-0; a clear profit of rupees 19-4-0 is thus shown to accrue to the cultivator. We shall see the further profits in the *manufacture* of Indigo as cultivated above.

Cost of manufacture.

Cost of manufacturing Indigo from the produce of one cawnie of land, the manufacturer himself being the cultivator :—

	RS.	AS.	P.
Cost of 250 bundles (each 7 feet girth) of plant grown by ryot on his own account (as already exhibited),.....	16	8	0
Wages of six men at 2 annas 8 pie each per day for five days for stacking, beating, &c.	5	0	0
Wages of four men for boiling, pressing, drying, &c., for three days at the above rate...	2	0	0
Wages of plug maistry for eight days, at 4 annas per day.....	2	0	0
Contingent expenses.....	5	4	0
Total cost...	30	12	0

Proportion of Indigo obtained.

The average quantity of Indigo obtained from 250 bundles of the plant is 2½ maunds, and the average market price of such Indigo is rupees 35-0-0 per maund of 25 lbs.

	RS.	AS.	P.
Value of the Indigo. Thus 2½ maunds of Indigo at 35 rupees per maund ...	87	8	0
Deduct cost as above	30	12	0
Profits. Net profit...	56	12	0

Cost of outlay not considered.

Profits less where manufacturer buys his plant.

The cost of outlay for setting up the factory with the necessary apparatus has not been taken into account; nor yet the losses in case of failure of the periodical rains, or of want of success in the manufacture. In cases where the manufacturer *buys* his plant, we have to deduct from the

	RS.	AS.	P.
Net profit (as before shown) of rupees.....	56	12	0
The cultivator's profit (as shown above) rupees	19	4	0
The balance shows the *actual* profit to the manufacturer who buys his plant	37	8	0

In the latter system, although the profit is less, there are less risks. Nearly all the native manufacturers pursue this plan as the safer one.

Having detailed the native mode of the cultivation and manufacture of Indigo, as well as shown the cost of each, and their attendant profits, we shall now proceed to suggest improvements by which, if adopted, a superior quality of Indigo will be obtained, and in quantity sufficient to remunerate both cultivator and manufacturer; and the growth of Indigo, instead of being the precarious enterprise it is at present considered, will prove a very remunerative investment of labor and capital.

In pursuance of the plan originally proposed, we shall consider, first, the improvements necessary in the cultivation of the plant, such as selection of soil, ploughing, kinds of manure, choice of seed, sowing and mode of irrigation, weeding, cutting and gathering. As these points are of importance, we will give to each a separate consideration.

Care should be observed in the selection of the soil for

Selection of soil.

cultivating Indigo, and to carry this out more effectually, the chemical elements necessary for the nourishment of the plant, and the manner in which the roots strike the ground, should be kept in view. As the Indigo plant has branched roots, which enter more or less vertically into the soil, well drained land, neither too dry and sandy, nor too stiff and clayey, should be selected. A sandy light soil with a subsoil of clayey loam, will answer well; but in land that is rather moist and has a light free subsoil, or good loam, the Indigo plant grows very luxuriantly. When, however, the plant grows *too* rapidly, the quantity of dye yielded by a given quantity of leaf is comparatively small.

Too rapid growth of plant not desirable.

In selecting lands, open or garden lands are preferable as they allow free evaporation. At some places where wet land has been tried, it has proved a failure from excess of moisture and its liability to swamp, more especially during the rains. When the soil, however, is light and loose, it facilitates the descent of the root. A fair crop may be grown on lands formed of a dark clay loam if facilities exist for draining such lands.

Open lands preferable.

In choosing ground, advantage should be taken of localities where water abounds. It is a very good plan to select the site of factories in the neighbourhood of ground where the culture of Indigo may be carried on, and the wells of the factory brought into play for irrigating the plant, and whence it may be conveyed to the factory, with ease, in time, and with considerable diminution of expense.

Site of Factories.

The ground having been chosen, especial care should be paid to the ploughing. The ground should be ploughed so that at least a foot of the soil be turned up. The weeds, &c., found on the ground might with advantage be collected and burned for manure. After the earth has been repeatedly turned up, so as to expose every part of it to the action of the sun and air, it should be manured.

Ploughing.

Weeds used as manure.

In this country, sufficient attention has not been paid to agricultural improvements, and consequently the same rude process of manuring which has been in existence for centuries continues to be carried out to the present day. In the use of manure it is not the quantity, but the quality, which should receive attention. The native method of enclosing sheep on the ground has been alluded to, and the reason why it is not as effectual as it might be, has been noticed; so also where dung-heaps are used as manure, the essential ingredients having been already volatilized by exposure to atmospherical influence, the undecomposed rubbish, or refuse, is all that remains: the ryot is satisfied with this because he perceives no great loss in the quantity.

Kinds of manure.

It is now an ascertained fact that certain plants thrive only in soils where the necessary minerals required for their structural formation are found; and such are usually contained in the ashes of the plant. Indigo belonging to the Leguminous family, requires the phosphates of magnesia, lime, potash, soda, &c.; it is incumbent, therefore, on the agriculturist to supply these to the soil, with a view to enrich it; and if carefully attended to, almost any soil may be rendered suitable and productive. The necessary minerals can be readily obtained with little or no additional expense, simply by substituting a dung-pit for a dung-heap. Adjoining the byre, or other convenient place, a large pit of from three to six feet in depth with a proportionate width should be excavated, and it ought to be so constructed that all the urine and dung of horses, cattle, goats, pigs, fowls, &c., and other refuse matter, might be conveyed to it. For this purpose the bottom and sides of the pit should be faced with stone or metal. Brushwood or refuse straw, &c., with which every village abounds, should be placed to the thickness of a foot at the bottom and sides of the pit, and into it be thrown, besides what has been already mentioned, the washing of meat, fish, rice, &c., dead animals, as dogs, cats, and other carrion, generally found lying in the neigh-

Construction of dung-pit in substitution of the usual dung-heap.

bourhood of villages, and to which may also be added, human urine and excrement.

Uses of lime.

To deodorize the pit and prevent it from becoming offensive, as well as to facilitate the decomposition of animal and vegetable matter, and to supply an element in the fabric of the plaint, a small quantity of fresh lime should be occasionally thrown in, so that in a few months a valuable quantity of manure may be obtained, rich in its fertilizing properties and containing the necessary ingredients, not only for the Indigo plant, but for all other Leguminosæ and Gramina, as well as other plants. The manure thus obtained, will nearly equal American guano, and eventually become a marketable article. The pit should have a covering of thatch, so as to protect it from the sun and rain. There is no reason to doubt that when this subject is thoroughly understood in its practical application it will be adopted by the ryots, who will thus realize an increase of double or treble the usual crops. This is the kind of manure required for the cultivation of Indigo, and by which a luxuriant crop, rich with the dye will be produced, as it is evident that the dye depends on the healthiness and luxuriance of the plant.

Manure prepared as suggested, when fit for use.

Manure prepared after the manner just described, will, in twelve months, be sufficiently disengaged by putrefaction, to be ready for distribution in the ground. It should then be carted away to the field in the cool of the afternoon, and on its being laid on the field, the ground should be ploughed, so that it may at once become mixed with the soil, and thus prevent any of its volatile ingredients being dissipated by exposure to the atmosphere. The ground should next be levelled and laid out in square beds of a convenient size. Beds eight by twelve feet each are easier irrigated than those of a larger size.

Choice of seed.

In the choice of seed, it is necessary to satisfy ourselves from its weight and appearance that the seed is sound; and, if possible, to

ascertain the crop from which it has been collected. That from the first and second crops is the best; but, from a mistaken notion of economy, the seed from the third crop, though inferior, is that generally used by the native cultivator. The seed from the second is superior to that collected from the first crop, because at the time the second crop is gathered, the plants have arrived at maturity; and from being in full vigour, the seed then produced, will abound in the nourishment requisite for the plant in the first stage of its growth. In fact, seeds should be chosen from the finest specimens that can be procured. Unfortunately, however, it too frequently happens that when the cultivator is obliged to resort to the market for his seed, he has no means of correctly ascertaining from which crop the seed has been collected, except by external appearances: that from the second crop looks more sound and is larger in size, has a glossy appearance, and a light-brown color; whilst that from the third crop, is of smaller grain, with the husk more or less wrinkled, and of a dark brown color.

It is necessary to be aware that several impositions are practised upon purchasers of seed, exposed for sale in the market. Old and new seed are mixed in equal proportions, but this can be detected by their difference in color. It sometimes occurs that this pulse, like the cereals, is attacked by weevil, and then, although the grain appears entire, the embryo is destroyed. To deceive the purchaser, seed of this description is soaked in a thick mixture of clay for an hour or two, in order to close up the orifices made by the insect in the grain: but this trick may be exposed by steeping the seed in pure water, which when renewed several times, will make the orifices distinctly visible. Lastly, old seed, as well as those first described, is submitted to a process of oiling, with the view of giving it the glossy appearance of new seed. This imposition can be detected by washing the seed with soap and water, and drying it in the sun, for it thus loses its glossy appearance and becomes of a dark-brown color.

Sowing.

The cultivation of Indigo in this Presidency is generally made dependent of the rains, and seed is, therefore, sown according to the different seasons; but when facilities exist for irrigating the field, the seed should be sown early in October, or immediately after the first shower of rain. The ancient method termed "broad-cast" is still carried out, and answers very well when the cultivation is entirely dependent on the rains; it however, entails considerable waste of seed. The more economical and successful method of sowing by drills is feasible, for it may be practised from bed to bed, and from field to field; the best instrument for the purpose being a hand-drill. The short-cast method may also be carried out by scattering the seed from bed to bed in regular succession, the seed being carried in a cloth round the waist of the sower. Care, however, should be taken that the seed be not sown too closely, as the young plants are likely to be choked in their growth. The plants should be about eighteen inches apart, and never nearer than twelve inches. We should, on the whole, prefer the usual broad-cast method prior to squaring the fields into beds; and after the seed has been cast, the ground should be twice ploughed over for the purpose of covering in the seed, and afterwards formed into beds to facilitate irrigation.

Precaution in sowing during dry seasons.

In the dry season, after the ground has been prepared, as already pointed out, it is necessary to irrigate it, in order to supply the necessary amount of moisture to the seed. On the third or fourth day after watering, it should again be ploughed to break up the incrustation formed by the evaporation of the water: the seed is now cast; the ground harrowed and afterwards squared into beds, so as to facilitate subsequent irrigation. Should this precaution of irrigating *before* sowing be not adopted, the seed will not germinate for want of moisture; as a thick impermeable crust results from the evaporation of the water, and which effectually prevents the young plants from shooting up; unless, indeed,

Consequences of neglecting to irrigate previous to sowing.

there is such a quantity of water supplied as will prevent incrustation. The evil effect of an over-supply of moisture, as already explained, is the rotting of the seed and consequent loss to the cultivator.

Treatment of seedlings.

The seedlings will show themselves on the third or fourth day, sometimes not until the sixth day, and when they attain the height of about six inches, the field should be carefully weeded. It is now time to see that the plants are at a proper distance from each other: those growing too closely should be transplanted to parts where they are too far apart, or they might be removed altogether. It is a great mistake to have the plants too near each other, as it interferes with their growth and prevents their branching out laterally; they, in consequence, grow up straight with but few side branches, and these have but few scattered leaves. Moreover, when plants are crowded, it interferes with the free circulation of air between them and deprives them of vigour, as well as checks their growth; and as the quantity of dye depends upon the amount of foliage, it is desirable to increase the quantity of leaves by encouraging free branching.

Evils of over-crowding the plants.

When the plants are five or six weeks old, they attain the height of six or eight inches and begin to throw out branches. It is now necessary to loosen the earth around each plant with a hand-hoe, and at the same time to remove the weeds which may have sprung up since the first weeding. This work can be done well by women or boys.

When about two months old, they should be weeded for the third time, and care should be taken not to bruise or otherwise injure the plants. The circulation of air through the crop, which now becomes more than ever necessary, will thus be facilitated.

Irrigation.

The irrigation of land growing Indigo does not appear to be generally adopted, the cultivation of the plant having hitherto been made dependent on the rains; and this accounts for the frequent

failure of crops. The irrigation of land enables the plant to throw out a larger quantity of foliage and consequently increases the quantity of dye. It has been already noticed, that factory wells should be so situated that advantage may be taken of them when the plants require water; when the factory wells cannot be so employed, as will sometimes happen, wells may be sunk in the neighbourhood of Indigo fields for the purpose of irrigating them. To flood the lands is in many instances a means of fertilization, water being absolutely essential to the successful cultivation of Indigo, inasmuch as it secures moisture, and affords the necessary sort of nourishment to the roots, and prevents the bad effects that frequently arise from want of moisture in the soil; it also acts beneficially, by causing the more equable diffusion of nutritive matter which already exists in the ground. Excess of moisture will, however, rot the plant; hence the objection to cultivate wet land. On the other hand, it is necessary to recollect that too much dryness stints the growth or altogether destroys the plant. Great care and attention, with a certain amount of local practical experience, are essentially necessary to guard against both these evils.

Excess of moisture, as well as over-much dryness, inimical to the growth of the plant.

Indigo fields require to be watered on the eighth day after sowing, and once a week during dry weather, and fortnightly if the season be fair.

The usual means by which land is irrigated in this Presidency is either the *Picota* or *Cavalay*.

A Picota requires three men to work it, and a boy to distribute the water on the ground. These will water about *one* cawnie of ground daily, and on an average, cost 10 rupees per month. The cost of erecting a picota is about 16 rupees.

Picota, or Yethum—cost.

The cavalay requires a pair of bullocks, with a driver and a boy; these will water about *three* cawnies of ground daily, and will cos

Cavalay—cost.

about 13 rupees per month. The cost for erecting a cavalay and purchasing bullocks will be 64 rupees.

One or other of these appliances will be necessary for supplying the vats, &c., of the factory with water, so that if land adjoining the factory is cultivated, it may be turned to account either way. The cavalay should be preferred, as the bullocks will be of service in furnishing and carting manure, ploughing the ground, conveying the plants from the fields to the vats, &c. When the cavalay is not worked in watering the fields or filling the vats, the driver and boy may be employed in keeping from three to five cawnies of ground free of weeds.

Indigo plants are liable to be attacked by caterpillars, which sometimes devour the greater part of the leaves; they should, therefore, be sought out and destroyed. When they are numerous in the neighbourhood, dusting the fields with powdered quicklime early in the morning, before the dew evaporates from the leaves, is a very successful mode of keeping out caterpillars and other insects.

Ravages by insects, how prevented.

The appearance of the blossoms indicates the period at which the plants are mature, and they may then be gathered for the purpose of extracting the dye. This period may sometimes be ascertained by the leaves breaking between the fingers with more or less brittleness. When the root leaves begin to ripen and drop—which generally happens when the plants are about three months old—it is an indication that the plants are ready for the sickle.

Signs of maturity.

In cutting the plant, care should be taken not to leave too short a stem in the ground, but to cut immediately above the ripe or yellow leaves, so as to leave from six to eight inches of the stalk above ground. The leaves, as is well known, are the respiratory organs of the plant, and in order that the stalks may rapidly throw out buds and shoots, the more lower or yellow leaves are left the better; and the larger the stalks, the greater the subsequent branching. Still

greater attention should be paid to this matter in a second and third cutting.

A day or two after the first crop has been gathered, the fields should be thoroughly weeded, and the ground loosened with a plough or hand-hoe; all clods should be broken, the fields manured and the ground levelled. The fields should then be irrigated, and the irrigation be carried on as before stated, viz., once a fortnight in fair, and twice in dry weather. In about a week or ten days, the stumps will begin to throw out shoots. It is at the second sprouting that the plants attain the greatest amount of vigor, and thus yield a large amount of dark-colored foliage. Each plant will throw out as many as ten and twelve branches if sufficient lateral space has been allowed them. In the third week, and again in the sixth week, after the first cutting, the fields should be weeded; on each occasion of weeding, the earth around each plant should be loosened and the plants watered, and they should be carefully attended to, to prevent the ravages of caterpillars and other insects. In about three months, the fields will be ready a second time for the sickle.

Greatest vigour when attained.

In a day or two after the second crop has been gathered, the fields should be again weeded, and the earth loosened and manured, and immediately afterwards irrigated. The same attention should be paid to weeding, watering, &c., as for the first and second crops. In three months after the second cutting, the fields will be ready a third time for the sickle. Instead, however, of being gathered, the plants are now frequently allowed to run to seed; and in about a month or six weeks, the plants will be laden with small pods, of about two inches in length, each containing from three to ten seeds. The seeds will be known to have become mature by the plant itself becoming more or less yellow, and by the pods becoming of a dark brown color. The plants are now cut down

Period of second cutting.

and dried in the sun for a few days, and the pods gathered, either by threshing or by the hand. The pods are now submitted to a wooden mortar and pestle to be husked; the seeds are further dried in the sun for a week or ten days, and after they have been winnowed to free them from chaff, they are collected and preserved in closed earthen vessels. The seed will be of a light yellow color, and will be full-grained if the plants have been properly irrigated. The seed from the second crop is the best, and only from this crop should seed be procured; the second crop, moreover, yields nearly double the quantity of seed yielded by a third crop. The market value of seed is about eight measures per rupee.

Collection of seed.

Preservation of seed.

Best seed from second crop.

Market value of seed.

After each cutting, the plants are gathered and made up into bundles, usually of 7 feet girth each, for the purpose of being conveyed to the factory, to be stacked into the steeping vat. In making or tying up bundles the cuttings should not be roughly handled, nor should they, either then or subsequently, be subjected to any great pressure, as they are thereby likely to get contused. The secret of success consists in having the plants up to the vat as fresh as possible—they should be removed to the factory as rapidly as they are gathered. The cutting should invariably take place between 6 and 10 A.M., and it is always best to avoid cutting later, as exposure to the sun scorches the plants, and this materially interferes with the success of future operations.

Gathering.

It is necessary here to state, that the proportion of dye obtained from every hundred bundles of the plant from the three crops, is as follows:—

Proportion of dye from the three crops.

From the 1st crop..... 1 maund.
From the 2nd crop ..... 1¼ maunds.
From the 3rd crop ..... 1 maund.

II. Manufacture of the Dye.

Division of subject of Part II.

We are now able to enter on the consideration of the suggestions for the improvement of the manufacture of Indigo, and as the various processes are of importance, a separate consideration shall be given to each of the following heads: boiling, beating, collection of fecula, pressing, cutting, cleaning and packing.

Boiling.

On the arrival of the plants at the factory, no time should be lost in stacking them into large boilers filled with water for the purpose of being boiled. The boiling should be continued until the leaf yields its coloring matter to the water; in the mean time, each boiler should have an attendant with a large prong with which the plants should be constantly kept under water, and who should be careful to see that the heat of the fire is reduced the moment ebullition occurs, for if the boiling is carried on longer than necessary, the coloring matter will be destroyed. This requires a great amount of practical knowledge, and no rule can be laid down which alone will be sufficient for the guidance of the inexperienced. By opening the cocks occasionally, and observing the color of the decoction (which should be somewhat oily in appearance, and have a reddish color with a peculiar musty odour), we may judge that the period for discontinuing the boiling has arrived.

Beating.

At this stage the liquid should be drawn off into the beating vat and there beaten with oars or paddles. Hitherto this has been done by cooly labor, but in some places an apparatus with paddles reaching to within a couple of inches to the bottom of the vat is used, and worked by animal power.

Proposition for a steam engine.

The consideration of capitalists should be turned to the question—Whether a steam engine of 10 horse-power with an apparatus for pumping attached, might not be employed so as to facilitate

Cost of a steam engine.

labor of every kind in the factory, such as pumping up water for the boilers, working the paddles in the beating vat, &c.? When not thus employed, it might be brought into play for general irrigating purposes. An engine of 10 horse-power will cost about 8,000 rupees, and would irrigate from eight to twelve cawnies of land. The cost of fuel would be trifling, inasmuch as wood might be substituted for coal, and the refuse of the Indigo plant also be used to effect still further economy of fuel. Bratties, or cow-dung cakes, also might furnish cheap fuel for an engine.

The beating, if properly carried out, will not require above an hour; possibly less when machinery is used. After the liquid in the vat assumes a black color, and the froth which first formed has subsided, fresh froth is thrown up; but the air-bubbles will be found smaller and of a more uniform size, and will give to the fluid a white dazzling appearance. It will now be necessary to test it: with this view, if some of the liquid be taken on a white plate (China-ware), the fecula will be seen settling into dark colored flakes, and the supernatant fluid will be of a yellowish color; a second examination will be necessary some twenty minutes after the first examination; the sediment or fecula will then be found to be coarsely granular, moving along the plate, or inclining it to either side, and the water will have become of a bright yellowish color, and sometimes even brown.

Testing.

The change in color, though sudden, is readily detected by watching the liquor; the mode of detection by the plate process, however, is quite sufficient to those who have had a little experience.

Evils of insufficient as well as excessive beating.

It is important to know that if the beating is not sufficiently carried out, it occasions a great loss of the dye, for instead of the dye becoming oxidized and precipitated, it remains suspended in the fluid and may be let off with it. On the other hand, excessive agitation breaks up the grains

into a fine powder, and the deposition of the dye is thus retarded. No rules, however correctly and clearly expressed, can supply the place of a little practical knowledge, and the process when once seen practically carried out, is not readily forgotten. The moment the beating ceases, the froth in the liquid should disappear, leaving a clear surface of a chocolate-brown color intermixed with shades of blue; the absence of this latter tint will at once indicate that something has gone wrong.

Appearance of fluid after beating is completed.

All precipitants are not only utterly useless, but even injurious to the dye, as they deteriorate its quality. The essentials necessary to ensure a profitable yield, are that the plants should be fresh, healthy and of vigorous growth, the water clean and pure, and the different processes of boiling and beating carefully attended to. The best precipitant is a thorough beating, which is necessary to give the liquid abundance of fresh air, so that the dye should become fully oxidized by combination with oxygen from the air—then, its own weight will precipitate it to the bottom of the vat. The apparent gain said to be obtained from the use of lime-water or ash-water is nothing beyond the additional weight of earthy matter and other impurities which interfere with the quality of the dye and thus reduce its market value.

Precipitants useless and even injurious.

It is necessary here to briefly describe the chemical changes which are supposed to take place, and to state the objects kept in view in the different processes necessary in the manufacture of the dye. Opinions of chemists are divided on this subject, and the chemistry of the process has not as yet been correctly ascertained: one set of chemists believe that in the Indigo plant the dye exists in combination with either an acid or an alkali which keeps it colorless until it has been separated from this combination; another set

Chemical changes.

Varieties of opinion on the subject.

assert that Indigo does not exist in the plant, but that it is formed during the manufacture by a peculiar process while fermenting.

The generally received opinion, however, is that boiling reduces the plant into its primary simple constituents, prior to the changes which attend their final resolution into water, carbonic acid and ammonia. The usual process of fermentation operates much in the same way as boiling, but it is not quite so manageable. These changes are as follows: the water, assisted by heat, penetrates the immediate particles of the plant and dissolves the gum as well as the gum-resinous sap; at the same time the alkali and oil, aided by heat, unite and form soap; this mixes with the gum solution natural to the plant, and renders the fluid saponaceous and opalescent; it is then sufficiently consistent to hold the resin or dye in suspension in the form of innumerable spherical globules.

Supposed chemical changes.

It is well known that the sap of the Indigo plant contains, besides salts, oil and resin, gum and other substances which are of a mucilaginous nature; and though the dye or resin itself is insoluble in water, the ebullition favors its formation into a mucilaginous and saponaceous fluid sufficiently thick to enable it to retain the resinous dye in solution. The formation of the soap assists, no doubt, in the separation of the resinous dye from the salts and oil contained in the plant, which unite to render the fluid saponaceous. The union of the dye resin with the liquid is mechanical; the decoction obtained being not a chemical, but a mechanical mixture. It is now the object of the manufacturer so to treat this fluid as to cause a precipitation of the dye, and for this purpose he practises what is termed agitation, or beating. This brings every part of the fluid in contact with the atmosphere, and as the Indigo contains a small portion of iron, it readily attracts oxygen from the air, and by becoming oxidized, gains weight sufficiently

Agitation.

to render it heavier than the menstrum in which it has hitherto been suspended. From the friction of the Indigo globules against each other, caused by the agitation, they unite into grains, as well by their mutual affinity as by their viscid quality; they thus become sufficiently large to be precipitated by their own proper weight. The vat should now be allowed to stand for a couple of hours, when the supernatant fluid should be drawn off by two sets of plugs, which, without the loss of time attending the use of a small aperture, prevents also the rush of water and loss of dye consequent on the use of one large opening. The water should at first have a dark brown madeira color, and as it continues to run out, it may vary slightly in color from the above. A brownish scum which rises to the surface should be carefully removed with a bamboo, which by extension across the vat, allows the scum to collect around it, while the liquor escapes through the plug-hole.

The water having escaped the fecula should be washed down with fresh clean water, so as to collect it at one end of the vat. There should be a drain here for conveying the water from the fecula through a flannel strainer into a reservoir, from whence it should be passed a second time through a flannel strainer into the boiler. The object of these strainings is to free the Indigo of sand and other impurities. Cotton cloth is generally used as a strainer, but flannel or serge would be better, because their loose down will more readily arrest foreign bodies. The best kind of strainer is a freely perforated box with a tightly fitting frame within, to which the flannel should be fastened. The box thus prepared, should be slung to the mouth of the drain. The filtering is a slow and tedious process; attention should, therefore, be paid while constructing the box, to have it sufficiently large, so as to facilitate this process as much as possible.

The various processes in the manufacture of Indigo should be carried out expeditiously, more particularly that of boiling; for if after agitation the fluid is not submitted

to the boiler almost immediately, fermentation commences, which will, in great measure, deteriorate the quality of the dye. After the boiler has received the strained fluid, no time should be lost in bringing it up to the boiling point, and the liquid be carefully attended to while boiling. There should be an attendant at each boiler with a large perforated ladle, who should, the moment ebullition takes place, keep the liquid agitated in order to prevent the fecula from settling, or becoming attached to the sides of the boiler. If this is not attended to, the fecula gets burnt, and this damages the quality of the dye.

To avoid delay, manufacturers are in the habit of having water boiling in the boiler before the fecula or dye-fluid reaches it, which is an excellent plan as it saves much time. The object of boiling the agitated fluid at this stage is to concentrate the active principles of the dye, by causing the evaporation of the watery elements and volatile ingredients it contains. It also favors the further oxidation of the dye by bringing it into contact with the oxygen of the atmosphere. The dye by boiling attracts oxygen, and the heat facilitates the combination with it; and when this takes place, it gives out a strong sugary smell in place of the musty odour it had at first.

The fluid should now be turned out into what are called the "tables" by opening the stopcocks of the boilers. The liquid should be made to pass through another flannel filter while boiling-hot, as it will then hold in complete suspension the active vegetable principles; whereas, if the fluid in the boilers be allowed to cool, the principles become precipitated, and consequently will not pass with the fluid through the filter. The "table" alluded to, consists of a vat built in proportion to the cubic contents of the boiler. This should have within it on either side of a floor a walling of masonry, or wood of about two feet in height. On this should be placed a strong wooden frame, and on the frame should be laid a stout sheet of cloth having its ends drawn up and fastened to the walls of the vat by means of iron rings; within this

sheet, the decoction rich with the fecula should flow. After a while, the fluid percolates through the sheet into the vat below, where it is allowed to stand for a time till any remnants of the dye it may have held in suspension and carried with it below the sheet, are precipitated. This is ascertained by the color which the fluid has when the plugs are removed and it finds its way out of the vat.

Any fecula found on the floor of the vat, is now collected and conveyed to the reservoir vat to be returned to the boiler with the fresh decoction. As the water percolates through the sheet, the ends are gradually raised and tied together so as to collect the whole of the fecula on its surface, when weights are placed on the cloth to express as much of the fluid as possible: for this purpose it may be allowed to stand for several hours, sometimes for a whole night. When the weights are removed, the dye will be found to have attained the consistency of a stiff paste, when it is transferred to the press-box.

Press-box.

The press-box consists of four pieces of well-seasoned tough wood, perforated on all sides and kept together in the form of a box (without top or bottom) by means of iron screw rods fastened with nuts, so as to be able to sustain considerable lateral pressure, when the moveable top and bottom approximate in screwing the press. The box should measure inside 3 × 2½ feet, and have a depth of 1 foot; the bottom of the box, which is moveable, should also be freely perforated. The box is to be lined with a coarse cloth of length and breadth sufficient to cover in the dye with which it has been filled from the tables, the bottom having been previously placed on the platform of the press exactly between its screws. The top of the box, which should be about 7 or 8 inches thick, and made so as to pass easily down into the box, is now put on, and the whole placed immediately under the press-beam.

The press-beam should then be let down and when the water ceases readily to escape through the holes, the beams

should be screwed down by degrees until the top disappears within the frame of the box. When still more pressure is required, a couple of wooden blocks may be placed between the top of the box and the under part of the press-beam moved by the screw. Care should be taken to have the frames freely perforated, and the holes should be kept open by occasionally driving a stout iron wire through them. The perforations, by facilitating the escape of the water, permit of the more uniform pressure on the cake, and this prevents the fracturing of the formed slab. The time allowed for pressing should never exceed eight or ten hours. The force thus excited will reduce the Indigo from 10 or 12 inches in height, to 3 or 3½ inches. When the beam has been removed and the frame opened, a slab of well-pressed Indigo will be found at the bottom of the press-box. The cloth should now be removed and the slab cut up into 3-inch cubes.

Great care is necessary in the use of the press, for if the pressure be unequally distributed, or too rapidly communicated by screwing down one end more than the other, the slab is likely to get injured.

Cutting.

For cutting the Indigo, a wooden frame having a number of partitions each of 3 inches square with one edge of the partitions sharpened, can be used with advantage as it facilitates the process. The top of the frame is to have a board let in containing the factory mark, so that while the cakes are being cut into squares, a little additional force will also mark them, and both the operations of cutting and stamping might go on at one and the same time. Some breakage will, of course, occur, but if a cake break it should be slightly wetted and the pieces brought together by a little force, which will cause the fragments to adhere. The practice often resorted to of breaking up the cakes to have them submitted to the press-box a second time, is objectionable as it deteriorates the dye.

The cakes having been cut and stamped, should now be placed on a tray with a double layer of stout coarse cloth having a layer of

good bibulous paper between. The common unsized country paper answers the purpose very well. On the frame thus prepared the cakes should be gently and carefully laid, about 3 inches apart. The tray should then be removed to the drying house, and there be placed in a loft where it should remain for some three or four days, after which the cakes should be as carefully removed on to the stages in the drying house, observing the same interval of space as was given when they were placed on the tray. The stages may be formed of wood or bamboo. The cakes will retain their sugary smell for some days, unless something has gone wrong in the manufacture, such as excess or insufficiency in boiling. The cakes when drying, should never on any account be turned, for this drives the moisture from the surface to the centre. The drying house should be capacious, airy, and well lighted, for if not so, the white coat which the cakes of Indigo acquire from the growth of fungi upon them, will not occur; as it is well known that light is essentially necessary for the growth of these fungi; and it being desirable that the cakes should be as sound as possible, their growth should be encouraged by the free admission of light and air.

Cleaning.

When the Indigo is dry, each day's manufacture is taken up and cleaned with a very soft brush. Soft brushes are best, because hard brushes remove the white fungus covering the cakes, and thus take away from their appearance and value.

Packing.

The cakes are now carefully compared and arranged, after breaking off the edge of one side of a cake for the purpose of exhibiting its inner surface. They are then packed, and in doing so, a sample cake is generally kept, which should be one of the worst in the box. Natives, however, frequently exhibit the best as a specimen.

It will take nearly a month before the cakes are thoroughly dry for packing into boxes; and in packing them, they ought to be arranged so closely to each other as not to [illegible]

displaced on moving the boxes. There is always a quantity of broken Indigo which should be packed separately. In packing the cakes it is a good plan to put down a layer of soft cotton at the bottom of the box, and a second layer about the centre, and on the top there should be a third layer of cotton before the lid of the box is put on. This, if properly done, is sufficient to keep the cakes firmly in their places, and consequently no friction or displacement can occur. Simple as the operation may seem, it requires some practical skill to pack the cakes neatly and correctly.

A short description may now be given of the apparatus required for the manufacture of Indigo as proposed, and which has been termed the "European method." Of the apparatus already alluded to, the following are the most important, viz., Boilers, Beating Vat, Tables, Press-box and Press.

Boilers.

Boilers should be of copper, two, three or four in number, according to the quantity of plant to be boiled. Each boiler should have a diameter of 5½ feet at top and 4 feet at bottom, and have on a level with its lower part a stopcock at each side, one to lead to the agitating vat and the other to the tables. The drains leading to these parts should have a filter suspended at their mouths where they open into the agitating vat and tables. The filter is usually a wooden frame, of 1½ feet square, the bottom being formed of a layer of flannel, through which the decoction filters in passing to the vat and tables.

Agitating Vat.

The Agitating Vat, built either of stone or wood, should be 18 × 14 feet, with a depth of 3½ feet. On a level with the floor of the vat, there should be two circular holes of 1½ inches each in diameter, and 1 foot apart; these holes should lead into a reservoir. One foot higher than the above, there should be two other holes of the same size leading into another reservoir. The floor of the vat should be made to slope towards these openings. The openings should be

furnished with a tubing of copper, or they should be cut through a solid slab of granite and be nicely fitted with wooden plugs, wrapped over with flannel and made air-tight. The upper plugs are to be opened when the supernatant liquor is required to be let off; and from the reservoir where these open, there should be a drain to convey the fluid to the adjoining fields. The fecula is washed down with clear fresh water, and passes through the lower openings (each of which openings has a filter similar to those already described) into the reservoir with which they are connected, and from whence the fecula is conveyed by buckets to the boiler, passing through another filter before entering. To save time, the boilers should be cleaned out and refilled with water, and brought up to the boiling point during the time occupied in the agitating process. After the necessary time in re-boiling, the second set of stopcocks (already alluded to) in the boiler should be opened, and the fecula be allowed to pass on to the tables. Instead of employing men to agitate the fluid in the vat by means of oars, an agitating punkah or paddle might be so constructed as to supersede this common and laborious mode of agitating, and for this purpose, a wooden shaft, 16 feet long and 6 inches in width and thickness, should be placed across the centre of agitating vat. It should rest on the wooden blocks, having semicircular notches to receive the ends of the shaft which is let into the vat walls. One end of the shaft, external to the vat, should have a moveable crank handle to work it, and the other end should be furnished with a fixed pulley. Into the portion of shaft within the vat should be fixed, at equal distances, three sets of paddles or fans, each set having four arms, the arms should each be 3 feet long, 2 feet broad and 1 inch thick; each set of paddles should be encircled with quarter-inch iron tires at the ends, (*i. e.*, two tires for each paddle), for the purpose of fixing the arms of the paddle firm on to the shaft.

The crank end can be worked by human power, and the pully end by animal power. This is done by attaching it

to a wooden frame-work 8 feet high, and 12 feet wide, with a perpendicular shaft, 8 feet long, having a fixed drum at its upper third, and a lever arm at its centre. The two ends of the perpendicular shaft should be made so as to evolve in the frame like a pivot. A circular strap or rope should encircle the pulley at the end of the shaft across the vat, and be made to pass round the drum of the perpendicular shaft in the frame-work. By yoking a pair of bullocks, to the free end of the lever of the perpendicular shaft, the shaft is made to turn on its own axis, which causes the vat shaft, with its attached paddles, to revolve also, and thereby uniformly to agitate the liquid in the vat.

By having an apparatus of this kind, either animal or human power may be employed, at the pleasure of the manufacturer, for the purpose for which it is recommended.

Tables.

The table is a cistern 12 × 4 feet, with a depth of 3½ feet; about two feet from the bottom of the tables there projects a ledge 6 inches wide, and on this ledge should rest a stout wooden frame, crossed with 2-inch rails, and on which a stout sheet rests. The fecula, on escaping from the boiler and passing the filter already mentioned, falls on the sheet for the purpose of being drained. The water passing to the bottom of the table is allowed to stand for two or three hours, so that any fecula carried through the sheet may become precipitated. At the floor of the table there should be a couple of holes with plugs, through which the drained liquid may pass into the adjoining fields. The fecula found at the bottom is collected next day and taken to the boiler, together with that which is brought from the agitating vat. The ends of the sheet may now be raised, the fecula collected in the centre, and the folds laid over so as to cover in the fecula, and weights placed over it to express more of the fluid; it is thus kept draining for about four hours, when the weights are removed and the fecula (now

brought to the consistence of a stiff paste) is transferred to the press-box.

Press-box. The press-box recommended, has been already fully described under this head (*vide* page 124.

Press. The press consists of two upright beams of wood 4 feet in height and about 4 inches thick, each having a groove on the centre of its inner surface, so as to allow a play of two feet to a cross beam 5 feet long, which screws up and down between the uprights. The uprights are mortised to a platform formed of two beams, each 5 feet long, 6 inches wide, and 4 inches thick: these are connected by a couple of cross pieces of same breadth and thickness which serve to keep the beams about two feet apart; and it is to these cross pieces at each end of the platform that the uprights of the press are fixed. On the cross pieces within the uprights of the press, are placed two boxes, each furnished with a female screw. There should also be two male screw-rods, 3 feet in height with a diameter of 2½ inches, placed so as to work into the female screws; the upper ends of these screw rods should be made so as to receive handles for working the screws with.

The cross beam of the press has a simple box let into it through which the rods pass to enter the female screw on the platform; the ends of the cross beam, as already stated, play into the grooves of the uprights, and which when worked down, leaves a space of one foot between itself and the platform. The press-box being placed on the platform, the cross beam is let down, and when the water ceases to escape, several blocks, about 4 inches thick and of the same length and breadth as the top of the press-box, are placed in it to give a depth of 8 or 10 inches, as found necessary, so that when the screws are worked, the top (with the blocks) is driven well into the box, reducing the mass of fecula from 12 inches to a slab of 3 inches of Indigo. In working the press it is necessary to observe that both screws are carefully and evenly worked, for which purpose

there should be an attendant at each screw to watch that the force be exerted gradually together. Unequal pressure injures the Indigo, and causes it to fracture subsequently. After an interval of eight or twelve hours, the beam is raised by unscrewing it, the press-box opened and the cloth unfolded, when a well-pressed slab of Indigo is seen at the bottom.

Cutting and Stamping. For the purpose of cutting and stamping a square 36-inch frame is required, and which should be divided into twelve partitions, each 3 inches square. If at the top of such frame a board be let in with the factory mark, the cakes may be stamped at the same time that they are being cut, thereby facilitating the processes of cutting and stamping.

Before concluding, I beg to acknowledge having derived considerable assistance in the preparation of this Essay, by consulting the following works:—

Balfour's Cyclopædia of India.
Calcutta Review, No. 59, March 1858.
Ure's Dictionary of Arts, Manufactures and Sciences.
Peddington's Paper on the Manufacture of Indigo, dated 10th June 1829.

INDIGO.—Various schemes have been initiated from time to time for the improvement of this dye, with little or no success: recently Surgeon Major Ranking, of the Bengal Cavalry, was reported to have secured a Patent for the improvement of the dye by the addition of *Hydrate* and *Nitrate* of *Potash* to the decomposing or permeating vat, and the produce of the Indigo is increased 25 to 60 per cent. and the labour of beating and its attendant expense in the oxidising vat is diminished by the Indigogen or white Indigo, contained in the solution being readily soluble in the *Hydrate* of *Potash* that is added to the vat and the *oxygen* of the *Nitrate* of *Potash* which is also added, removes an

atom of Hydrogen from the white Indigo, and the blue Indigo is at once precipitated in its nascent state. This is the only explanation I can arrive at in this matter. Since the following interesting communication from H. C. Willock, Esq., of Azimgarh, appeared in the *Asian*, which I here insert as it treats of a new product, viz., Indigo green as well as the Indigo blue being manufactured from the same plant.

On October 5, 1887, Mr. F. W. Tylter, of Goruckpore, N. W. P., filed two specifications in the Patent Office, Calcutta, viz., No. 178 of 1887 for the production of Indigo green, direct from the Indigo plant, and No. 179 of 1887 for increasing the quantitative production of Indigo blue direct from the Indigo plant.

In the manufacture of *Indigo green*, by Mr. Tylter's process, the plant is first *crushed*, and then placed in the steeping vat with water and well worked and mixed for about half an hour, more or less, care being taken, that the crushed plant is kept completely under the surface of the water. It is then allowed to steep for two or three hours, more or less, according to the state of the weather the liquor being carefully drawn off before any fermentation takes place. The liquor whilst being run off from the steeping vat, should be carefully strained, so as to prevent all refuse vegetable matter from passing into the beating vat.

The liquor thus obtained is of a bright, deep green colour. It is then beaten off in the usual manner, the beating process taking somewhat longer than in the manufacture of Indigo blue. During the beating process, the liquor froths a great deal, and gradually turns to a deep rifle green, when it is allowed to settle, and the water drained up in the usual manner. The fecula is then collected and strained before being placed in the boiler, when it is carefully boiled and run on the draining table. When sufficiently drained, the green *mal* is prepared and cut into cakes in the usual manner.

For the manufacture of *Indigo blue*, the plant is *crushed* as in the process for the Indigo green, as above mentioned, but instead of being taken out of the steeping vat, before fermentation takes place, it is allowed to steep and ferment as it is now done. When the fermentation is sufficient, the liquor is run off, the rest of the process being exactly the same as it is now carried out in the manufacture of Indigo blue. The blue so obtained is equal to the best blue as now made, the produce being *one hundred per cent.*, more than is obtained by the present mode of manufacture.

By crushing the plant, the *vat space occupied* is about half that required for the same quantity of uncrushed plant. Cloth dyed with the Indigo green, as above obtained, is of a bright *emerald green*, the darkest and lightest shades being obtainable.

I note in the *Indian Planter's Gazette* that Captain Olpherts has also manufactured a green dye, but he states that he obtains his green dye *from the Indigo blue waste water by the use of chemicals and precipitants* for which he has taken out a Patent No. 168 of 1887. You will see by the above process as Patented by Mr. Tylter that *no chemical or precipitants are used in any way* on either of the above processes. This is in itself a recommendation, Ammonia and other precipitants being expensive and, secondly, in the trade are objected to.

Artificial Indigo.—We learn from Munich that "Artificial Indigo equal to Indian, has been discovered here by a scientific man." This is not by any means the first time that an announcement of this kind has been made, and has caused some alarm in Mincing Lane and elsewhere. But the artificial product of the laboratory has as yet failed to meet the requirements of manufacturers. Yet it is always "on the cards" that some chemist will invent a perfect substitute for the Indian dye, and thereby be instrumental in ruining a very important industry in this country. The

following table shews the quantities and value of Indigo exported from India in ten years :—

Year.	Quantity.	Value.	Year.	Quantity.	Value.
—	cwt.	£.	—	cwt.	£.
1869	... 99,206	2,893,823	1874	...115,980	3,555,300
1870	... 98,085	3,178,045	1875	... 81,466	2,576,302
1871	...103,184	3,192,503	1876	...110,392	2,875,065
1872	...115,414	3,705,475	1877	...100,384	2,962,786
1873	...115,212	3,426,824	1878	...120,605	3,494,334

We are indebted to Chambers's Encyclopædia for the following remarks :—

"This dye is, without doubt, the oldest in use; the Greeks and Romans obtained a knowledge of its uses from India, were its employment has been very general for a great length of time. Much obscurity involves Indigo and its early use, in consequence of the variation in its name; for instance, the Tamils of India call the plant *Averie* and the dye itself *Neelum*; in Sanscrit, the plant is *Vishashodanie*, and the dye *Nili* and *Nilini*, whence the *Anil* of the Portuguese. The Malays call the dye *Tarom*, and the Arabs, *Neel*. Commercially speaking, indigo may be said to be the produce of India and Central America, as these are the only localities which supply the recognised form of the article. In India, the chief seat of the Indigo Manufacture, Bengal is the most important district. The total quantity received in Great Britain in 1861 was nearly 80,000 cwts.—a vast quantity, when it is borne in mind with what difficulty it is cultivated and manufactured. When pure Indigo has a rich, dark-blue colour, almost purple, it is in small cubes or parts of cubes, and its facture shews a tendency to break up into square pieces, and indicates cracks in its substance, often filled up with a film of whitish efflorescence, probably the lime used in precipitating it. It has neither taste nor smell, and its specific gravity is about 1·50; if rubbed with any hard substance, it gives a streak with a bright coppery lustre. The varieties recognised in commerce are—1st, Bengal, which, from the care taken in its preparation, and the large scale on which it is made in that district, is the best; and its various gradations of quality, ten in number, varying from 9*s.* to 5*s.* per pound, are always kept distinct. In other sorts, they are usually much mixed; 2nd, Madras and Kurpah; 3rd, Oude; 4th, Manila; 5th, Java; and 6th, South American. The last is packed in serons or cases of dried ox-skin, and its qualities are distinguished as follows: 1st, Flores; 2nd, Sobres; and 3rd, Cortes; all the others are in wooden chests, containing about 250 lbs. each. Few materials are of greater importance to the dyer than indigo, and none require the exercise of more care and skill in using. Being insoluble in water, it requires the action of other solvents to render it capable of penetrating the fibres of the materials to be dyed. Many compounds of great chemical interests have been derived from Indigo blue. It was from Indigo that aniline (now so largely employed in the production of the pigments known as *mauve* and *magenta*) was first obtained."

Plate A.

Explanatory of the Ground Plan of the Indigo Factory.

A. Verandah of Factory.
B. Drying Room.
C. C. C. Drying Lofts.
D. D. D. Boilers.
E. E. E. E. E. E. Stopcocks on both sides of Boilers.
F. Channel leading to Agitating Vat.
G. G. G. Fans in Agitating Vat.
H. Crank for working Agitating Vat.
H. H. Agitating Vat.
I. Well.
K. K. K. Drain leading to Water Reservoir.
L. Water Reservoir.
M. Fecula Reservoir.
N. Reservoir for passing water out, after fecula has been precipitated a second time.
O. Drain leading to Tables.
P. P. Tables with frames.
Q. Ground plan of Press.
R. Press.
S. Press-box walling.
T. Top board of Press-box.
U. Bottom board of do.
V. Section of Oven and Boiler.
W. Section of Draining Table.
X. Frame of Draining Table.
Y. Section of Water Reservoir.
Z. Section of Fecula Reservoir.
a. Section of Agitating Punkah.
b. Frame for working Agitating Punkah by animal power.
c. Drum of Frame.
d. Yoke and Pole.
e. Section of Drum.
f. Section of Pulley.
g. Endless Strap.
h. Cutting Machine, with stamping board drawn out.
i. Section of do. do.

PLATE B.

Explanatory of Factory Buildings.

A. Longitudinal section of Buildings.
B. Verandah.
C. C. Windows.
D. Agitating Vat.
E. Transverse section of Buildings.
F. Door leading to Drying Room.
G. Main Door of the Building.
H. Old-style of Native Paddle for Agitation.
I. Copper Cup.
K. Spoon.
L. Knife used by Natives for cutting the slab into cakes.

TOBACCO,

*ITS HISTORY AND CULTIVATION,**

I. HISTORY.

IT has been supposed by some that the use of tobacco was familiar to the Asiatics long before the discovery of America. *There is no doubt that the plant was known, and its properties understood prior to that event.* Columbus and his followers, in 1492, saw smoking practised, for the first time, by the natives of Cuba, who rolled the tobacco, which grew wild in the heights of that Island, like a modern cigar; and they subsequently found that a similar practice existed on the Continent of America, but in different modes, some smoking pipes and others cigars. Some writers affirm that the plant was first discovered in the Mexican Province of Yucatan, in A.D. 1520, where it was called *petum*. Both the Mexicans and Peruvians practised chewing the leaf and snuff-taking. Tobacco was introduced into Europe in 1560 by Francisco Hernandez, a Spanish Physician, who is said to have brought the seeds to Spain. At the same time it was made known in Italy and France. Jean Nicot, Lord of Villemain, and Master of Requests of the French king's household, was sent to the Portuguese Court in 1559, as agent of Francis II. When Nicot returned to France, in 1561, he presented the Queen, Catherine-de-Medicis, with some plants, which he grew from seed purchased at Lisbon from a Flemish merchant, who had obtained it from Florida. Hence it was called *Herbe-de-la-Reine* and *Herba-Mediciana*; and from Nicot it subsequently received the generic term *Nicotiana*. It seems to have been first introduced into

* By Surgeon-Major John Shortt, M.D., F.L.S., &c., Superintendent-General, Vaccination, Madras. Originally published in the Madras Revenue Register, since enlarged.

England, about A.D. 1586, by a Captain Lane, who, with some others had been left by Raleigh to colonize Virginia, but who, their provisions having failed, and the Indians proving hostile to them, returned home in nine months. During their residence in Virginia they learnt the use of tobacco from the Indians, and, on their return, taught their companions the method of using it. Raleigh and some young men of fashion speedily adopted the habit of smoking, and it gradually spread in England. The tobacco plant was introduced into India in A.D. 1605, during the reign of Akber.

Various attempts were made to put down the practice of smoking in Europe. Heavy imposts were levied on smokers, the use of tobacco was condemned in pamphlets, and bodily punishment was even resorted to, but all without success. Some Eastern potentates endeavoured to check the habit of snuffing by cutting off the noses of those who indulged in it. The specific name of tobacco is by some considered to be derived from the Indian word *tabac*, by which the Caribbees recognized the pipe in which the leaves were smoked. In Tamil tobacco is called *Poga Yellei*; * or smoke leaf. A cigar is known as *churuttu*,† the word cigar being corrupted from the Spanish word *Cigarris*, signifying a small tubular roll used for smoking. Snuff is from the Dutch *Snuffen*, and the German *Schnuppen*, meaning to draw in, or inhale pulverised tobacco.‡ Tobacco, in Mexican, *Yelt*, is derived from a Haytian word §

II. Botanical Character.

Tobacco belongs to the natural order *Atropaceæ*, which may be considered a section of *Solanaceæ*. According to the Linnean system, *Pentandria Monogynia*. Habitat: Central America; now cultivated in most parts of the world.

* In Hindoostani and Persian, *Tambaku*; in Telugu, *Pogaku*.

† *Churuttu* in Tamil means a roll or curl, and the English word Cheroot is probably a corruption of it.

‡ *Vide* Cassell's Botany; Pereira's Materia Medica; Ainslie's Materia Medica; Royle's Reproductive Resources of India.

§ *Vide* Prescott's Conquest of Mexico, Vol. I, page 85.

Generic Characters.—Calyx, urceolate, five-cleft; corolla much longer than the calyx, funnel-shaped, five-cleft; regular-stamens: five stigmata: *emarginate*; capsule, two-valved.

Special Characters.—Leaves, sessile, oblong, lanceolate, accuminate, the lower ones decurrent; *throat of the corolla*, inflate, ventricose; limb with accuminated segments; a viscid herb; root, branching, fibrous; stem, three to six feet high, erect, round, hairy, branching at the top; leaves, very large, pale-green, with glandular short hairs; bracts, linear, acute; flowers, panicled on the end of the stem and branches; calyx, hairy; corolla, rose-colored; ovarium, ovate; style, long and slender; stigma, capitate, cloven; capsule, two-celled, opening crosswise at the top, loculicidal; seeds, numerous, small somewhat reniform, brown.

III. Varieties of the Genus Nicotiana.

This genus contains about forty species, most of which yield tobacco, and many are cultivated in gardens in Europe. The species of Nicotiana are most of them herbs, rarely under shrubs, and generally clothed with clammy hairs or down. The flowers are terminal, racemose or panicled, and of a white, green, or purplish color. The calyx is five-cleft, permanent; corolla, funnel, or salver-shaped; divisions, five plicate and spreading; stamens, five-anthers, debiscing lengthwise; stigma, clavate; capsule, two-celled, two-valved; valves, bipartite; seeds, minute, numerous.

1. *Nicotiana Tabacum, Linnæus.*—Common Virginian, or sweet scented tobacco, is an herbaceous plant with accuminated, oblong, lanceolate, sessile leaves, lower ones decurrent; throat of corolla, inflated; segments of the limb, pointed. This is a native of several parts of America. The stem rises to the height of from four to six feet, and bears pink flowers. There are three chief varieties of this, known in America under the name of Orinoco, broad-leaved, and narrow-leaved. *Lindley* enumerates eight varieties of *Nicotiana Tabacum*. It is the species most commonly used in the manufacture of tobacco and cigars, and is also exten-

sively cultivated in flower-gardens as an ornament. It is said by some authorities that this variety was introduced into Europe by Sir Francis Drake. Shag, Returns, and other cut kinds are prepared from it, and named after the localities in which they are grown.

2. *Nicotiana Macrophylla.*—Orinoco tobacco—is an herbaceous plant with oval acute leaves clasping the stem; throat of corolla, inflated; segments, short, pointed. This plant is a native of America and is taller than most of the varieties, the stem often rising to the height of seven feet. It is an ornamental annual, bearing broad leaves and pink flowers. The milder Havanah cigars are said to be made from its leaves.

3. *Nicotiana Rustica.*—This is the species usually cultivated in Europe. It is known as English tobacco from being the first tobacco introduced into England for propagation. The much esteemed tobacco of Salonica and Latakia is manufactured from this plant, and is known in England as Turkish tobacco. This species produces white flowers, and seldom attains a greater height than three feet. The tobacco is of milder flavour, and is used as delicate cut tobacco, and cigars. The Latakia, Syrian, and Turkish tobacco are prepared from this variety. It is a native of America, and is found growing wild in other countries, and popularly recognized as English tobacco.

4. *Nicotiana Persica*—*Lindley*—is an herbaceous plant, clothed with clammy down, with the leaves of the root oblong, those of the stem accuminate and sessile; corolla, salver-shaped, with a long tube and rather unequal segments. This plant is a native of Persia, and produces the famous Shiraz tobacco.

5. *Nicotiana Fruticosa*, or, shrubby tobacco—an ornamental ever-green shrub bearing pink blossoms, it grows to the height of three feet, is a native of Persia and China, and is used for delicate kinds of smoking; it is used for cigars, but not medicinally.

6. *Nicotiana Undulata*, sweet-scented, or New Holland

tobacco—a green house-perennial, native of New South Wales, with white flowers, and is two feet high.

7. *Nicotiana Paniculata*, or panicled tobacco—an annual plant bearing greenish-yellow flowers, a native of Peru, and rises to the height of three feet.

8. *Nicotiana Glutinosa*, or, clammy-leaved tobacco—also an annual plant, a native of Peru, growing to the height of four feet, with bright scarlet flowers.

9. *Nicotiana Plumbaginifolia.*—Curl-leaved tobacco, an ornamental deciduous, annual, a native of America, with white blossoms, and rises to the height of two feet.

10. *Nicotiana Pusilla*, or, primrose-leaved tobacco—an ornamental deciduous, biennial, with white flowers, a native of Vera Cruz, rising to three feet.

11. *Nicotiana Quadrivalvis*, four-valved, or, Missouri tobacco—an ornamental annual, a native of North America, with white blossoms rising only two feet high.

12. *Nicotiana Nana*, or, Rocky-mountain tobacco—a curious green house-annual, a native of North America, with white blossoms, rising only three inches high.

13. *Nicotiana Langsdorffii*, or, Langsdorffs tobacco—an ornamental annual with greenish-yellow flowers, a native of Chili, reaching five feet high.

14. *Nicotiana Cerinthoides*, or honeywort tobacco—an ornamental annual, with greenish-yellow flowers; native country unknown.

15. *Nicotiana Repanda*, Havana tobacco—an annual, with white flowers, a native of Cuba, rising two feet high. A few species, natives of the Province of Buenos Ayres, may be particularized.

16. *N. Canariensis*—having white flowers.
17. *N. Glauca*—yellowish-green flowers.
18. *N. Longiflora*—white flowers.
19. *N. Viscosa*—pink flowers.*

* Balfour's Cyclopædia.

IV. Cultivation of Tobacco in America.

A.—Virginia.—The success of the growth of this product depends in a great measure on soil, situation, climate, and season. New ground or virgin soil produces the finest description. Plant or nursery beds should be formed, if possible, in moist situations, and should consist of pure vegetable mould; the soil should be well opened out, the clods crushed and weeds exterminated. In some places the soil is burned by the firing of brush-wood, or refuse-grass.

The seeds, after the beds have been prepared as above, are scattered pretty thickly, and sometimes raked in. The sowing generally takes place in the month of February; and, in from three to four months, the plants are ready for transplantation, when they are removed to the field and placed on ridges at a distance of from eight to twelve inches apart; and, in some parts, where the soil is rich, they are placed from three to four feet apart. The plants require but little attention until they begin to throw out suckers, which must be carefully removed by the hand as they make their appearance; the weeds must be completely removed, and the plants must receive the same attention in this respect as a well-kept garden. The planter must be guided, as to the number of leaves to be left on each plant, by the strength and richness of the soil; from six to sixteen may be left, and the tops are pinched away. The plants are very liable to attack from caterpillars. Consequently, great attention will be necessary to free them from these pests. The leaves now continue to progress towards maturity, and they are known to be ripe by the crackling sound given by the lamina on being broken, as well as by its thickness. The plants are now ready for the sickle, and, as they are cut, they are placed flat upon stakes and exposed to the sun for a few days till they wither and change color, taking a yellowish or brownish hue, and they are at the same time protected from heavy rains and dew. From this they are removed into log-houses and

suspended from the roof, when the process of curing goes on.*

B.—West Indies.—The Island of Cuba is celebrated all over the world for its tobacco culture, from which the much prized Havanah cigars are manufactured. The natural richness of its soil and tropical climate make the Island favourable to the growth of tobacco, and the cultivation is carried on in very much the same manner as in other localities, the plants requiring the greatest care during their infancy. The particular kind cultivated on the Island is the *Nicotiana Repanda;* the plants when transplanted are placed in rows three feet apart, but this is not done until they have attained a height of from six to eight inches. When they have established themselves in their new localities, the lower leaves are removed and the plant stopped at the height of three or four feet, from eight to twelve leaves being left on each stem. This is done in order to strengthen the plant, and add to the vigor and luxuriance of the leaves, from which it is intended to manufacture tobacco. As the plant progresses in height and vigor, the vigilance of the planter is continually required to remove the side-shoots and suckers, and to destroy the caterpillars which infest the plant from its infancy. As the leaves approach maturity, they become somewhat paler in color, rich in aroma, and feel rough when handled; at this time they are cut down; this is generally done in the morning after sunrise, and the weather during the tobacco harvest should be clear and fine. The stalks are allowed to be on the field till after mid-day to liberate their natural or acquired moisture, when they are stored; and, on the following day, the leaves are plucked off the stalks and strung up in rows to dry.

C.—Philippine Islands.—The soil is prepared and marked out into convenient sized beds, which are generally from five to six feet wide, and from eight to twelve feet long. The soil is well opened up, the clods are crushed, and the seed is sprinkled over with ashes to prevent crowding,

* Captain Basil Hall's Travels.

which is likely to happen from their minuteness. The seedlings show themselves in from five to seven days, when they require to be carefully weeded to prevent the plants from being choked.

The seeds should not be sown during the rains, as from their small size they are sure to suffer from heavy showers; and consequently, the nursery beds are frequently protected on such occasions by a low shed, which keeps off the rain, and allows of ventilation until from three to five leaves are developed. In two months from the period of sowing, the seedlings will be ready for transplanting, but this will depend very much on the reproductive powers of the soil. Sometimes the period of transplanting may be deferred without injury to a fortnight or three weeks later, when the plants will have become stronger and will have attained from eight to ten inches in height. Much attention is necessary to prepare the soil in the cultivation of tobacco. In Cagayan, where the best tobacco is produced, there are highlands and lowlands. Should the season be fair, excellent tobacco is produced on the highlands when transplanted; but the lowlands are generally preferred in consequence of the greater amount of moisture in the soil by percolation from the adjacent rivers, and this is sufficient to carry the plants forward in the absence of rain; but should the moisture and rain fail, the plant is dwarfed. The land having been well cleansed and prepared, furrows about three feet apart and from ten to twelve inches deep are made. The plants are placed in them at a distance of three feet from each other, so that each plant occupies a square yard. When first planted out, the roots should be protected from the sun till they have struck root afresh in the soil by being well covered with earth. From the moment of transplantation, the plants are liable to be infested with worms, and unless carefully searched for and destroyed, they will devour many of the leaves. Constant attention is necessary during the whole period of growth. At times the destruction effected by worms is so rapid that plants placed in the furrows on one day disappear on the next; thus the field may have to be

planted over several times. When the plant has once rooted itself in its new situation, there is no fear of its destruction; but the leaves will now be attacked, so that the plantation will require daily attention, night and morning, during the period the plant is arriving at maturity, to save it from the ravages of the caterpillars. In fact, the planter's whole time will be occupied in weeding and freeing the plant from worms, and removing suckers as soon as they appear, to prevent the plant being weakened. Two months after transplantation, the plants are topped, leaving on each from twelve to fourteen leaves, except in those intended for seed; for the seed from subsequent crops is not so good as that procured from the first. Four months after transplantation, the growth of the plant will be complete; and advantage must be taken of the seasons, so that the plants may have the benefit of rain during the first two months only, as rain is injurious to the tobacco as it approaches maturity; and very often, under these circumstances, the leaves become diseased and covered with white spots, which render the crop worthless. Whereas a shower of rain or two, when the leaves are thoroughly ripe, proves of advantage; for, although the leaves become discolored by yellow spots, these are considered indications that the tobacco was gathered in due time, and that it bears the stamp of being well seasoned. The whole crop is not gathered in at the same time, as the leaves do not ripen together; but the lower and older leaves ripen first, and the others follow successively. The ripening of the leaves is ascertained by the stalks beginning to assume a yellow color, when they should be gathered. After the tobacco has been gathered, the stem should be cut to within eighteen inches of the soil. From the "stool" left two, three, or more shoots will push out. As many of these as may be thought desirable should be left, and the others removed; those left form the second crop.*

* Colonel Joseph-de-Hezeta.

V. Australia.

In Australia the cultivation of tobacco has been making great progress. The plants are grown in deep, loose, and naturally rich soil, to enable the young and delicate plant to sustain its rapid and luxuriant growth. Naturally rich lands are selected for the purpose, and when such is not available, artificial means are employed to secure a good crop. The rich alluvial flats in the vicinity of rivers and creeks are taken advantage of for the purpose, and it is from such localities that excellent returns have been obtained. Stiff clays on the one hand, and poor sandy soils on the other, should be avoided; the former being too retentive of moisture in wet weather, and apt to bake hard during the summer, whilst the latter needs too much manure to render it fertile, and is, besides, too dry. Medium soils will require much manure. Bone dust, guano, and stable manures have proved themselves to be highly valuable as fertilizers for tobacco fields. A proper spot having been selected, and, where necessary, improved by manuring, draining should then receive attention, as the tobacco plant suffers readily from excess of moisture, or stagnant water. The land should be ploughed up to a depth of eight or twelve inches, and the soil loosened by the subsoil plough, so as to loosen it thoroughly to a depth of eighteen or twenty inches, in stiffer kinds of soils. New lands should always be broken up a season before planting, and allowed to be in a rough state, and exposed to all the influences of the weather until the following spring, when a second ploughing will be found highly beneficial. All clods should be carefully crushed and the surface well harrowed and prepared for the reception of the plants. Whilst the land is under preparation, nursery beds have to be formed in some well-protected or sheltered locality, which is best dug by hand, and finely raked. It is advisable to erect a frame over these, so that they can be covered over with calico or branches during very hot or very cold and wet weather. Calico, though more expensive, is nevertheless preferable, as it also affords shelter against the often-very heavy and continu-

ous spring rains, which, if allowed to fall on the tender seedlings, might damage or, at least, retard their growth. The seeds are very fine, and two or three ounces are sufficient per acre. They should be thinly sown and but lightly covered with soil. The beginning of September appears to be the best time for sowing the main crop. A second sowing may be effected towards the end of that month or the beginning of October. The young plants, under favourable circumstances, appear above ground in about three weeks; they are allowed to grow undisturbed until they have made three or four full leaves, proper attention being paid to them in the meantime to water them if required, to handweed and thin the plants out if, by unequal sowing, they should be anywhere too thick. The plants having attained sufficient size, as stated above, advantage should be taken of dull and rainy days, during which they have to be transferred to their permanent places in the field. They are carefully lifted from the seed bed, so as not to break the tender roots, singled out and planted in the same manner as cabbage plants. Particular care is required in planting not to twist or damage the main or tap root, which should be dropped perpendicularly into the ground. If dry weather sets in after planting, the plants ought to be watered occasionally, until by their renewed growth they show that they are established. Four feet from row to row is generally allowed, whilst, except perhaps for very large growing varieties, a distance of three feet in the rows will be found sufficient. Planting operations may be carried on (during favourable weather) in November, and even up to Christmas; but early planting is always to be preferred, the plants being established before the hot summer checks their growth, whilst besides, a second, and in exceptional cases, even a third crop may be obtained from such plants. The latter, after they have made some fresh leaves, are earthed up at their base, and the space between them has to be kept loose and free from weed by occasional hoeing. Once established, they generally grow very luxuriantly, and form from eight to ten or

more leaves before the flower buds appear. These and a the lateral shoots, which may be formed, are carefully broken off as soon as they show. The plants thus require a frequent examination, which, even before, is necessary for the purpose of collecting and destroying a caterpillar which generally infests tobacco plants, and which, if not early removed, endangers the whole crop, as these pests will not only devour the heart of the plant, but also eat away large portions of the leaves already formed, rendering them thereby almost valueless. The leaves will, under proper treatment, rapidly increase in size and substance; their colour is fine dark green, and their freshness sufficiently denotes the luxuriance of the plant. By degrees, however, the leaves cease to increase, their colour becomes duller, yellowish spots make their appearance, and the best sign of their ripening—a gummy substance exudes from their surface and makes them feel sticky. Experience alone can guide us in regard to the proper season when the harvest should commence. Though it is not advisable to defer it too long, it is nevertheless better than to commence too soon, as the quality of the leaf depends, in a great measure, on its ripeness. In harvesting, the whole plant is cut off close to the ground, and allowed to remain there for about twelve hours. The evening or morning hours should be chosen for that operation, in preference to the middle of the day. The plants and leaves thus cut and exposed soon lose their stiffness and are less liable to be damaged in being brought to the drying shed. Arrived there, a slit is made in the thick end of the stalk, through which a thin rope or stake is pushed by means of which they are hung up to dry. The latter should be effected in the shade, and very slowly and gradually. If dried too rapidly, they do not get the proper colour, and greatly lose in quality and value. Six to eight weeks, or even more, are necessary for the drying process. All large plantations require special drying sheds, barn-like houses having windows provided with shutters, to regulate the admission of air, in the sides, and stages in the inside, on which the strings

with tobacco are fastened. The tobacco is placed close together without actually pressing the single stalks against each other, which might cause their heating or getting mouldy. The green colour of the leaves gradually changes to a more or less dark brown; they become thinner and leathery, until at last, having thoroughly dried, they get brittle, and crumble to pieces if carelessly handled.

During damp weather, when they are less liable to be damaged, the stalks are taken down, and the leaves stripped off and assorted, all the worm-eaten and soiled or otherwise inferior ones being kept separate. The leaves are tied by their stalks in conveniently-sized bundles, and packed up in baskets or otherwise made ready for market. Some growers submit the leaves previously to fermentation; but as this requires special attention and experience to determine when it should cease, or at least be interrupted, and as the value of the leaves greatly depends on the performance of this process, it appears to be much wiser to let it be performed by the manufacturer, whose business it is to prepare it for the various purposes for which tobacco is used.

The roots of the plants, which were cut down, soon send up several fresh shoots. The strongest one is selected and allowed to grow, and treated in the same manner as mentioned above, so as to secure a second crop, which generally is obtained from all the early planted plants. A third crop, though of inferior quality, may occasionally be produced, but this has rarely time to ripen sufficiently. The leaves of the latter, and the lateral shoots broken off during the growing of the first and second crops, may be mixed together to serve as sheep-wash or other inferior tobacco.—*Australasian.*

VI. India.

In Behar, tobacco is cultivated to some extent. The ground is prepared by free ploughing, and the clods are well crushed and opened out frequently to permit the dew to act upon the soil, especially during the cold months of

the year, when the dew falls very heavily. The land often allowed to lie fallow for a whole year, being kept free of weeds and manured with the usual dunghill rubbish, consisting for the most part of cattle manure and wood-ash. The sowing season commences in the beginning of June. The seeds are put down in duly prepared beds, and, when the seedlings have attained a height of three inches above the soil, they are transplanted, and placed at a distance of eighteen inches from each other. The soil is kept free from weeds, and about the month of September the leaves attain maturity. The first crop is cut and thrown aside for curing, and the second crop allowed to succeed. The stalks, left on the field, push out new shoots, and from this the second crop is realized and prepared after the same manner as the first; the stalks are then allowed to run to seed.

The produce of a Begah* is equivalent to twenty maunds† from the first crop and fifteen from the second: sometimes a third and fourth crop are taken off successively, when the third yields ten, and the fourth five maunds. The price rises according to the season and demand.

1st sort	Rupees	3	to 5	per	Maund.
2nd ,,	,,	2	to 3½	,,	,,
3rd & 4th sorts	,,	1½	to 2½	,,	,,

1. *Nagpore.*—The large and celebrated town of Bhilsa, situated in latitude 23° 35″ north, and east longitude 77° 58″, chiefly supplies the province of Nagpore with tobacco, and the cultivation is carried out much in the same way as at Behar. The soil is said to be a ferruginous, sandy loam, abounding in minerals, to which the tobacco owes its superior excellence; but, at Nagpore itself, it is cultivated in small patches for local consumption, when the backyard or compound of houses is the chief place brought under cultivation. At other times, this spot forms a receptacle for refuse of all kinds, wood-ashes, cattle

* One-third of an English acre.
† A maund in Behar is equivalent to 3,200 tolas or 3,200 rupees' weight.

manure, &c., &c., and at the time of culture, frequently receives a further supply of wood-ash and cattle manure.

2. *Orissa.*—In this province during the season almost every ryot cultivates tobacco in the backyard of his house, the culture being carried out in the usual way. I found during my travels in Orissa, tobacco extensively cultivated in small patches in every village, intended solely for individual or village consumption.

The Ooryas are great smokers, men, women and children smoke, using a leaf for a pipe, which they fill with tobacco and carry about their persons.

3. *Northern Division of Madras.*—Various villages in this division including the districts of Kistna, Godavery, and Ganjam are highly extolled as tobacco-producing places, the chief of which are along the low sandy flats at the mouths of the Kistna and Godavery forming deltas and the Islands are termed Lunkas. Tobacco is also cultivated on a small scale in the compounds of houses for village consumption. The town of Masulipatam is in this tract of country, where the renowned Masulipatam snuff is manufactured, and on the islands formed by the mouths of the Kistna, the soil is richly impregnated with iron, and frequently silted from the deposit of rivers, abounding in alkalies, to all of which the soil owes its fertility; the tobacco produced here is termed "Lunka." The mode of culture is the same as practised elsewhere, and the species is the *Nicotiana rustica.*

The seeds are sown in October and transplanted out in November or early in December, according to the growth and vigour of the seedlings as they attain a height of three to four inches. The ground into which the tobacco is lifted is generally of a red ferruginous, or white and gray soil, which is prepared by repeated ploughings with the free addition of manure. The seedlings are put out at about one foot apart, and watered from earthen pots by hand and not by streams as is usual in other districts. The plants are stopped as soon as the blossoms begin to appear, and in February or March the crop is reaped by being cut

from the stems at the level of the soil, when they are collected and heaped up on the field and covered with straw or palmyra leaves. They are taken up in the course of a few days and tied up in bundles and hung up to dry in a shed for a fortnight. They are then taken down, the leaves separated and tied into bundles of ten or fifteen leaves each. The bundles are again heaped up and covered with straw for three days, and this process of heaping and unheaping is carried out several times, so as to give the required colour and flavour to the tobacco, when it is ready to be disposed of to the merchant. At best, tobacco cultivation is looked upon as a laborious and precarious occupation.

4. *Coimbatore.*—In this district tobacco cultivation begins about the middle of August, and is continued to the same time in October; the ground selected for the nursery is well and repeatedly turned up by the mamooty, or is freely ploughed up and squared into beds of 4×4 or 4×6 feet, and into these beds, after they have been well manured by wood-ashes and dunghill rubbish, the seeds are sown at three or four successive intervals of about ten or fifteen days each, so as to secure a succession of seedlings. The seed is sown and covered over by the hand, and the beds are sheltered from the sun by being covered with cut bushes till the seeds sprout up fairly. They are freely irrigated daily for the first fortnight or three weeks, and then once in every three or four days, according to the season at the time.

The preparation of the field for the transplantation of the tobacco seedling also commences about the same period; it is not only freely ploughed and manured, but cattle and sheep are frequently folded on them to secure their droppings, and it continues to receive several successive ploughings till the plants are ready to be lifted out, when the soil is levelled, the clods crushed and divided into square beds of 4 × 4 or 6 feet, or into trenches of proportionate length and breadth.

The fields are now freely watered, and immediately after

the plants are taken up carefully from the nursery, and put down into the soft mud formed by the water at distances of two feet apart, successively, according to the different sowings and, generally, of an evening (the plants are transplanted). In about a month from the period of transplantation, the fields are freely weeded and the soil loosened with a hoe and heaped around the stems of the plants. About the end of the second month the plants will have attained a height of from two to three feet, according to the richness and fertility of the soil, when the terminal shoots are broken off each plant to arrest their further growth. Each plant will then contain from ten to sixteen leaves. Care is now taken to break off the side shoots as they appear; and in four months from the date of transplantation, the crops will be ready for the sickle, when the plants are watered, and soon after cut down close to the surface and allowed to lie on the field till the next day. They are then taken up and tied into bundles by their stalks, and hung up about the hedges till the leaves become dry. In fair weather, this occurs in about ten days; but should the weather prove cloudy, it takes a fortnight. They are then taken up and heaped together and covered over with straw or cut-bushes, and weighted with stones for four or five days. After this they are stripped of their stalks, and the leaves tied into bundles by their leaf-stalks, and heaped up, covered and weighted for another five days; when they are again taken up and sorted, according to the different sizes of the leaves, tied into small bundles, and heaped and weighted for another five days; when the heaps are again opened out and repacked and continued on for a further period of five days, by which time the leaves are said to be cured.

The produce of an acre is estimated at 500 lbs.

Tobacco from the taluks of Coimbatore, Palladum, Cheyoor, Dauankencottah, Chukkaragherry, and Pullachy, is much appreciated by the natives as possessing superior qualities, and is exported to other districts. The villages in these taluks are situated in alluvial plains. Large quantities of tobacco from these places are exported to South

Malabar and Trichinopoly and in the last station, such tobacco frequently comprises the famous Trichinopoly cigars. The superiority of the tobacco produced in this district is, in a great measure, attributable to the richness and suitability of the soil for the culture of the plant, and to its being irrigated from wells containing much nitre, as well as to the fact that greater attention is given to the cultivation.

Tobacco deteriorates from scarcity of rain, or water from wells, cloudy or foggy weather, and easterly winds. Should the irrigation, at the time the plants are stopped, prove insufficient, the plants are injured by the roots throwing out a white fungus resembling asparagus, which is recognized by the natives as "*Cosilan.*" This has the effect of arresting the further growth of the leaves and injuring the quality of the article itself; and, should the weather prove unusually dry, the leaves get spotted, a species of scald, which is recognized by the native name of "*Poryan.*" This scald injures the plant materially should the weather prove sultry at the time the plants are stopped; or should the east winds continue to prevail, the leaves become white and are completely spoiled. The blight is known by the term of "*Sambal*" in Tamil. The abolition of the monopoly of tobacco in Malabar in 1853 has been the means of extending this cultivation greatly in Coimbatore.

5. *Trichinopoly*, a town in the Southern Division of the Presidency of Madras, is greatly famed for its tobacco and cigars. The method of culture adopted is much the same as that pursued in other parts of India.

The tobacco in some parts of this district is known by the Tamil name of "*Samudali.*" The soil selected for the purpose is alluvial, on the banks or immediate vicinity of rivers, or even tank beds, and is of a dark brown or blackish colour, frequently containing much silt. About the middle of October and November land is selected and prepared for the nursery. It is ploughed or well turned up with the mamooty and manured freely with wood-ashes and

unghill rubbish. The ploughing or digging, according to the size of land, is now repeated several times, and the clods are crushed and divided into beds, 4 × 6 feet each, when the land is ready to receive the seeds.

The seeds are, owing to their minuteness, mixed with twice their bulk of ashes or fine sand, and are then scattered over the beds. The seed beds are watered by hand and covered over with straw, date leaves, or cut-bushes, for four or five days, and then removed. In the course of the week the seeds commence to sprout. The beds are daily irrigated till the plants are old enough to be transplanted. In the meantime the field, for receiving the nursery plants, is prepared and laid out, and the plants put out on attaining three to six inches in height at the distance of two feet apart. They are freely watered daily, the soil is freed of weeds and kept clean. When the plants attain the height of two feet, the tops are pinched off and the side shoots removed, as they appear—ten, twelve or sixteen leaves being left on each plant in proportion to their size, vigor, and luxuriance. About May or June the crop is ready to be harvested. The plants are then cut close to the soil in the afternoon and allowed to lie on the ground. The next morning, they are taken up and stacked into a heap with their stalks uppermost, and are covered with straw. At sun-set they are taken up and laid out again and exposed on the field to the night dews. This process is repeated for four or five days successively, and then the crop is removed to the ryot's hut, where it is suspended by a rope to dry in the shade till the stalks become dry, which takes about a month, when it is termed raw or uncured tobacco. The curing now begins: the tobacco is heaped up and covered over with straw or cocoanut leaves, and kept for a fortnight to sweat, when it is turned up so as to reverse the position of the plants, and so kept on for another fortnight, when the leaves are sorted and made up into bundles.

6. *Tinnevelly.*—In this district a blackish loamy soil is selected for the cultivation of tobacco, which is prepared

and manured in the usual way, but sometimes it is grow in all sorts of soil except clay or sand. Seeds are sown in well prepared nursery beds and planted out into the fields at the proper time. The further cultivation or growth and cure of the tobacco is much the same as that practised in other districts. Palmyra jaggery water, mixed with a decoction made from the stalks of the tobacco, is frequently used to prevent brittleness, and to keep the cured tobacco leaves moist. The produce of an acre will average, in a fair season, from 900 to 1,200 lbs., the market value of which will be about 100 rupees, at the rate of one *Pody* or 168 lbs. for rupees 15-8-0; and the cost of production will be about rupees 50 the acre, returning a profit of cent. per cent. to the cultivator.

7. *Cuddapah.*—Tobacco is cultivated in this in much the same way as in other districts. Garden soil of a light sandy loam is preferable: the richer the loam the greater the produce. The cultivation begins about the middle of June or July; and the usual process of free ploughing to the depth of ten to twelve inches, and removal of weeds, is carefully carried out; and the soil is allowed to continue fallow till required for planting. The manure is the same as that in use in other districts, the quantity used varying from twenty to thirty cart-loads to an acre. Cattle, sheep, and goats are penned in the ploughed ground at an average rate of three to four thousand head per acre, and the land is levelled smooth, and drawn out in trenches and ridges successively. On either side of the ridge the young seedlings are planted out at the distance of two feet apart either way, and are freely watered according to the season. The refuse from the indigo vats, when available, is strewn along the trenches as manure when the plants are about a month old, and the trenches are flooded to promote putrefaction and absorption of the elements to enrich the soil. The plants are stopped to the usual height and pruned of side shoots. When four months old, the leaves give evidence of approaching maturity by getting spotted with brown; and in the course of the next month

or six weeks, these spots increase in size and depth of colour, when they are ready to be harvested. They are watered to render them succulent, juicy, and sweet, before being cut down. The subsequent treatment of the cut-tobacco is much the same as that practised in other districts for curing it. Good tobacco is of a dark greyish colour, and is sold by *Pulties* of twenty maunds each, one maund being equal to 25 lbs. avoirdupois; and a putty of 500 lbs. fetches from 35 to 45 rupees in the market according to quality. Seedling tobacco plants are grown, as usual, in nursery beds and sold to ryots, who purchase and plant their fields with them: a square bed of 2×2 feet of growing seedling plants from 6 to 8 inches in height, fit for immediate transplanting, will fetch from 1 to 3 rupees, and an acre would cost about 16 rupees for seedlings to plant it with.

8. *Chingleput.*—In this district the cultivation of tobacco extends over a period of four months, and is carried out in the following manner. The seeds are sown in seed beds late in the month of December, and the tobacco is gathered early in April. The beds are square, and sometimes receive the seeds before and sometimes after being irrigated. They are carefully prepared for the reception of the seeds by free digging and turning up of soil, as small seeds like those of tobacco require a rich thoroughly prepared surface soil, to save the loss of a large proportion of seeds; for it is necessary that the soil next the seed contains the necessary supply to the plants as they sprout; consequently tobacco requires nursery beds; indeed it is difficult to grow them otherwise. A well sheltered locality is always chosen, a manure consisting of equal parts of wood-ashes and dunghill rubbish is thrown into the beds, and small narrow parallel trenches are then dug about a foot wide, with intervening ridges of the same breadth. When the seedlings have attained a height of from three to five inches, and have put out three or four leaves, which they do in about twenty days, they are ready for transplantation. The trenches are previously filled with water and the seedlings planted on the top of the ridges at the distance of

fifteen inches from each other, and for the first three or four days are irrigated daily, after which irrigation is practised every second day throughout their growth. About fifteen or twenty days after transplantation, the weeds are scraped off the land, either with a cocoanut shell or an iron scraper. In about a fortnight after this, the soil is loosened and the weeds exterminated. Advantage is taken of this opportunity to complete the stand of plants by filling up the gaps left by the failure of some plants, and the accidental destruction of others, irrigation being practised as usual. At the commencement of the third month, a second hoeing or loosening of the soil, and a further extermination of the weeds, are practised; and some two or three days after this, the side shoots, which have begun to show themselves in the axilla of the leaves, are removed by being broken off; and about the end of the third month, when the stand of plants has attained a height of about two or three feet, the tops of the bushes and all superfluous leaves are pinched off, leaving to each plant some ten or fifteen of the best shaped leaves. The plants throughout their growth are subject to attacks from caterpillars, which should be looked for daily the first thing, picked out, and destroyed. When the plants have become ripe, which they do at the end of the fourth month, the leaves become speckled, and frequently crackle between the fingers. At this period, if the plants have grown well and luxuriantly, the average size of the leaf is from twenty-five to thirty inches in length, and five to seven inches in breadth. The plants are then cut down, leaving a couple of inches of the stem in the ground, and are allowed to remain on the field to dry. In the evening they are gathered and stacked into a heap in some open place for the night. When the tobacco plants are cut down, the stumps left in the soil soon throw out fresh shoots; and these, if carefully weeded and watered, thrive well, and the produce thus obtained will realize one-third the value of the original crop. The tobacco from the second crop is greatly inferior to the first in quantity and quality; and, consequently, it deteriorates in the market.

The produce of one *cawnie* of land is about 350 *thooks* of tobacco, a *thook* being equivalent to 3 lbs. and 10 oz. avoirdupois weight.

The attendant expenses are:—

	RS.
For ploughing the land	14
„ Watering, weeding, &c....	15
„ Land rent	5
Rupees...	34

The value of the produce of one cawnie, viz., 350 thooks of tobacco, is estimated at 150 rupees; from which, if we take 34 rupees, and allow 16 rupees for contingent expenses, a clear profit of 100 rupees remains to the cultivator. The seeds are so minute and numerous, that three to six ounces suffice for planting a cawnie of land, the price of a pound of seeds being 8 annas. One tobacco plant produces 360,000 seeds.

I have named the chief producing districts and have left out others, not that they do not grow tobacco; but, having visited every district in this presidency and examined the plants at various stages of their growth, I did not see any particular difference in the cultivation; and the export, if any, is not great, except perhaps in the Kurnool district, in which the cultivation is extending, and tobacco is exported to some extent. North Arcot produces a good deal, chiefly about Vellore, which is consumed in the district and is used up in the manufacture of cheroots and snuff. The produce of South Arcot, Nellore, Bellary and Salem, is consumed locally.

Note.—A vegetable parasite, known in Godaveri and Kistna Districts as Bodu. *Phelipæa Indica*, belonging to the natural order *Orobanchaceæ* grows parasitically on the roots of this tobacco plant; it is also met with, in other parts of India. The method to get rid of them, is persistently to cut out the roots of the parasite, as the plants show themselves above ground and before they flower. The plant being an annual and a parasite, it is possible to exterminate them, as the seed may not survive beyond a season. The soil should be burnt with the stubble and grass, that may be found growing on the land, followed by a change of crop; this is the best way to get rid of the parasite that is so inimical to the cultivation of tobacco in these and other districts.

VII. Insects Destructive to the Tobacco Plants.

No animals will touch the tobacco plant, but insects belonging to the order *Lepidoptera* are very destructive to it, for they eat through the leaves in a very short time; and when their numbers, in connection with their variety, are taken into consideration, we can easily imagine the amount of destruction they may cause on a plantation, if not soon exterminated. Those that attack the tobacco plant belong to Class VIII, *Insecta;* Order IX, *Lepidoptera;* Sub-order I, *Heterocera,* and of the second group or tribe *Tineidæ;* the larva known as caterpillars are found crowded on the leaves. The eggs are first deposited on the leaves in large numbers, and are scarcely the size of a pin's head; some are oval and others round; and in from three to five days the caterpillars make their appearance. As they increase in size, they scatter themselves over the plant and, ere attaining maturity, change their skins on four different occasions. A full-grown caterpillar is a quarter of an inch in diameter, and 1½ inches in length. The animal is made up of 13 segments; the head is horny, and furnished with jaws and antennæ. If disturbed, it lies still as if dead, or curls up; but is extremely active otherwise, and when injured or handled, ejects a greenish acrid fluid from its mouth. It has sixteen legs, three pairs attached to the thorax. these are jointed and clawed, and four pairs of prolegs, which are fleshy stumps. A fifth pair of the same kind is attached to the caudal extremity. The caterpillar is naked, and has three yellow longitudinal stripes, and the two outer lines are dotted with black triangular spots, whilst the ground is of a greenish grey; a dark stripe of the same color, forms the marginal surface towards the abdomen and is serrated at its lower border. The under-surface is of a dull opaque color, and the claws of the thoracic legs are dark-brown. At the time of changing into pupa, they escape and bury themselves under ground, or seek shelter in some crevice, where they remain quiescent, and, after from 24 to 36 hours, put on a dark-brown horny covering forming the chrysalis. The pupa or

chrysalis is motionless, but if disturbed, the small end moves gently from side to side; and on the seventh day the insect emerges in the shape of rather a quiet-looking moth. The antennæ of these are filiform, three lines in length, color brown, with darker markings, which have a metallic bronze-like lustre, and grey margin, wings narraw and elongated; the bases of both are fringed; length of wings, six lines; of body, five lines; diameter of body, two and-a-half lines; this is the chief kind of moth whose larva proves so destructive to tobacco at Chingleput. I have examined the plants frequently during several seasons, and on only one occasion found a single larva of the *Geometridæ* or *Loupers.* Those described above were always to be seen in swarms. In Georgia the *Sphinx Carolina,* a species of the Hawk moth, and other insects of the same kind, and especially the *Phalœna Rhexiæ* are said to be great pests to the tobacco plant.* Various remedies have been suggested for the destruction of the caterpillars that infest the tobacco plant, such as sulphur, lime, and the smoking of the plantations. These are not only expensive but are supposed to prove injurious to the aroma of the plant, if used when it approaches maturity. The safest and most effectual method is to employ people to pick out the worms daily. At early morn an acre can be freed of this pest in a couple of hours by three women or boys, but, of course, this operation will require to be carried out daily to meet with success. At the same time that the caterpillars are being picked out, any eggs found on the plants should be brushed away from the leaves with a soft brush. I have employed poultry with success, and found that the turkey is recommended for the purpose in America; but in India this is a delicate bird to rear, and from its weight and size is likely to injure the tobacco leaves. The common fowl is quite effective for the purpose; but the Guinea-fowl, the *Numida Meleagris* of naturalists is the best and most successful from its wandering habits; it roves freely over the plantation, and

* Kirby and Spence's Entomology.

does not injure plants or leaves in any way, while it is at the same time very quick and active in picking off caterpillars and *other* insects from the plants.

VIII. Review of the Cultivation.

On reviewing the methods of cultivating tobacco, it will be observed that it is very generally cultivated in Southern India and in many other parts of this country, either for commerce or for local consumption. Perhaps there is scarcely a village in India where it is not cultivated for the consumption of the villagers. The produce, in the first instance, depends on the soil and climate, and secondly, on the process of manufacture.

Soil.—The soil for the successful growth of tobacco should be richly impregnated with iron, and should abound in alkalis. This we judge by analysing the ashes of the plant, from which we can readily ascertain its wants, so as to grow it successfully. "In the analysis of Havana tobacco by *Hortung* 100 parts of the ash was found to consist of

Salts of potash	34·15
Salts of lime	51·38
Magnesia	4·09
Phosphates	9·04

These were for the most part insoluble in the earth, and must have been dissolved during the growth of the plant.

The following are analyses of five samples of tobacco grown on Argillaceous and Calcareous soils.

	No. 1.	No. 2.
Potash	29·08	30·67
Soda...	2·26	—
Lime...	27·67	24·79
Magnesia	7·22	8·57
Chloride of sodium	·91	5·95
„ of potassium	...	...
Phosphate of iron	8·78	7·03
Sulphate of lime	6·43	5·60
Silica	17·65	5·54

Grown on Calcareous soil :—

	No. 3.	No. 4.	No. 5.
Potash	9·68	9·36	10·37
Soda	...	...	...
Lime	49·28	49·44	39·53
Magnesia	14·58	15·65	15·04
Chloride of sodium ...	4·61	3·20	6·39
„ of potassium ...	4·44	3·27	2·29
Phosphate of iron	5·19	6·72	7·56
Sulphate of lime	6·68	6·14	9·42
Silica	5·54	6·28	8·34

There is no doubt that the manure, which contains the largest proportions of the alkaline carbonates, magnesia, lime, and gypsum, is the best adapted for tobacco. I subjoin an analysis taken from Professor Johnstone's Lectures (2nd Edition) of the ash of the tobacco leaf, and the composition of a special manure for tobacco.

"Potash	12·14
Soda	·07
Lime	45·90
Magnesia	13·09
Chloride of sodium	3·98
„ of potassium	3·98
Phosphate of iron	5·48
Sulphate of lime	6·35
Silica	8·01"

All the ingredients which are necessary to replace 100 lbs. of the ash of tobacco leaves are present in the following mixture :—

Bone dust, sulphuric acid	23	lbs.
Carbonate of potash (dry)	31	„
„ of soda („)	5	„
„ of magnesia(„)	25	„
„ of lime („)	60	„
	144	„*

* Balfour's Cyclopædia of India.

The following is the result of an analysis of the fresh leaves of tobacco by Posselt and Reimann :—

Nicotine	·06
Nicotianine	·01
Extractive matter slightly bitter...	2·37
Gum with a little malate of lime...	1·14
Green resin	·26
A substance analogous to gluten...	1·04
Malic acid	·51
Malate of ammonia	·12
Sulphate of potash	·04
Chloride of potassium	·06
Potash combined with malic and nitric acids...	·90
Phosphate of lime	·16
Lime in union with malic acid ...	·24
Silica	·08
Woody fibre	4·96
Water (traces of starch) ...	87·21.

Dr. Covell, in *Sullivan's American Journal*, Volume VII, shows its components to have been imperfectly represented in the above German analysis. He found in tobacco, by chemical examination, first, gum; second, viscid slime, equally soluble in water, and alcohol, and precipitable from both by subacitate of lead; third, tanin; fourth, gallic acid; fifth, chlorophyle (leaf green); sixth, a pulverulent matter which dissolves in boiling water, but falls down again as the water cools; seventh, a yellow oil possessing the taste, smell and poisonous qualities of tobacco; eighth, a large quantity of a pale yellow resin; ninth, nicotine; tenth, a white substance analogous to morphia, soluable in hot, but hardly so in cold alcohol; eleventh, a beautiful orange red dye stuff soluble only in acids, it deflagrates in the fire and seems to possess neutral properties; twelfth, nicotianine. According to Buchner, the seeds of tobacco yield a pale yellow extract of alcohol, which contains a compound of nicotine and sugar.

M. M. Henery and Boutron Charlard found the following quantities of nicotine in 1,000 parts of

Cuba tobacco	8·64
Maryland	5·28
Virginia	10·00
Ile et Vilaine	11·20
Lot et Garonne	8·20*

The proportions of nicotine given by M. Henery and Boutron Charlard's analysis, are not correct. The quantities of nicotine in 1,000 parts are, according to Schlœsing—

Cuba tobacco	20·
Maryland	22·9
Virginia	68·7
The et Vilaine	62·9
Lot et Garonne	73·4

These quantities vary from 2 to 7 per cent. In Broughton's analysis, the quantities vary from 1 to 7 per cent. But in the analysis of Harvey, the quantities vary from ½ to 1 per cent. This is certainly a mistake.

The amount of nicotine in leaf or manufactured tobacco may be accurately ascertained by a simple and easy process. Ten grammes of tobacco are exhausted with ammoniacal ether in a continuous distillatory apparatus, the ammoniacal gas is expelled from the nicotine solution by boiling; the liquid is then decanted and after evaporation of the ether, neutralised by a solution of sulphuric acid of known strength. —*Schlœsing.*

Nicotine exists, not only in the leaves, but also in the root, and in the seeds of tobacco. It is obtained by infusing the leaves in water, acidulated with sulphuric acid, concentrating the infusion and distilling with lime or magnesia.

The distilled product is a solution of ammonia and nicotina, and is to be saturated with sulphuric acid and evaporated to dryness: the sulphate of nicotina is then to be dissolved out by ether, and decomposed by hydrate of

* Dr. Ure's Dictionary of Arts, Manufactures and Mines, 4th Edition, Vol. II, 1853, page 867.

baryta. The nicotina is obtained by spontaneous evaporation. To obtain it pure, it should be distilled by an oil bath at the temperature of 288° F. The following are its leading properties:—It is a colorless, liquid, volatile alkali, with the odour of tobacco and an acrid, burning taste. It restores the blue color of reddened litmus, and renders turmeric-brown. At 375° F. it boils, and at the same time undergoes decomposition. By exposure to the air it becomes brown and thick. It is readily combustible by the aid of a wick. It is soluble in water, ether, alcohol, and the oils (fixed and volatile). It combines with acids and forms salt; the *sulphate, phosphate, oxalate* and *tartrate*, are crystallizable. "The *acetate* is not; its atomic weight is about 210. The acetate of nicotina yields a white flocculent precipitate, with a solution of bichloride of mercury, and a yellow granular precipitate with chloride of platinum. The precipitates (which are double salts) lead to a suspicion that ammonia was present in the nicotina salt. Heated with water, the yellow precipitate obtained by chloride of platinum is converted into the platinum bichloride of ammonia. Mr. E. Davy found that nicotina acted as a narcotic poison on insects. The quantities of nicotina, yielded by 1,000 parts of various kinds of tobacco, have already been given." "Concrete volatile oil of tobacco (nicotianin, *Hermbstädt, Tobacco comphor,* Gemelin) obtained by submitting tobacco leaves with water to distillation. Six pounds of the leaves yielded 11 grains of oil, which swims on the surface of the liquor. This oil is solid, has the odour of tobacco, and a bitter taste. It is volatile, insoluble in water, and the dilute acids, but soluble in ether and caustic potash. According to Landerer, fresh tobacco leaves yield no nicotianin, which, therefore, would appear to be developed by the drying of the leaves under the influence of air and water. Nicotianin excites in the tongue and throat, a sensation similar to that produced by tobacco smoke. Hermbstädt swallowed a grain of it, and experienced, soon after, giddiness, nausea, and inclination to vomit. Applied to the nose, it causes sneezing. *Empyreumatic oil*

of tobacco is rather less solid than the empyreumatic oil of ox glove; but it is undistinguishable from the latter by either taste or smell. It is produced, in part at least, by the decomposition of some of the constituents of tobacco. It has been suggested that this oil is '*the juice of cursed hebenon,*' alluded to by Shakespear (*Hamlet Act I, Scene* 5) who also calls it a *distilment.*"

Tobacco smoke.—The constituents of tobacco smoke, according to Raab and Schenk, are much *carbonate of ammonia, acetate of ammonia, nicotianin, emphyreumatic oil, carbonaceous matter* (soot), *moisture,* and several *gases.* Unverdorben obtained by the dry distillation of tobacco, water, oil, and resin. These products consisted of, *a volatile oil, an oleaginous acid, an emphyreumatic acid, resin,* traces of *a powder insoluble in potash and acids,* a small quantity of *odorin, a base soluble in water* (nicotin) *fuscin, red matter* soluble in acids, and *two extractive matters,* one forming a soluble and the other insoluble compound with lime.*

The combustibility of tobacco is influenced to a considerable extent by the proportion of potash and lime contained in it and the manner in which these bases are combined with acids. The ash of the more combustible tobacco is comparatively rich in carbonate of potassium, showing that in these tobaccos, the potash is in combination with organic acids; whereas the ash of the less combustible tobaccos contains sulphate and chloride of potassium, together with carbonate of calcium, instead of carbonate of potassium, showing that in these tobaccos, the organic acids are combined with lime. A slowly burning tobacco, may be rendered more combustible by adding to it an organic potassium salt, in such quantity that the amount of potash in the ash may be more than equivalent to the sulphuric and hydrochloric acids present, and on the other hand, the combustibility of tobacco, may be diminished by mixing it with such a quantity of sulphate or chloride of magnesium, calcium or ammonium, that the amount of hydrochloric or

* Pareira's Materia Medica.

sulphuric acid in the ash may be more than equivalent to the potash so that the ash will not contain any potass. carbonate.—*Schlœsing.*

Tobacco always contains nitrates. According to Schlœsing these salts are most abundant in the midrib of the leaf which, in different varieties from 0·15 to 6·1 per cent. nitric acid, the leaf deprived of its midrib containing from 0·02 to 2·0 per cent. The ready inflammability of tobacco and its capability of burning with a smouldering flame, are due in a great part to this large amount of nitrates.

Note.—In the smoking of tobacco an imperfect combustion takes place one part of the tobacco burning in contact with the air and producing by its combustion a quantity of heat sufficient to decompose the remainder by destructive distillation, producing water and tar (oil of tobacco) which when the tobacco is smoked in a pipe, condense as liquid products.—*Watt's Dict. of Chemistry.*

J. Broughton, Esq., the Madras Quinologist, furnished the Board of Revenue with the following particulars of analysis of the different India Tobaccos:—

Number.	Tobacco Specimen from	Per cent. of ash.	Per cent. of carbonate of potash in ash.	Per cent. of nicotine.
1	Vizagapatam. Vizagapatam, No. 1, 1st sort ...	22·653	12·5	1·41
2	Do. do. No. 1, 2nd sort...	20·185	17·83	1·45
3	Do. do.	26 339	3·29	2·45
4	Do. Chipparapilly, No. 2	17·544	9·6	2·37
5	Do. Anakapilly, No. 3... ...	18·592	8·01	5·40
6	Do. Strungavarapukota, No. 4 ...	20 740	9·91	5·49
7	Do. Vizianagarum, No. 5	20·411	7·2	4·54
8	Trichinopoly, Trichinopoly A.	22·829	6·05	2·52
9	Do. do. B.	21·485	8·16	2·41
10	Do. do. B	24·434	5·29	1·83
11	Do. (Cigars) Tallampatty Puloor ..	20·396	8·25	3·28
12	Do. (Cigars) Natapur	26·848	4·42	4·55
13	Do. (Cigars) Valicundapuram ...	23·108	3·91	4·15
14	Bellary. Hospet	19 933	3·46	3·74
15	Do. Raidroog	18 931	13·29	1·70
16	Do. Harpenhully	20·29	3·75	4·99
17	Do. Sundoor	20·114	4·40	2·41
18	Nellore. 1st sort	19·422	8·12	2·16
19	Do. 2nd sort	18·606	5·81	1·83
20	Cuddapah. Pullampet, A.	20·701	4·62	2·03

Number.	Tobacco Specimen from	Per cent. of ash.	Per cent. of carbonate of potash in ash.	Per cent. of nicotine.
21	Cuddapah. Pullampet, B.	20·507	3·45	1 33
22	Do. Sidhout, C.	23·951	4·07	2·99
23	Do. Budwail, E.	22·453	3·71	2·70
24	Do. Chinniah Dandloor, G. ...	16·255	4·14	5·1
25	Do. Prodatore, H. No. 1	21·698	4·49	2·75
26	Do. do. I, No. 2	16·432	6·15	4·82
27	Do. Jammalmadugu, J.	22 105	3·52	5·07
28	Do. do. Ponnatolah K. I.	17·327	5·93	5·36
29	Do. Madanapully P.	18·743	5·95	7·44
30	Do. do. Q. I.	20·18	2·28	7·23
31	Do. from Board of Revenue	24·75	4·36	1·70
32	Tanjore. Tanjore	20·745	8·71	2·49
33	North Arcot	22·895	10·06	4·40
34	South Arcot, Ravathavullur	21·115	11·92	3·99
35	Nilgris, Todanad	20·596	29·26	1·43
36	Do. Koondahs	17·786	6·37	2·95
37	Kurnool, Nundial (Masub soil)...	4·030	4·31	1·41
38	Do. do. (Bagud soil)	22·535	0·78	2 49
39	Do. do. (Local soil)	16·85	9·89	1·33
40	Do. Markapur	22·767	3·89	2·45
41	Do. Cumbum	19·22	9·77	1·87
42	Coimbatore, Coimbatore	22·856	2·94	3·32
43	Do. do.	22·606	5·64	4·95
44	Do. do.	19·923	7·92	4·90
45	Do. Pullachy	24·987	4·39	1·95
46	Do. Moocasipoodoor	25·73	7·67	2·24
47	Do. Coorchy	26·39	7·93	1·17
48	Do. Poondoray Semoor	23·34	2·65	1·29
49	Do. Aval	23·49	19·97	1·46
50	Do. Momgumpollium	26·65	2·61	2·95
51	Shiraz tobacco from Tanjore	22·86	2·99	1·91
52	Cheroots supplied by Dr. Ross	28·50	0·39	2·04
53	Do. made from Shiraz tobacco grown at Tanjore	25·68	5·98	1·67

In summing up the results of the above analysis, the chief points to which Mr. Broughton calls attention, are as follows: that the quality of tobacco cannot always be inferred from an analysis, however complete it may be; that chemistry can only lay down the broad proportions in which certain constituents must occur to produce excellence; that the strength of tobacco depends immediately on the amount of contained nicotine; but tobacco containing over four per cent. of this powerful alkaloid is strongly intoxi-

cating, while that which contains less than three per cent is called mild; that another important constituent of tobacco of high quality is the organic salts of potash; these in combustion being converted into the carbonates found in the ash; that the permanency and whiteness of the ash entirely depend on the amount of potassic carbonate it contains; and that the presence of nitrates in quantity as no connection with the quality of the tobacco. He further infers that Nos. 1, 2, 4, 7, 8, 9, 11, 15, 18, 32, 39, 41 and 46, in the table of analysis possess, in the main, the qualifications necessary to tobacco of good quality; and is of opinion that the presence of calcic carbonate in abundance in the soil in connection with a comparative absence of potassic salts, must inevitably cause the ash of tobacco to abound in calcic carbonate, and thus depreciate its quality; that the general inferiority of Indian tobacco is owing to this fact; an examination of the first fifty of the analyses showing that thirty-nine kinds contain less than 9 per cent. of potassic carbonate in their ash. Mr. Broughton attaches significance to the fact of the natives in several districts asserting that tobacco requires to be irrigated from brackish wells, and that river water is prejudicial; that the practice in some parts of sprinkling tobacco in the process of curing with water containing jaggery, and the bark of *acacia arabica* is both useless and injurious; that, in order to cure the very general defect of Indian grown tobacco, the soil should, in addition to cattle manure, be also manured with the ashes of wood or plants burnt on the ground, if possible; that a poor soil and lax cultivation will never produce good tobacco; and that much care to manure it highly, and to cure it with great attention, when harvested, is absolutely necessary.

From these different analyses we see the composition of the plant, and the duty of the cultivator is to furnish the soil, where wanting, with similar elements to enable him to obtain successful results.

IX. Climate.*

Tobacco thrives best in a warm moist climate, and the occurrence of a few showers of rain, after the plants have established themselves after transplantation, as also heavy dews at night, add to their vigour. Frost destroys the plants, and the cold north-east winds are extremely inimical to their health; they are soon blighted by them, unless protected by a close lofty hedge or situated in a sheltered locality.

1. *Culture.*—From what has already been written, it will be seen that the tobacco forms a crop of four months, and that, owing to the minuteness of the seeds and the extreme delicacy of the first sprouts, the plants require to be raised in nursery beds. This is a universal practice in the culture of tobacco, whether grown in America, Australia, Persia, or India. When the plants are sufficiently grown, and are from five to six inches in height, and have thrown out from six to eight leaves, they should be transplanted. The grand secret in the culture of tobacco, whether in first raising it in nursery beds, or subsequently maturing the leaves out in the fields, consists in the preparation of the soil, enriching it with manure containing the necessary elements required by the plants, and in keeping the ground clean and sweet and thoroughly free from weeds. It will be seen from the descriptions given above, that there is not much difference in the mode of culture pursued in different countries. Of course, the plant may thrive in one locality better than in another, and may also attain a greater richness and perfection, which will, in a great measure, depend upon the soil and climate.

Soil.—The best soil for the cultivation of tobacco is a dark grey loam, and the silt or alluvium deposit from streams and tanks is greatly appreciated for the purpose;

* Climate interferes with gradual process of drying and seasoning so necessary to the cure of tobacco, the curing is hurried to prevent the leaf becoming brittle and loss of weight in the rapid evaporation of moisture in the leaf.

in consequence of which, in most districts, river banks and islands formed by the alluvium are preferred, as they abound in the necessary vegetable and mineral ingredients required for the growth and nourishment of the tobacco plant. The land should be freely ploughed or be turned up by the mamooty, so as to expose every part of it to the action of the sun and air; and, where feasible, after being broken up, should be allowed to lie fallow for a season. The soil should be loose and friable for nursery beds as well as for the fields in which they are to be subsequently transplanted out.

2. For nurseries the plots should be freely ploughed up to a depth of twelve or sixteen inches, and be squared into beds of four by six or eight feet, the clods crushed and the surface levelled smooth, and channels formed to facilitate irrigation. The transplanting ground should also receive the same attention.

3. *Manure.*—The best manure to use is equal parts of wood-ashes and good farm or fold yard manure; if preferable, artificial manures may be used, and the composition given in Part VIII of this Essay is well adapted for the purpose, and will furnish the required materials for the successful growth of the plants. Each acre should receive eight to ten tons of the mixed manure, and the same should be evenly scattered over the ground and be ploughed into the soil as soon after as possible.

4. *Cost.*—The average cost of an acre may be set down at 50 rupees, distributed as follows:—

	RS.
Ploughing	14
Watering, weeding, &c.	15
Land rent	5
Contingencies	16
Total...	50

5. The produce of an acre in an average season is about 1,500 pounds of tobacco, the price varying according to the

quality; but estimating the crop at the low rate of 100 rupees, the result will be a clear profit of 50 rupees, or cent. per cent. on the outlay: from this it will be seen that tobacco is a very profitable investment.

6. *Seeds.*—The seed should be of the best description procurable, and the produce of the first crop. After being well dried and freed of foreign particles, the seed should be mixed with an equal proportion of wood-ashes or fine sifted soil, to enable the sower to scatter the seeds evenly over the beds broadcast; after which the beds should be lightly scattered with a hand-hoe or be dusted over with fine pulverized manure, so as to cover in the seeds; and the seed beds should be irrigated for the first time with a watering pot having a fine rose; after which the usual method of channel irrigation may be pursued. The seed beds should be covered over with straw or cut bushes from three to eight days, to be removed as soon as the seeds begin to sprout. Should the seedlings appear much crowded, they should be carefully pricked out; and, in the course of two or three weeks, as they put out from three to six leaves, they will be ready for being lifted out into the field.

7. The ground or soil into which the plants are transferred, after being well prepared, is laid out differently in the several districts: in some, they are simply levelled flat and the plants are put down in rows two feet apart either way and watered by hand from a chatty for a few days till they become established; after which they are treated as dry cultivation and left dependent on the seasonal showers of rain and the fall of night dews till ready to be harvested. This is the case in all the Northern and Ceded Districts; but in other districts, the ground is squared into beds or into parallel trenches, two or three feet apart, and these beds are flooded by channels from wells, brooks, or other water reservoirs, either before or after the plants are transplanted out, and the watering is continued once in every three or five days, according to the season, till the crop is ready to be harvested, and also immediately before the

plants are cut down, so as to render them succulent. this respect, every cultivator has to make his own arrangements, so as to agree with the varying conditions of the soil, climate, and season of the several districts. No rule can be laid down, but it must be left to each cultivator to act according to the requirements of the particular locality. The same remark is applicable to sowing: for, in those districts which are subject to the south-west monsoon, the sowing season begins as early as June, and is continued up to August, and the crop is harvested from October to December. On the contrary, in the districts subject to the influence of the north-east monsoon, the sowing commences in October and ends in November; and the crop is gathered in from February to March.

8. Careful attention should now be given to the plantation. From the time the plants have established themselves after being put out, they should be examined daily in the mornings, to remove any caterpillars that may be found on them: these should be carefully picked out by hand and destroyed on the spot; at the same time, all side shoots or suckers should be broken off to enable the plant to attain vigor and grow up straight and strong; and, on its attaining from two-and-half to three feet, and containing from ten to sixteen leaves, the tops of the plants should be pinched off to stop their growth further and prevent them from flowering. The number of leaves left should vary with the size and vigor of each individual plant, but they should at no time exceed sixteen. The plantation should be scrupulously freed from weeds, the soil kept loose, and the stems of the plants be well earthed up frequently, care being taken to make the stand of plants as complete as possible. As soon as a plant has died off, or has become injured, it should be immediately replaced by one from the nursery, where all superfluous plants should be retained for six weeks or two months after transplantation, to fill up vacancies that may occur subsequently.

9. Tobacco, as already stated, takes about four months to harvest from the time of sowing. As soon as the leaves

grow a pale green or slightly yellowish color, they are ready for the sickle: the leaves will then emit a strong mawkish or sickly odour and feel rough and somewhat brittle to the touch, the lamina readily breaking in two when doubled.

Harvesting.—Having decided to gather in the crop, the plants should be cut down at between two and three inches above the soil, and be allowed to lie on the field to wither and become pliant till the next morning. Should they not then be sufficiently supple, they may be allowed to remain on the field for another twenty-four hours, when they should be removed and have the stalk end pierced with a hole, through which a cord is strung, in order that the plants may be hung up in the shade to dry for a week or ten days, till the stalks begin to dry, when they should be tied into bundles of half-a-dozen stalks each; and, some straw having been spread on the floor, they should be stacked into a heap, a portion having the stalk end resting on the ground, and the rest reversed the other way; the whole covered with straw and weighted with stones, and allowed so to remain from 36 to 48 hours to promote fermentation. The heat and moisture set up a slow process of fermentation, and a thermometer should be invariably used so as not to allow the heat to exceed 98° Farenheit. The heat should be maintained at the same temperature for three or four days, when the stack should be opened out; and, after exposure to the air for a few hours, the plants should be again restacked in the opposite way, so as to bring every part of the stalks and leaves under the fermentative process. The next day, on the temperature reaching 98°, the stack should be unpacked, and the bundles be taken up and hung in the shade exposed to a free current of air for 48 hours; when they should again be restacked into a heap for about 24 hours till they attain the usual temperature of 98°, and be so maintained for three, four, or five days. This stacking, unstacking, and exposure to the air should be carried out on four separate occasions during the month in order that the tobacco be cured. The temperature should on no occasion exceed 98° Farenheit.

The leaves should now be stripped off the stalks, and sort and tied into bundles of twenty-five each. The tobacco will have attained a light brown color; but should the temperature exceed 98° degrees, it takes a dark brown color, and has a strong, rank ammoniacal smell, and possesses the *Karum** which the natives look for and appreciate, but which is so much disliked by Europeans. The tobacco is now wrapt in gummy sheets, with a view to preserve its moisture; but, should it become too dry, to prevent it from becoming brittle, it is sprinkled over with a decoction prepared from the leaf stalks or with a solution of jaggery and water. This is actually necessary in some districts to keep the tobacco moist, and to prevent it from crumbling to powder when transported from one district to another. The object of the sweating or fermentative process consists in the promotion of fermentation by decomposition of the albuminous constituents of the leaves: this, aided by heat and moisture, yields carbonate of ammonia. The organic salts are next converted into carbonates, and the lignin is the last to undergo decomposition. It becomes friable and yields ulmic and a little acetic acid which gives color to the tobacco. Nearly two-thirds of the nicotin disappears during the process, being either decomposed or volatalized by the aid of the carbonate of ammonia; moreover, in the fresh plant, the nicotin is found in the state of a salt (malate) insoluble in ether; in the fermented plant, it is found chiefly in the state of acetate or subacetate, when it is soluble in ether; but the true secret is that, by the process of fermentation and subsequent exposure to air, the leaves of the tobacco undergo a slow process of oxydation, by the carbon and hydrogen of the leaves being converted into water, carbonic acid, and ammonia similar to the process, termed by Liebeg, *Eremacauses*, from the Greek, signifying slow combustion; but if the fermentation be carried to excess, putrefaction begins, breaking up the constituents into other compounds previous

* Pungency.

to oxydation; and, as is well known, fermentation is a process by which organic substances resolve themselves into simple compounds preparatory to their resolution into water, carbonic acid, and ammonia.

As regards the manufacture of tobacco, no account ever so clear will make up for a practical knowledge of the subject. Practical experience is chiefly necessary. The native ryot does not use a thermometer and is solely guided by experience: he generally overdoes the thing, more frequently perhaps, as the natives prefer a strong tobacco; and, on that account, the native manufacturer carries the fermentative process to excess. The temperature should, when curing for the European market, be invariably guided by a thermometer.

We shall now review the various methods of curing tobacco by Europeans and Natives in different parts of the world.

X. Preparation of Tobacco.

We have now to consider the preparation of what is known in the "market" as the raw or cured tobacco. In carrying out the process of preparation, much difference exists in the various tobacco-growing countries. This difference, taken in connection with the different climates, in which the process is carried on, causes a difference in the flavour, which greatly depends on the mode of curing. Good tobacco, according to Dr. Royle, as it occurs in commerce, "is of a yellowish brown color, soft and pliable, a little clammy, with something of a honey smell mixed with a narcotic odour; the latter is, however, not obvious in fresh leaves." The taste is bitter, acrid, and nauseous. That the tobacco may obtain this state, much manipulation is necessary, and no rules ever so succinct can make up for a deficiency of practical knowledge; and great forethought and decision will be necessary to modify the process, so as to adapt it to circumstances suited to the locality in which it may be grown.

A—Preparation in America.—In Virginia, the leaves are

dried in log-huts, from the roof of which they are suspended; and, when the weather is wet, charcoal fires are lighted and the stem is dried by the smoke, and mouldiness is thus prevented. After hanging for three or four weeks, the plants are, when dry, removed and carefully packed on the dry floor to preserve them from the frost. Should the weather prove very wet, they are hung up several times, smoked with a charcoal fire, and replaced in bulk. Lastly, in the month of May they are hung up and so continue till a warm moist day occurs, when they are taken down, and the leaves being stripped off the stalks, are tied in bundles of six or eight in each, with a leaf binding them together, and are thus packed carefully into hogsheads; the butt end of the tobacco touching the cask, and the points directed inwards to the centre. Smoking is injurious, and if the season be sufficiently dry and warm, it is better to cure the tobacco entirely by the aid of the sun.* In Cuba, the stalks are allowed to remain on the soil till after midday, to free them from their natural or acquired moisture, when they are stored; and the following day the leaves are plucked off the stalks and strung up in rows to dry. On the completion of this process, some are put into rolls with the view of being ready for exportation, and the packages are left piled up together. In the storing away of the tobacco into hogsheads, care should be taken to see that each bundle is separately placed, and the leaves have their ends reversed at each alternate tier. If the tobacco be well pressed, each hogshead will contain as much as a thousand pounds of tobacco. Frequently the tobacco is intended for the manufacture of snuff, in which case the leaves are compressed into handfuls and well corded with a peculiar fibre, so as to harden the balls which, when dry, have only to be rasped to produce the genuine rappee snuff.*

B—In the Phillippine Island the leaves are gathered and dried in the shade, strung on little sticks, so as not to

* Mrs. H. Lynch, "Wonders of the West Indies."

touch each other and to allow of the free circulation of air. At this time exposure to the sun or air is injurious to the tobacco, causing it to become discolored, and making the leaves dry and brittle. When this happens, the leaves are laid out in the dew for a night to render them moist, and in that state they are left to ferment in bandalas or rows. Care is necessary, as excessive fermentation will rot the leaves. About two days will generally suffice, after which time the packs are turned and allowed to remain thus for three days longer, and are then pressed. Before doing this all the bad leaves are removed, and the good ones allowed to remain on the sticks in rows, but well covered, to prevent getting dry.*

C—Preparation in India.—In Chingleput palm leaves and straw of the *Varagoo* or *Panicum Miliaceum* are spread thick on the ground, and on this the tobacco plants are stacked and covered over with straw and palm leaves and pressed down with stones for five or six days. When the weights, straw, &c., are removed, the tobacco plants are taken up and hung in the shade by their stalks for a few days till the stalks become quite dry, when they are taken down, placed in a small close room, and covered as before with palm leaves and straw, and pressed down by weights. Should the plants have become too dry and brittle, a few stalks are cut out and boiled with a sufficient quantity of water, to which a cake of palm sugar or jaggery is added; and this decoction is sprinkled on the tobacco previous to stacking it the second time. The stack is turned once in three or four days; and when this has been done several times, the leaves are stripped off the stalks, and are tied in bundles, each containing from sixty to seventy leaves. These are again stacked in bundles, and weights are placed on them after being covered with straw, &c. The bundles are re-arranged once every three or four days for two or three weeks, when the tobacco is considered cured and fit for use. In Behar, the leaves are plucked and laid on the

* Colonel Joseph-de-Hezeta.

fields night and day, so as to have the benefit of the dew and sun, and they are then gathered and packed in straw or hill grass. Before they are packed, the stalks are cut away and macerated in water for several days, and the infusion thus obtained is sprinkled freely over the leave with the view of improving their aroma. This is repeated as often as is considered desirable, and, after each application, the leaves are repacked. When they have continued thus sufficiently long, the packages are undone and some soil impregnated with alkalis* is sprinkled upon the leaves till they are quite dry. In Orissa, Salem, and a few other Provinces, the tobacco is wrapped up in straw and buried under ground for the first six or eight days. It is then taken up, stripped of the leaves, and weighted, &c.

D—Preparation of the Tobacco of Commerce—Shag is prepared by moistening and compressing tobacco, and then cutting it with a knife-edged chopping instrument.

Returns is another variety of smoking tobacco. Kanaster is a favorable kind prepared from Havanah tobacco. It received its name from Canastra (a Spanish word, signifying a basket) because it was sold in baskets. The term is now also applied to the tobacco from Varinas. Pigtail and negrohead are chewing tobaccoes. Cigars and cheroots, the latter distinguished by their trunkated extremities, while cigars have a pointed extremity, called the "curl" or "twist," are extensively manufactured in London. Woodville's cigars and Manilla cheroots are in request by smokers. "In the manufacture of snuff, the tobacco is fermented by placing it in heaps and sprinkling it with water. It soon becomes hot and evolves ammonia. The extent to which this process is allowed to proceed varies with different kinds of snuff. The immense variety of snuffs found in the shops are reducible to two kinds; viz., dry snuff, including the Scotch, Irish, Welsh, and the rare Spanish; 2nd, moist snuffs or rappees, under which are

* Known as "Dhobies' earth," containing impure carbonate of soda, or potash.

included simple rappee (as the brown and the black, the Cuba, the Carotte, the Bolangero, &c.,) mixed rappees (as Hardman's genuine, No. 37), and the scented rappees (as Princes mixture, Princeza, &c.) The Scotch and Irish are prepared for the most part from the midribs; the Strasburgh, French, and Russian snuffs, from the soft part of the leaves. The rappees are usually kept moist by pearl-ash. Sal-Ammoniac is frequently added to the snuffs. The siftings, sometimes termed thirds, are usually reground." Tobacconists employ in the preparation of tobacco a solution of sea salt spgr. 1.107: this is termed the sauce or liquor. In the preparation of the Macouba snuff of Martinique, Molasses, or a solution of extract of liquorice, is added to the salt sauce by which this snuff acquires a violet color.*

E—Manufacture of Cigars.—Men, women, and children are employed in the manufacture of cigars. The lamina of the leaf is torn off the midrib, and each half of the leaf is passed to a second person, who, with the assistance of a third, crops off the refuse, which is placed in the leaf, a broom stick or thick straw being fixed in the centre. The leaf, with its contents, is rolled into a cigar, when both ends are cut or the free end moistened with gum and fastened, all this is completed very quickly. All Indian cigars have the broomstick, the object being free ingress of air, and that the cigars may draw well when smoked. To prevent the tobacco getting dry and brittle, a decoction of the stalks is frequently sprinkled over the leaves, and they are kept well covered. In some places a little nitre is added to the decoction. In India, imitation Manillas, Trichinopoly cigars, and Lunkas, are the great favorites. In Calcutta, Chinsura cheroots are well spoken of. In Europe, Havannah cigars are the most prized. Cigars have also fancy names given them according to the locality in which they are manufactured or the name of the maker. The tobacco met with in commerce has a brownish color, a strong narcotic and peculiar odour, and a bitter nauseous taste. The dark-colored tobacco is the strongest.

* Dr. Ure's Dictionary of Arts, Manufacture and Mines, Vol. II, 1853.

The following are the principal commercial kinds:—

F—American or North American.—The Virginian is one of the strongest kinds, and is therefore not fit for cigars, but is smoked in pipes, and is used medicinally, or for the manufacture of snuff. Its color is a deep brown, and the leaves feel *unctuous*. The Maryland is paler, yellower, weaker, and fit for smoking purposes. The pale cinnamon is the best, the "scrubs" the most common. The Carolina is less frequently met with.

G—South America.—The Havannah is most esteemed for smoking. Its color is yellowish brown; its odour musky or spicy. It is imported in heads. The Cuban tobacco is an excellent kind. Both these kinds are remarkable for the light yellow spots on the leaves. The Columbian is imported in heads and leaves, and is much esteemed for cigars. The Varinas is brought over in rolls; the Orinoco in leaves; the Porto Rica in rolls; and the St. Domingo in leaves.* The tobacco of Paraguay is scarcely, if at all, inferior to that of Havannah.†

XI. Description of Indian Tobacco.

The tobacco leaves of Southern India are of a yellowish brown color, soft, pliable, and moist, of a strong narcotic and rather unpleasant odour when well prepared; otherwise it has a sickly mawkish smell with a bitter, nauseous, acrid taste. The localities in which the tobacco is grown, and the modes of culture and cure adopted, give rise to variations of greater or less degree from the above description. East Indian tobacco has never attained a high repute, doubtless from its culture not having received attention. The Manilla is much esteemed. It is a dark colored tobacco.

The following are the principal kinds met with in commerce:—

1. Bhilsa is largely produced and exported to most parts of India, and is the kind most in demand. It is

* Pareira's Materia Medica.
† Mansfield's Paraguay, Brazil and Lakate.

used chiefly in smoking and chewing. It is generally of a dark brown color with a strong narcotic odour.

2. The Lunka* of the Northern Circars is in great request for the manufacture of cigars and snuff, and for chewing. The celebrated Masulipatam snuff is manufactured from it. A good deal of tobacco, the produce of various villages, often finds its way to different parts of India, and, when procured from the bazaar, it is difficult to distinguish one kind from another. Cheroots were sent to the Madras Exhibition of 1855 from Trichinopoly; and a large supply of Lunka cigars, manufactured from the nicotina rustica on the islets of the Godavery, where the cultivation is rapidly increasing, were also exhibited. The Lunka cigars exhibited were of a superior quality, and the whole stock sent to the exhibition, amounting to 40,000, was purchased and sent to the Crimea. Manufacture exercises a great influence over the quality of tobacco. Some samples of the cheroots exhibited were very badly prepared and of an inferior quality. Two bottles of snuff from Masulipatam were sent to the Madras Exhibition of 1855; this appeared oily and moist.† To the Madras Exhibition of 1857 tobacco was sent from Chingleput, Coimbatore, Masulipatam, Pegu, Rajahmundry, Moulmein, Madura, Tanjore, Hyderabad, and Vizianagarum. The tobacco from Tanjore was considered the best, that from Rajahmundry the next, and all the rest inferior. To the London Exhibition of 1862 tobacco was contributed from Mysore, Wellesley, Penang, Moulmein, Rangoon, Akyab, Arrakan, Sandoway, Cuttack, Assam, Ahmedabad, Poona, Midnapore, Lucknow, &c. A medal was awarded to Colonel Phayre for sound, well-grown, and fragrant leaf-tobacco, and the Government received honorable mention for leaf-tobacco. The Shiraz and the Salonica (ancient Thessalonica) are valued Asiatic kinds, as also the Latakia, or Laodicean. Turkish tobacco is pale and yellowish.

* From Lunka, an Island.
† Jury Reports.

3. *European Tobacco.*—The only European tobacco extensively consumed in England is the Amersfoort, a Dutch tobacco. Several German, Hungarian, and Ukraine tobaccoes are occasionally meet with. (*Sinsheim Die Rauch u Schnuff tabako Fabrikation*, 1826.)*

XII. Uses of Tobacco.

Tobacco is now in very general use in all parts of the world, either in the form of chewing, smoking, or snuff-taking. Tobacco-smoking among the natives of America seems to have been of very ancient date. The tobacco was either rolled up in leaves and so smoked, or was placed in pipes manufactured for the purpose, and consisting of a small cup or bowl attached to a tube, through which the fumes were drawn to the mouth of the smoker. This mode was adopted for the sake of economy, as thus no part of the tobacco leaves or stem was lost. The various kinds of cigars and cheroots are made to suit the fashion of the day; and, as a rule, a part at least, about one-eighth, is thrown away unconsumed owing to the heat it conveys directly to the mouth on becoming short. Both smoking and chewing are very general in India, not only among the more civilized natives, but also among the wild tribes that inhabit the jungles; these are not able to do without tobacco, and cultivate it for their own use. Pipes are not much in use, cheroots being the usual form in which tobacco is smoked by the natives. The poorer classes roll up a small piece of tobacco in a large leaf and double it in the centre, when the upper opening is filled with powdered tobacco. The leaves are then doubled to a right angle to prevent the tobacco falling out. Such rolls of leaves are often carried about, stuck in the string usually worn round the waist. Smoking is practised by women and children as well as by men.

1. *Chewing.*—If anything, this is more practised than

* Pareira's Materia Medica. The customs duty on tobacco and snuff for 1874 was £7,522,207 showing an increase of £185,055 on the preceding year.

smoking. Most betel consumers make use of tobacco with their betel-compound. The poorer classes who cannot afford betel use tobacco alone. The leaves of the tobacco are used for this purpose, and a piece is taken off as required and retained in the mouth like a quid. In some parts of India I have met with natives who powder the tobacco and place it between the lower lip and teeth.

2. *Snuffing* is a general practice among the natives: both dry and moist snuffs are procurable in the bazaars. Most of these are prepared in the different towns and villages, and many people prepare their own supply. The only snuff that is imported is the celebrated Masulipatam snuff, which realizes about 2 or 3 rupees the quart bottle. I have never yet met with native tailors, no matter of what caste, who did not snuff; they say it clears the eye-sight. Snuff is sometimes prepared on the spot. A native will smear the palm of his left hand with chunam, and then drying by the fire a piece of tobacco till quite brittle, will place it on his palm thus smeared, and bruise it to powder with the right thumb, when it is ready for use. The more wealthy frequently scent their snuff with otto of roses, sandal wood, or some other scent.

Snuff boxes of all kinds, made of various metals, horn, &c., are in use. Natives frequently use the base of the dried stalk of the plantain, or that of the areca nut, for keeping their snuff in. Shells of different fruits are also in use, of which may be mentioned the cocoanut, bael, wood-apple, seed of the *Calophyllum Inophyllum*, or Alexandrian Laurel.

3. *Medical Uses.*—Tobacco is useful in various complaints, such as dropsy, colic, strangulated hernia, tetanus, asthma, &c., &c., but its use always requires great caution. It is generally used as an infusion, one ounce of tobacco to a pint of boiling water; but it is more frequently administered in the form of an enema. The principal effect of tobacco is its power of relaxing the muscular fibres by the depression it causes, and of producing a purgative, emetic, or diuretic effect. Tobacco enters largely into Indian

Veterinary Medicine, and is also used to destroy vermin, either in the case of man or beast. It is in general use in the form of a strong decoction, and is thought to prevent the ravages of insects. Here also care is necessary as to its indiscriminate use as an insecticide to man or animals.

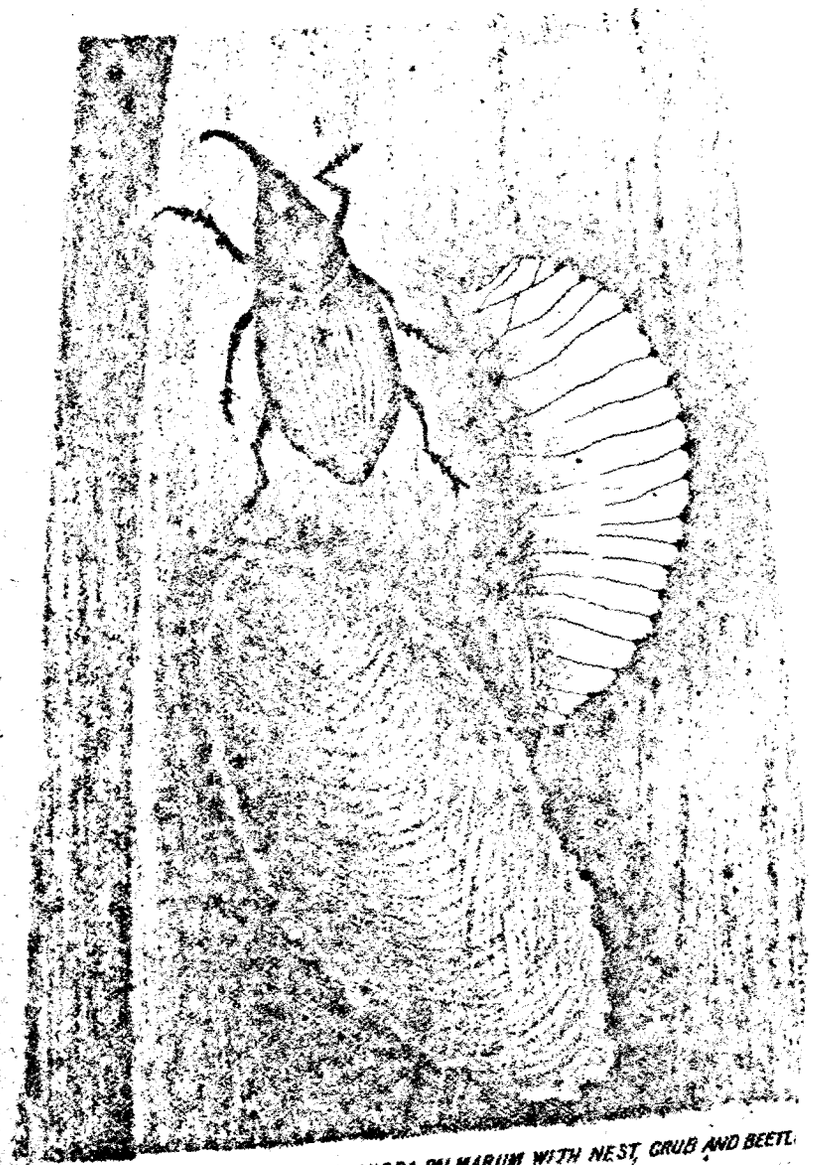
XIII. Physiological effects of Tobacco.

The effects of tobacco are sedative, antispasmodic, purgative, emetic, and diuretic. These effects are dependent on the quantity and mode of administration.

Tobacco, smoked for the first time, produces nausea, sickness of stomach, and vomitting, depressing the action of the heart and arteries. In those habituated to its use, it produces a soothing or calming effect on the system. In some peculiar temperaments it even produces poisonous effects. Although like all similar habits it would be better were it never contracted, the use of tobacco does not generally do any harm, and may, in some instances, be beneficial; but, within my own observation, the immediate use of tobacco has sometimes produced very serious results. Many of the ill effects of tobacco-smoking might be avoided by the use of a silver, ivory, or other mouth-piece and which, before being affixed to either cigar or pipe, should be loosely stuffed with a little cotton-wool. The adoption of the mouth-piece in the first place, saves the lips from the direct irritant effects of the tobacco itself, which is a great advantage. And the cotton-wool arrests the empyreumatic and other oils that the cigars contain without interfering with the process of smoking, or with its soothing effects. This may be proved by the fact that the wool will be found saturated with oil, &c., if examined afterwards.

Snuffing produces at first violent sneezing; subsequently it rouses the nervous system for the time being.

Chewing acts as a sialogogue by increasing the flow of the saliva. Taken internally, it causes nausea, vomitting, and vertigo, with great prostration of the system: these effects are in proportion to the dose administered. In poisonous doses the prostration increases, the pulse becomse



THE COCOANUT WEEVIL OR CALANDRA PALMARUM, WITH NEST, GRUB AND BEETL

small, low, and tremulous; the skin gets cold and covered with clammy perspiration; and confusion with imperfect vision and syncope take place. Tobacco acts on the nervous system, and, by depressing the heart, causes palsy. It should always be considered a potent, unreliable sort of medicine, and requires great caution in administering as a remedy. Immoderate smoking causes nervousness in persons of peculiar temperament. Its sudden withdrawal has no prejudicial effect on the system beyond the feeling of requiring the usual stimulus at the accustomed hour, and it only requires a little moral courage to shake off the habit. I have known many inveterate smokers (Europeans) who have suddenly forsaken the habit without any prejudicial effect; and an experience of seven years of jail-practice, in which I have carefully watched the sudden and complete withdrawal of tobacco, in all its forms, from native convicts, convinces me that the sudden withdrawal of tobacco exercises no ill effect on the individual; for I have never seen any such consequences ensue, nor have the persons thus deprived of their accustomed stimulus attributed any ailments to this cause.

In calculating the profits of tobacco cultivation in India, the callings of three distinct individuals, should be taken into consideration, viz., that of the farmer, the cigar-maker and of the cigar shop-keeper or seller, further the middlemen should also be taken into account. Thus a farmer grows 2 or 3 candies of tobacco. A middleman purchases the produce of 2 or 3 farmers and takes it to the neighbouring shandy; it there exchanges hands and is carried to a town of some importance, where it passes into the hands of some Mundy* merchant. It is then carried to Trichinopoly or Madras and passes thus into the hands of a second Mundy man, who sells it to the cigar-maker. All these middlemen incur charges and realize profits that come out of the price obtained for the cigars. The proper method is to ascertain, not the bazaar price of tobacco, but the

* A large bazaar, or, market place.

price paid to the farmer by the itinerant merchants who go from village to village to collect produce.

There must be mistakes in the quantities of tobacco said to be produced at various places, I have reduced all to a common denomination, viz., lbs. per acre with the following result:—

Berar first crop ...	20 Mnds. per Begah	4,920 lbs.	per acre.
Do. Total of crop	50 do.	12,300	do.
Coimbatore ...	...	500	do.
From another source	...	750	do.
Tinnevelly ...	...	900 to 1,200	do.
Chingleput 350 thooks, per cawney	...	959	do.

XIV. Commerce, Statistics, &c.

Tobacco, notwithstanding all prejudice against it, continues to prosper and drive a thriving trade, and the demand for the article is enormous. Notwithstanding the extent to which the commerce has extended, its price having tripled or quadrupled what it was some twenty years ago, the consumption is still daily increasing; and, if the supply were in proportion to the demand, the latter would no doubt greatly increase. Although the supply of 1863 is said to be two millions of pounds greater than in 1862, the price has not in any way been affected. In 1820 the proportion consumed or allowed to each individual was about 12 ounces; and in five years the quantity had increased to 15 ounces. In ten years smoking became so general that 1¼ pound was necessary to supply the cravings of each person. In the subsequent ten years 1½ pound was greedily purchased; and, had a larger supply been forthcoming, it would have met with ready purchasers. Yet, we should call to mind that, perhaps, fully one-half of the population, including women and children, do not smoke, and a large proportion of males dislike the weed; nevertheless, the consumption of tobacco is so great, that the investment in tobacco cultivation would be equivalent

other staple products, such as cotton, coffee, and indigo, if the necessary attention were paid to it.*

The late American war centered the attention of nearly the whole civilized world on the subject of cotton, to the exclusion, I fear, of other products, such as tobacco, which, if not equally useful, is of great commercial value, and for which, like cotton, we are principally dependent on America, while India is at all times capable of producing both cotton and tobacco.

The English, of all European smokers, smoke the strongest tobacco, and consequently prefer the American to the Asiatic kinds, which latter are principally consumed in Asia itself, or by the European nations bordering on it.

Tobacco suitable for cigar-making is appreciative for the following properties. The degree of inflammability, the volume of smoke produced, the flavour and aroma or fragrancy, the percentage of narcotic, the colour and brightness of appearance, the evenness, thinness and elasticity of the leaves, the absence of thick or irregular veins. Lunkah's burn freely, but they are deficient in aroma and they contain an excess of narcotic. Fresh Trichinopolies and all inferior kinds burn irregularly and have an acrid flavour and nauseous smoke; but they improve by keeping. As they are liable to be worm-eaten, various devices have been resorted to, for their preservation. Some pack their cigars in tea an expensive article to be so used. Others find that sea-sand is a very good substitute for tea. Others again preserve their cigars in jars closed hermetically. If properly preserved even indifferent tobacco becomes mellow and smokes agreeably. There is this peculiarity about Trichinopoly cigars that those accustomed to burn prefer them to any other description. Even the best Havanahs are not prized by habitual smokers of Trichys.

The Indian cigar-maker like all other Indian artisans, works with very few tools. To turn out the most approved cigars, he needs only a small board, a pair of scissors and

* Madras *Daily News*.

a smooth stone, weighing 5 or 6 pounds to serve as a pounde He first tears off the midrib, out of a parcel of leaves, which he sorts at the same time in two heaps. One of these contains the best leaves, reserved for the covers, and those unfit for that purpose are put in the second heap and they are used to fill the interior of cigars. Then a roll is made of the leaves intended for the covering. By this means the wrinkled leaves are stretched and made even. The roll is then beaten with the pounding stone to flatten the veins and further to stretch and stiffen the leaves, which after this process come out of the roll in bands as neat as fresh paper. The cigar-maker then takes up one of these bands and cuts out a crescent about 8 inches long and 2 inches broad at the centre: meanwhile his assistant takes up a few of the leaves, unserviceable for the covering and he gathers them into a rough cigar, which he covers with a coarse wrapper of tobacco. This is the core. The cigar-maker takes up one of these cores and by rolling it between the palm of his hand and the board, he gives it a neat appearance. Much of the drawing qualities of the cigar depends on this stage of the process. If the core be very irregular, a little extra pressure will make it appear even, but the air passages will, at the same time, be choked. If the core be properly made, very little rolling is enough to give the cigar a neat appearance. When this is done, the outer covering called the *robe*, is put on and the end is pasted. In cheroots both ends are then trimmed with the scissors, but in the Havanah-shaped cigars one end being conical does not require further manipulation.

A cigar-maker and an assistant can roll from 500 to 1,000 cigars in a day of eight hours, and they are paid from 12 annas to Rs. 3-8 per thousand, according to the finish and the form of the cigars.

Except for some qualities of Pondicherry cigars, no substance whatever is used in Southern India to improve the quality of tobacco. But for Pondicherry cigars the water contained in tender cocoanuts is said to form a

inable *sauce* which is the technical name of the stuff used in preparing tobacco for cigar-making. English makers are prohibited from using anything, except water to moisten their tobacco. In France, Government has the monopoly of the cigar-manufacturing industry and the cigars made in their factories are from tobacco moistened with a solution of one part of sea salt for ten of water. The deliquescent magnesic chloride which exists in minute quantities in the interstices of sea salt, is said to keep the cigars agreeably moist. The other continental factories, in America and at Cuba various sauces are employed to improve the flavour of tobacco.

The far-famed Havanah is said to owe much of its excellence to the sauce which is used in its preparation and the composition of which is kept secret. In India tobacco is aromatised for the hookah and formed into a stuff called goodak, the best specimens of which are exceedingly fragrant.

Snuff.

Snuff is prepared from pulverized tobacco, prepared to be taken into the nose. It is chiefly prepared in this presidency at (Bundur) Masulipatam in the Kistna District and is exported for sale all over India, in large quantities, to Calcutta chiefly, where it is readily bought up by Jewish, Armenian and Arabian merchants for export to Persia, the Arabian Gulf and carried from thence to the interior of Asia Minor for sale. It is made of the best tobacco, produced in the district, specially in the village of Médûre or Madoor and Agimpurra in the Nuzinid Zemindary, Mowva and in the Chellapulli Zemindary.

Process of making snuff.—The leaves are cut into halves and the stem entirely removed. The first half, after the stem has been removed, is dried in the sun and powdered into a coarse powder and the second half boiled twice, first in salt water and then the juice extracted is used again in the place of salt water with fresh tobacco. When the juice becomes rather thick and gummy, it is poured in a big pot

and left to cool. The tobacco powder is now put into b chatties followed by the juice, into which a proportionate quantity of brandy is poured and mixed with the powder and left in large open-mouthed pots where it is allowed to remain covered up for about a week, when the snuff is taken and filled into English quart bottles and sometimes in pints, when it is ready for exportation.

Goodaks.

This is made in the proportion of two parts of tobacco to one part of palmyrah jaggery. Its process is, that tobacco of the best sort is cut into small pieces except the head of the stem which is thrown away and the cut tobacco is pounded well and a proportionate quantity of jaggery is mixed and pounded together until the whole becomes a soft and gummy mass. Care should be taken not to use any water during the process, otherwise the Goodacco will be spoiled and stink.

XV. Summary of the Subject.

Man, in the earliest age of the world, sought out substances for food, and materials for clothing; but his wants in these respects being supplied, he soon began to surround himself with luxuries which, from the force of habit, and increase of civilization, gradually became necessaries. Intoxicating and stimulating drugs and beverages came to be used; and man became so enslaved by pernicious habits, that it was impossible to eradicate them from his nature. The use of such stimulants led to their abuse, and arguments founded on religion and morality were urged against their use, but without avail. Tobacco, only introduced in the 15th century into Europe and Asia, &c., has become so absolutely necessary to mankind, that there is scarcely a portion of the inhabited globe, perhaps, in which it is not known and appreciated. Thus a plant that otherwise would be considered a worthless weed is now one of the staple products, and adds largely to the revenue of most nations. Thus too, a habit acquired from wild and barbarous Indians by a few travellers has become a necessary to civilized

tions, and the cultivation of tobacco has become of great importance, more especially when we consider that the demand is daily increasing. It will be seen from this essay that much care and attention are given to the cultivation of tobacco by the natives of Southern India, but that the seed is indifferent, and has more or less degenerated from long use in the same districts. I had occasion, in May 1862, to call the attention of the Madras Agri-Horticultural Society to the subject of tobacco, and I suggested that foreign seeds of the best description should be procured and distributed. This has been done since through the Board of Revenue and the Agri-Horticultural Society, Madras. The cultivation is extremely remunerative, and, according to the method detailed as in use at Chingleput, a profit of about 50 rupees is realized on every cawnie of land, but in consequence of the time and labour required being greater than in other cultivations, from the close attention which the tobacco plants require, the ryot can ill afford to bestow sufficient time on its culture without neglecting what he considers his more legitimate occupation of growing cereals: he seldom extends the cultivation of tobacco beyond one-sixth or one-fourth of a cawnie of land. There is also difficulty in disposing of the produce in many districts. But should a fair demand be created, there is every reason to suppose that a superior article will and can be produced equal to the best American. The distribution of superior varieties of seed should also be continued, and prizes for the best samples be given to the ryots in the different districts annually, to give greater encouragement to the growth of tobacco by such means. I fully believe that the cultivation of tobacco could be greatly extended and improved, so much so as to place India in a position to compete with America in the growth and supply of this article.

Tobacco.—Latakia Tobacco is supposed to be the produce of different plant from that yielding Turkish tobacco. It is combined of the flowering twigs made up in bundles which have been smoked by pine wood.

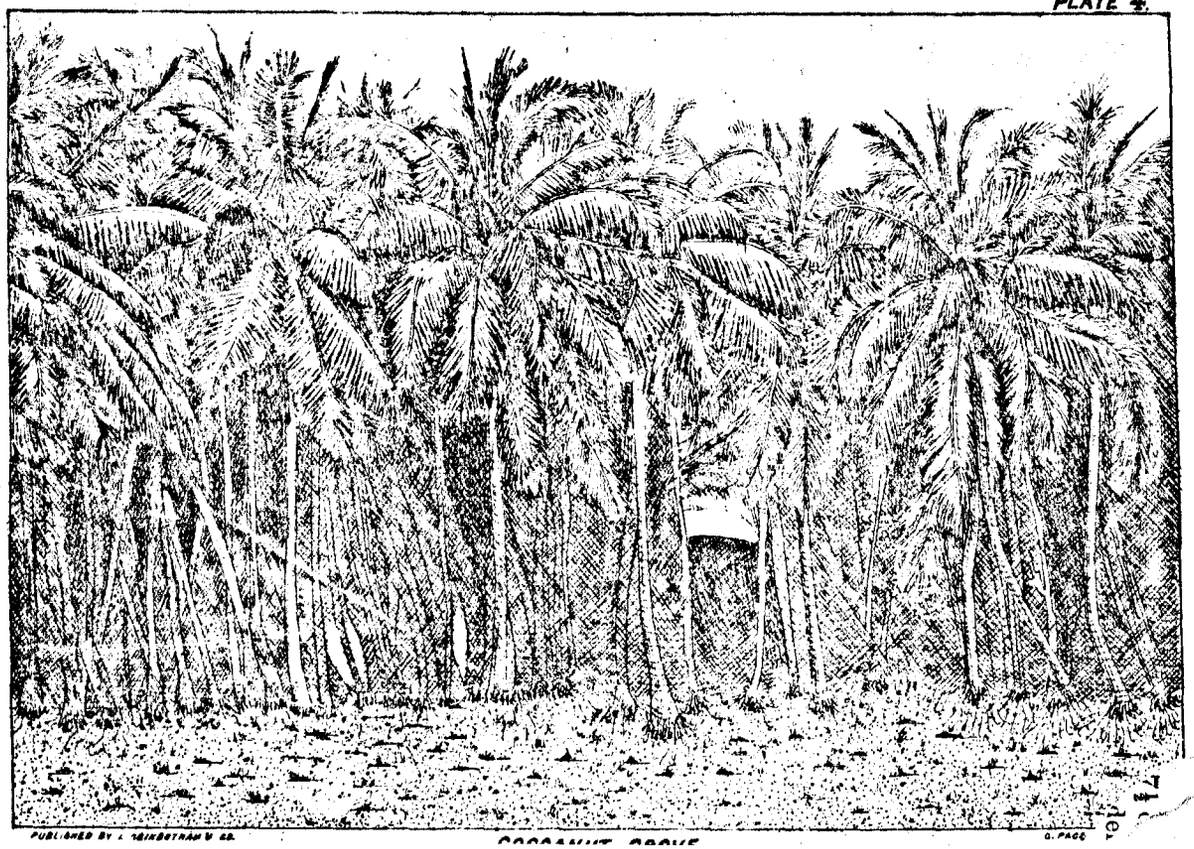
The quantity of tobacco cleared for consumption in the

united kingdom in the year 1876, was equal to 1 lb. 7¼ oz. per head of population. In 1841 the quantity was under 14 oz.; in 1851 it was a quarter of an ounce over 1 lb.; in 1861 it was 1 lb. 3½ oz.; and in 1871 it was 1 lb. 5½ oz.

A STATISTICIAN has taken the trouble to calculate that if all the tobacco smoked, chewed, or snuffed in one year was made into a cord two inches thick, it would, following the line of the Equator, encircle the globe thirty times.

The *Lancet* publishes a report by their Analytical Sanitary Commission on the results of their analysis of Egyptian cigarettes of five well-known brands. The following are the conclusions arrived at:—The Egyptian cigarettes, which we have examined, are made from genuine tobacco. No foreign substance, and particularly no opium or "enclassified alkaloid," whatever that may mean, is added. The paper and the cement are pure, the only possible objection being the trace of copper we found in the ash, which is probably due to the metallic lettering. Some proportion of Smyrna tobacco is commonly incorporated with the Turkish, which is always used. If this Smyrna or Salouk tobacco is present in excessive quantities, the throats of some persons, if not of all, will be affected injuriously. It is probably safer to avoid it. Doubtless there are smokers who enjoy the Salouk flavour, as there are coffee-drinkers who like an admixture of chicory. The smoker must select his cigarette for himself, and we trust that in this case, as in so many others, the forewarned will be forearmed. Let it be remembered that tobacco, to say nothing of opium, is not grown in Egypt. The Egyptian manufactures select and blend their leaves, and to judge from the popularity of the cigarettes, they do so with great skill. In future they will probably be more careful in the use of Salouk, as every motive urges them to retain and extend their trade. Physicians will do good service by watching the effects upon their patients of cigarette smoking. If they find that the change from Egyptian to Turkish or English cigarettes removes unpleasant throat symptoms there will soon be a definite condemnation of Salouk tobacco.

PLATE 4.



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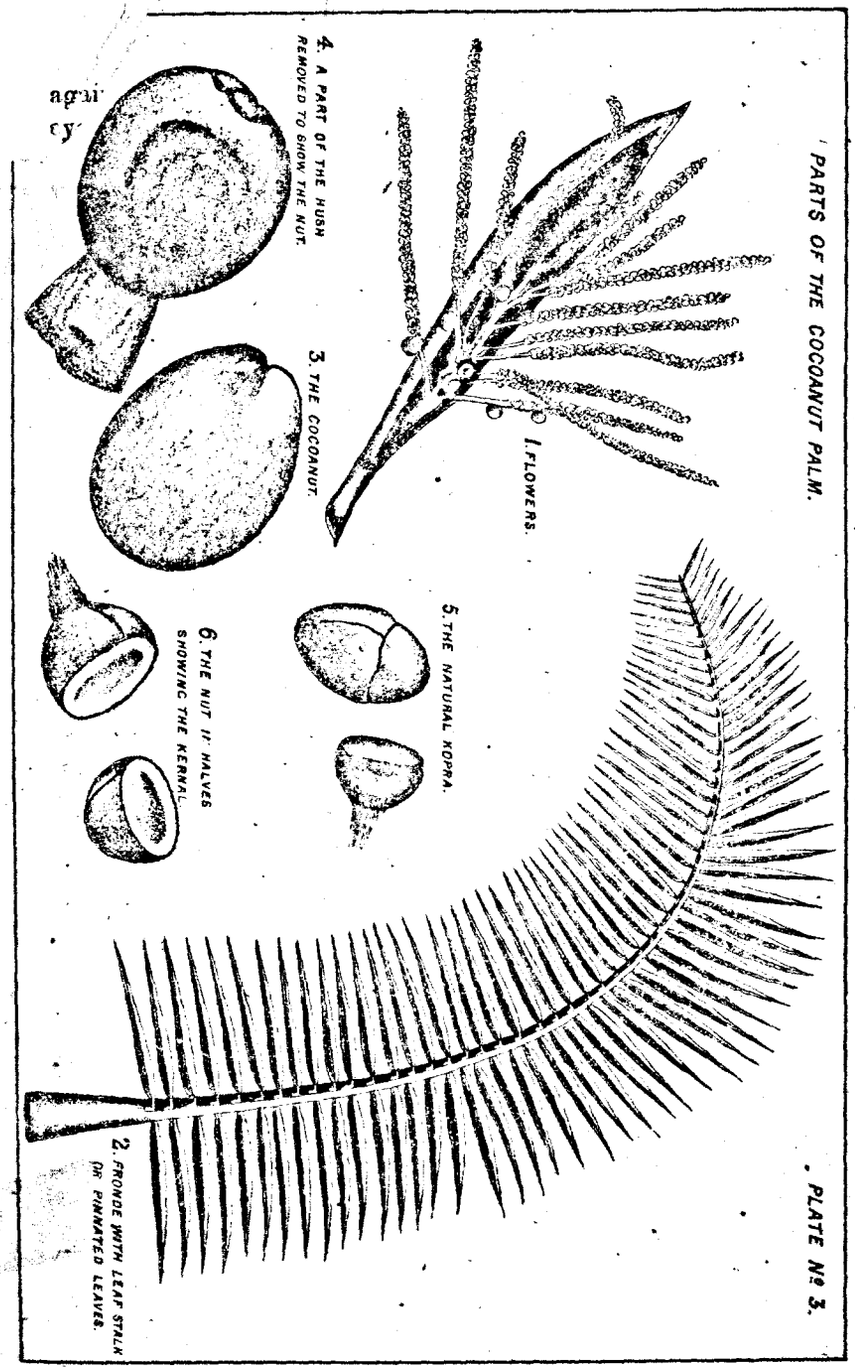
THE COCOANUT PALM.*

THE cocoanut,† called in Hindustani "naril" and in Tamil "tenga," scientifically known as the *Cocos nucifera*, belongs to the natural order *Palmaceæ*, a genus of palms, containing some 14 species, all of which, with one exception, are of tropical growth, and being littoral, are principally distributed within the inter-tropical regions of the Old and New Worlds. The cocoanut is the most important species of the genus. Indigenous in the East, it is now largely cultivated on the Malabar and Coromandel Coasts, in Ceylon, in the Laccadives, and in all the islands of the Eastern Archipelago, which are generally associated in large groups. It often grows wild in distant and isolated islands. The thick fibrous padding around the nut protects the germ as it floats on the sea. Owing to its triangular form, it remains upright when it reaches land, and so eventually establishes itself. Subsequent droppings of the ripe nut become self-grown topes or groves. Thus, as soon as the coral reefs of a new island appear above the waves, these trees take possession of them. The cocoanut palm flourishes luxuriantly throughout the South Sea Islands. Along the whole line of the Brazilian Coast, with but few interruptions from the river San Francisco to the bar of Mamanguape, a distance of nearly 280 miles, these palm trees are said to extend; whilst it is estimated that there are 20,000,000 of these trees in the south-west of Island of Ceylon. The cocoanut tree has a slender, erect, unbranched perennial stem, cylindrical, and roughened by the scars left by the fronds: the stem seldom exceeds 2 feet in diameter and

* This Monograph on the Cocoanut Palm was originally written at the special request of W. Wilson, Esq., M.A., Director of Revenue Settlement and Agriculture, and published by Government for distribution.

† Or coco, a contraction of Macaco, the name for a monkey in Portuguese, which it seems to have derived from the supposed likeness of the end of the nut with the black scars on it, to the face of a monkey.

60 to 80 feet in height: from 15 to 25 fronds form its crest. The sea-shore is its chosen home: it grows right down to the margin of the sea, and is constantly washed by the waves in many places. Yet it also thrives with vigor up to 3,000 feet above sea-level, hundreds of miles from the coast. At still higher elevations the nuts germinate freely, but the growth of the tree is stunted. On the Shevaroy Hills, for instance, a tree, ten years old, is about 3 feet in height; these hills being 4,500 feet above sea-level where this plant grows. At Bangalore, 3,000 feet above the sea, the trees grow freely, attain their usual height, and fruit freely. In the construction of the stem, there is no distinction between pith, wood, and bark, and there are no medullary nor concentric circles. The stem consists of definite vascular bundles diffused through the cellular tissue, without apparent order, enclosed by an external covering which differs from the bark of exogens in not having annual layers separate from the wood. The leaves are terminal, large, and pinnated, measuring from 12 to 20 feet in length; formed by a stout leaf-stalk, having numerous narrow sword-shaped leaflets pendant and drooping on either side. The flowers are monocious and are arranged upon a branching spadix, which, when young, is enclosed in a cylindrical spathe. The male flowers have an inferior perianth of six segments, arranged in two whorls, and six stamens, which are united at their base. The female flowers have also an inferior perianth of six segments, and there are not unfrequently present the rudiments of six abortive stamens. The ovary is ovoid in shape and 3-celled, but two of these cells usually become abortive. The style is short and is terminated by those stigmas, which in the bud are erect but in the matured flower recurved. There is one ovule in each cell and this is attached to the base of the cell. The fruit is triangular in form, which still indicates its tri-carpellary nature. The outer part *epicarp* consists of a thin smooth skin. Underneath this lies the *mesocarp*—a thick fibrous tissue, which, when macerated and cleaned, constitutes "*Coir*." Beneath this



again lies the *endocarp*, that hard horny shell with three eye-like markings upon it at one end. On the interior surface of this shell is developed a soft fleshy substance—the albumen—in the interior of which is to be found that thin sweet watery fluid commonly known as the cocoanut milk, and a minute embryo occupies a little cell in the albumen at the apex of the nut with its cotyledon becoming enlarged during germination and filling the central cavity. Whilst the nut is green and tender, its cavity is filled with a sweetish, pleasant, and refreshing fluid, which, as the albumen, consolidates, decreases in quantity; and in the ripe nut scarcely exceeds two or four ounces, often tasting somewhat brackish, whilst the kernel is white, firm, fleshy, rich and sweet tasted, and is known as the cocoanut from the Portuguese term *coke*. The cocoanut is a most valuable plant to man as regards its dietetical and economical application: being put to a greater number of uses than any other palm, both as regards food, luxury, clothing, habitations, utensils, implements, &c., and when grown in suitable localities, for products of articles of diet and in commerce and manufacture. It supplies man with sugar, starch, oil, wax, wine, resin, astringent matters and edible fruits.* The cocoanut requires an alluvial and loamy soil for its successful growth, but any soil with a free mixture of sand and clay answers fairly well. Pure clay soils and swampy lands should be avoided. The cocoanut thrives well in red soil, but does not fruit well. The cost of a cocoanut plantation depends greatly on its locality; as in some places a pit measuring a cubic yard is excavated for one anna; at others it will cost double that sum. The pits when excavated should be left open for a few days to get the benefit of fresh air and sunlight; half of the soil with which they are refilled should consist of the excavated earth, and the other half of river or sea sand. The object

* . . . . . the Indians nut alone
Is clothing, meat and trencher, drink and can,
Boat, cable, sail and needle, all in one.
G. Herbert.

of using sea sand is to keep off white ants which are readily attracted to the spot by the husks of the nuts, and destroy the seedling plants. With this same object in view, common salt is often thrown into the pit in some localities. The usual number of plants that an acre ought to carry should be 80. The adoption of this number would allow the plants a distance of 60 feet from each other either way. In such case the trees grow sturdy, perfectly straight, and (from having free enjoyment of sun and air) fruit freely, and produce more than the average number of nuts. The native cultivators usually crowd the plants together: instead of 80, an acre will ordinarily be found to carry from 120 to 200 plants. The result is that the plants grow up weak, and often awry in their attempts to reach sunlight and air, and seldom produce fruit. In a well-ordered plantation, the trees should be at least from 30 to 40 feet apart. The distance should in a measure be regulated by the locality, the aspect, and the nature of the soil. Where cocoanut palms are grown as avenue trees they may be planted at an average distance of 15 or 20 feet from each other.

Seeds.—The nuts for planting should be selected from trees over 15 and under 30 years of age. They should be fully ripe. Fruits gathered from February to May are generally considered the best; seeds from very young and very old trees should be avoided. The nuts should be the largest procurable, well formed, and with their outer husk dry when they are taken from the tree. They should not be *thrown* down, as they generally are; but should be let down in a basket by means of a rope, to avoid concussion. The seed-nuts gathered should be kept a month or six weeks before being planted, in order that any moisture about the husk may become dissipated; otherwise they are likely to rot when planted.

Seed Beds.—It is always a good plan to form a mound of sand about three feet in height, and of width proportionate to the number of nuts to be planted. The nuts should be

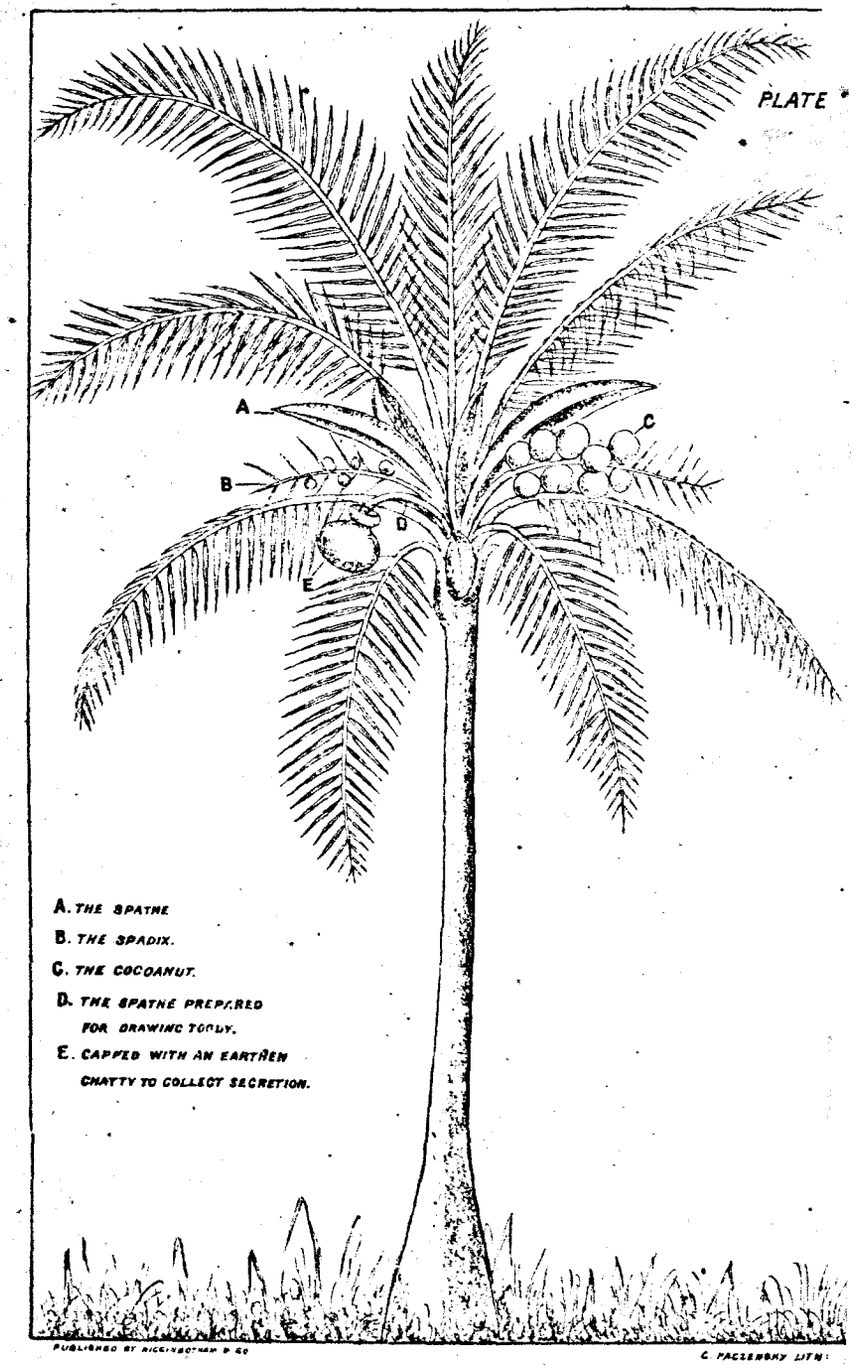
placed a foot apart; about two inches of the top should be left exposed. The only manure that seeds require is a compost of wood ashes and salt, not so much to nourish the seedlings as to keep white-ants and other insects away. A handful of this compost may be placed below each nut as it is planted. The sowing should be watered every three or four days, according to the season, care being taken not to damp the bed too much. In about six months the nuts will germinate. They will require attention: they must be protected from insects, from cattle, &c.

Varieties.—The natives give distinctive names to many varieties of the cocoanut, differing in size, shape, colour of the husk, &c. In Travancore, thirty different kinds are named. The largest variety of cocoanut that I have seen and examined comes from Ceylon. I have occasionally seen specimens nearly as large from the Coromandel Coast. There is a small dwarf variety which fruits while it is about two feet high; the plant continues to grow, and with age attains to a height of from 10 to 15 feet.

Transplanting.—The plants will be ready for planting out about the same month in the next year, but they should not be put out till after the first burst of the monsoon. Plants aged from three months to five years may be transplanted; but, as a rule, they should be put out before they are a year old; and it is only in exceptional instances that older plants are used for that purpose. In the Northern Districts (Godavari) young cocoanut plants are not put out till they are from three to four years old, when they cost from 40 to 70 rupees per 100; whilst seed-nuts are to be had at from 2 to 2½ rupees per 100. After being put out, they will for some time require some shelter to protect them from the heat of the midday sun; sheds of twigs, matting, &c., may be used. The plants should be freely watered (daily if necessary) till they have established themselves. The cocoanut is always a moisture-loving plant, and requires frequent irrigation, especially during its youth, say for the first five years. In many localities they do well without artificial

watering, and continue to grow and thrive; but in others they will require frequent watering, otherwise they will not thrive nor fruit, but gradually perish. It is a good plan in putting plants out to place them about two feet lower than the surface soil in the pit, and then cover in the plant to the surface level (either at once or as opportunity offers) with dead leaves and other vegetable matter, which will preserve moisture in the soil around the plant, and eventually as it decays form a layer of humus around it. The natives give the cocoanut seedling much care and attention, calling it *thenum pillay* (Tamil) "*the cocoanut child.*" If well attended to, and if the soil be good, the plants will begin to fruit at five years of age; but in poor soil and insufficiently watered, they may not fruit before they have attained seven to ten years of age. As a rule the cocoanut throws out a spathe and frond about once a month; each spadix yields 10 to 25 nuts. If we fix the average at 12 nuts per spadix, there will be 144 nuts produced during the year. A safe average estimate would be 100 nuts per tree per annum, taking the bearing and non-bearing trees together. Cocoanuts ordinarily fetch from 4 to 6 pies each. A perfectly safe estimate would be 1 rupee per hundred, for toddy-drawing trees are leased at from 2 to 2½ annas per tree per mensem, *i.e.*, Rs. 1-8-0 to 1-14-0 per tree per annum. Hence we may fix the lowest average value at 1 rupee per tree, whether the tree be allowed to fruit or be tapped for toddy. Thus, a plantation of 1,000 trees will bring in Rs. 1,000 a year. In addition to this there is always a small profit to be derived annually from the fibre of the nuts; and from the green and dry frond of from 4 to 8 annas per tree.

Cocoanuts are largely used as offerings to Hindu idols. "Cocoanut day" at the full moon in August is celebrated in most parts of India. A large number of nuts are thrown into the sea as an offering. The up-keep of a plantation is not costly: most plantations are left to nature; sometimes cereals, pulse, arrowroot, turmeric, &c., are cultivated in



the soil between the plants; this practice, however, is prejudicial to the trees: generally it is followed only while the plants are under five years of age.

A well-kept plantation should be manured once a year: the best fertilizers are good farm-yard manure, salt and ashes, paddy-husks, droppings of cattle and goats, and fish refuse. The soil should be freely ploughed up and kept loose and broken, and in dry localities irrigated once or twice a week. Cattle should be kept out of young plantations, as they devour the leaves and are likely to destroy the plants. When cocoanut trees continue unfruitful, the stem is well beaten with a rice pounder, one end of which is shod with an iron ferule: the blows dinge and make circular marks on the part beaten. This is done with the object of concentrating the sap, and it often proves successful. "Wintering," as it is termed, is also resorted to sometimes, by digging around the trees and exposing the roots for a few days to sun and air, the process being completed by free manuring and irrigation.

Toddy-drawing.—As soon as the flower spathe has attained its full size, and before it opens, it is bound round tightly with strips of fibre taken from the back of the stalks of the frond, and is then beaten twice a day, with a short stout stick, by the toddy-drawer for three or four days with the view of bruising the spathe and diverting the sap to it. Next he slices off the top, and continues this practice daily, or for a day or two longer, taking away a thin slice of the spathe daily, and as soon as the wound begins to bleed, an earthen vessel or a large stout hollow joint of bamboo, or the shell of a gourd is tied on to the spathe to receive the sap as it flows; the spathe having been previously bent over slightly and tied to an adjoining frond, so that it may be maintained in position. The vessel is emptied of its contents every morning and evening, and a fresh wound is on each occasion made in the spathe to keep it bleeding.

The quantity of sap varies according to the locality and the age of the spathe; 3 to 4 quarts is the average quantity obtained in the 24 hours for a fortnight or three weeks.

Sometimes this fluid is converted into what is termed "*nira*," by lime washing the vessels that collect the fluid in order to neutralize the acidity. It is then sold as a sweet and refreshing drink in the bazaars. Toddy is the sap of the cocoanut palm which, when fresh and recently drawn, has a pleasant sweetish taste, and in large doses acts as an aperient; in a few hours it begins to ferment, when it has a sharp acid taste, and is slightly intoxicating; if kept longer, it passes into the various stages of fermentation of spirits and vinegar. It is also boiled down into a coarse kind of sugar called jaggery, which is converted into molasses for the manufacture of spirits, or refined into white or brown sugar before fermentation sets in. When it has fermented it may be distilled into spirits or made into vinegar. 100 gallons of toddy produce 25 of arrack by distillation, and 8 gallons of sweet toddy yield 2 gallons of jaggery. It is in general use as yeast, as it begins to ferment in a few hours after it is drawn, and bakers in general, in this country, substitute it for yeast in bread-making.

Boiling for Sugar.—The sap is poured into large pots over an oven, beneath which a strong wood fire is kept burning, the dead fronds and other refuse of the plants being used as fuel. The sap soon assumes a dark brown semi-viscid mass, well known as jaggery or *ghoor*, which whilst warm is poured into earthen pots or pans for preservation. 10 to 12 seers of the sap yield one of jaggery; the value of a maund of this jaggery is about 2 rupees. In this state it is sold to abkarry contractors, sugar refiners, or merchants. The sugar refined comprises several sorts, known in the market as moist, raw, coarse, and fine sugar. The jaggery is placed in baskets and allowed to drain; the watery portion or molasses dropping into a pan placed below. This is repeated, so that the jaggery or sugar becomes comparatively white and free of molasses. This sugar, for so it may be called now, is put out to dry, and the lumps broken up: when dry it is termed raw sugar, and weighs about 25 per cent. of the whole mass, the rest of it being collected in the form of molasses.

The toddy-drawer or Shanar is of a particular caste that follow the profession of toddy-drawing as a hereditary occupation. Boys take to it at an early age. They use stout thongs made of bullock or buffalo hide, from 3 to 6 or more inches in girth and of a sufficient length to surround the tree and the body of the climber. This thong the climber fastens with a puzzle knot, and by leaning backwards and throwing his whole weight on the thong, he stretches it to its utmost, and is thus enabled to draw up his legs, whilst he has a ring of rope formed of coir or palmyra fibres around the insteps of his feet, which enables him to open his feet in front, whilst the heels are drawn together and placed against the trunk. With his left hand he presses against the trunk, and with the right he shifts the thong up the tree and draws up his body after him. Thus, by a succession of skips (as it were) he climbs the trees and proceeds to his work. Much practice and confidence in climbing is necessary to prevent accidents. Frightful accidents often occur resulting in death or disablement for life. After the toddy has been drawn, the stump of the spadix should be loosened out, as sometimes one or more nuts form from flowers left uninjured. The young cocoanut itself, if taken down when between the second and third month of its growth, contains the jelly or albumen which is tender, and in parts more or less approaching a fluid; and the nut itself is filled with a sweet refreshing water. With age this fluid, which secretes the albumen, decreases as the albumen itself, *i.e.* the kernel forms and thickens. The water of the tender cocoanut is often used by masons to soften and give adhesiveness to plaster, and is also mixed with whitewash. In good specimens the flesh or kernel of the cocoanut is about half an inch thick. The *elaneer* "tender water," is in general use as a refreshment during the hot weather, and the young nuts are sold in the bazaars at from 4 to 6 pies each. The outer skin, being too tender to produce fibre, is used for fuel when dry, or cut into a substitute for scrubbing-brushes. The shell of the ripe nut can be hollowed out by filling it with salt water, and burying it in sand for a

time, when the kernel rots and is washed out, and the shell itself can be used then as a bottle, a vessel for oil, &c., and for other purposes. The shells are beautifully carved into cups, vases, goblets, water-holders, lamps, ladles skimmers, &c., and the burnt shell or shell charcoal is used as lamp-black, tooth powder, &c. The green, as well as ripe nuts, with their husk, are used as torches for illuminations. The ripe nuts are collected several times during the year, and generally harvested before the outer skin dries: if dried on the tree, the fibre becomes coarse and dark in colour: if too young, it is weak. Therefore it is taken down still green yet nearly mature. The outer husk is ordinarily peeled off by blows struck upon an iron spike; sometimes a short upright crow-bar answers the purpose. Freed of its husk the nut is ready for the market. If ripe, it will keep for many months: if unripe, it may rot in a few weeks.* The kernel is eaten raw. If milk be wanted, the kernel is cut in halves, taken in the hand and grated against a small circular saw, which is fastened to a board, one end of which is held by the foot, whilst the operator squats on the ground, and grates the nut against the saw. The kernel is by this process shredded into fine floury flakes, which are received in a plate placed below. About half a pint of boiling water is poured on them. They are then taken up by handfuls and compressed. This extracts the milk which flows into a cup. This milk resembles cow's milk, except that it is much sweeter and denser, and has its peculiar flavour. A further supply of hot water is poured on what remains, and a second brew of milk is obtained; but the first is always the best. This milk is used for curries, &c., and to flavour coffee, and sometimes as a substitute for cow's milk. The milk expressed from the brayed kernel of the cocoanut is believed to be an antidote to poisons in general, and it is largely made use of by natives to counteract what they believe to be the ill-effects of "Love

* In 1859 I took to England about 1,000 cocoanuts, young and old. They kept well during the voyage of four months.

t[illegible]Aff[illegible]ions," and to neutralize the effects of any medicine know[illegible]aken into the system.

Superstition.—Deformed cocoanuts are sometimes met with: dwarfed in size, and sometimes containing no nut, but consisting merely of the husk with a slit in the centre, sometimes containing small deformed nuts without any kernel; this is attributed to the smelling of the flower by the tree frog or *Polypedates maculatus*. The kernel or flesh of the cocoanut is often cut into the shape of flowers and fruits, and worn in the hair, or formed into garlands for the neck by Hindu women. The nut fetches from 10 to 12 rupees per thousand, and recently in Ceylon, it was sold at 4 rupees per hundred. "Kopra," *i.e.* the dried kernel is of two sorts, "natural" and "artificial." The natural kopra is that formed whilst the nut is still on the tree; the fluid in the kernel is dried up, and the kernel becomes loose, and when the nut is opened, the kernel comes out whole. In the artificial kopra the nuts are broken in two, and then sun-dried or placed on bamboo trays over a charcoal fire; as the kernels shrink, they come away easily from their shells, and when thoroughly dry are ready for the market. They are used in the manufacture of oil.* Kopra is also ground into a paste and used in making curries, like fresh cocoanut.

Oil.—Cocoanut oil is prepared from "kopra" either by expression or boiling. Expression is the favourite method. The kopra is broken into pieces and thrown into a common country wooden mill, where it is subjected to expression and the oil thus extracted. The native oil-mill or *checkoo* consists of a large wooden mortar and pestle. The pestle is placed obliquely in the mortar, and is worked by a shaft, to the end of which a pair of bullocks are yoked, and they traverse a circle of about 18 feet in diameter, making three to four revolutions in a minute. The kopra fills the mortar,

* The Fiji Islanders are advertising for a machine to cut the cocoanut kernels out of the shell, to assist in the manufacture of kopra and supersede hand labour. Such a machine must be adapted to cut nuts of different sizes and shapes. It would need to be simple in construction and strong, and not too heavy, and workable by hand or foot power.

and is compressed against the sides, so that the oil ell squeezed out. The oil is mopped up with a piece of cloth and put into a pot. About 50 pounds of kopra forms a charge for the mortar, and three to four charges are worked in a day. Boiled oil is obtained by bruising the kopra or the fresh cocoanut, mixing it with an equal quantity of water, and then boiling the mixture. As the water evaporates, the oil rises to the surface. It is poured off, and the débris of the kernel is compressed by handfuls, so that any oil that remains may be extracted. Two quarts of oil are produced on an average, from 15 to 20 nuts. Cocoanut oil has a specific gravity of 892° and solidifies at 65° to 70°. It is a fixed fatty oil, exported largely. It contains solid and fluid constituents, comprising oleine and stearine, the former being separated from the solid stearine by pressure. The solid fat has been sometimes termed collin, and is much used for making candles, but owing to the chemical changes that take place during the process, it is now termed stearine. The oil is also used largely in cooking; also for lamps, and for anointing the body. The oleine from the crude oil after being purified is recommended as a substitute for cod-liver oil. Cocoanut oil is put into bottles half filled with water, well shaken, and placed out in the sun for several days, the water being changed on each occasion; the solid stearine is freed from the oleine, and the clear oil is poured off and coloured with alkanet, put into small bottles and sold as hair oil.

Oil-Cake.—Cocoanut oil-cake or "poonac" is largely used for feeding cattle and for fattening pigs and poultry, and is considered highly nutritious and valuable for such purposes. From 3 to 4 maunds of 25 pounds each are sold for a rupee. It is also highly prized as a manure by gardners, planters, and farmers.

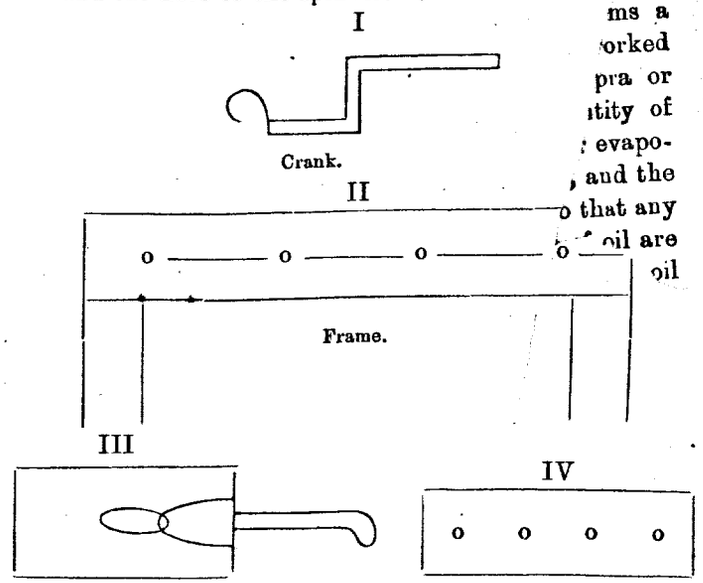
Coir or Cocoanut Fibre is an important article of commerce. The cocoanuts are taken down before they are ripe to prevent the fibre becoming coarse. On the other hand, if cut too young, the fibre is weak. The coir is peeled off

After known grow and thing l[illegible] s by striking them against a stout iron pin—somenut like a crow-bar—stuck in the ground. The husk readily from the nut. The husks, removed from peels off, are collected and thrown into pits containing the nuts, soak, and kept there till decomposition sets in. In water, to s[illegible]s the coir is sometimes buried in sand on the some plac[illegible] rot. The best and cleanest coir comes from sea-shore t[illegible]ve Islands, Amindivi, Kadamat, Kiltan, and the Lac[illegible] where the cordage is mostly manufactured by Chethen. The coir, when taken out of the pit, is beaten with stout sticks to break up the adhesion and free the fibre from impurities. Next it is hand-rubbed to remove the intercellular tissue that intervenes between the fibres. It is subsequently rolled into loose pads of about a finger's thickness preparatory to being twisted into yarn by the palms of the hands. Two strands of yarn are made at once. The constant handling of the fibres (owing to the presence of tannic acid and the action of the water) irritates the skin of the hands—in some cases very severely. As cocoanut plantations form the chief property of these islanders and supply their only reliable income, great attention is given to the preparation and cleanliness of the fibre.

Their system is rude and simple. During a visit to the Laccadive Islands in 1873, I was struck with the amount of labour they had to undergo. I met with a simple ropemaking machine which struck me as likely to suit. Through the kindness of the late Mr. Carment, of Coimbatore, I had one constructed and presented it to these islanders, through the then Collector of the district, Mr. H. S. Thomas. I have never heard whether it succeeded.

This machine is composed of wrought-iron cranks set loosely in a rough wooden frame. These cranks are made to revolve simultaneously by means of a light board pierced with four holes to receive the ends of the cranks. The whole is easily turned by one woman; two women are

required for spinning each strand, one to spin a ell
to hand the fibre to the spinner. loth



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NOTE.—*The Treatment of Cocoanut Husks.*

Mr. J. R. Jackson, the able Curator of the Kew Museum, has recently published an interesting account of a visit paid by him to the works of Messrs. Chubb, Round & Co., of Millwall, who are the largest importers and manufacturers of cocoanut fibre in this country. He says:—"The enormous heap of husks—which, indeed, is known in the locality as the "mountain"—comes upon view immediately upon entering the premises, and one can scarcely, at first sight, realise the fact that the enormous pile is composed entirely of these apparently useless portions of the fruit. At the time of my visit this reserve stock of husks was estimated at considerably over a million and a half. Before proceeding to describe the various processes through which the husks pass to convert them into marketable material, it will be well to say something about the nuts themselves.

Cocoanuts, or as they are generally termed in the trade Coker-nuts, to distinguish them from the Theobroma Cocao, which furnishes cocoa and chocolate, are shipped principally from Trinidad, Jamaica, Demerara, Tobago, several of other Leeward Islands in the British West Indies, Ceylon, Belize (British Honduras), all round the Coast of America and the Fiji Islands; the quantity landed in the United Kingdom being about 12,000,000 yearly. Nearly all the nuts are imported in the husks or outer covering, from which, on arrival, they are stripped by men using two fine pointed steel chisels, and who, by constant practice, become so skilful in the art that many are able to open 1,000 to 1,200 nuts per day. The nuts themselves after being removed from the husks are generally sold to wholesale fruit-dealers, who, in turn, supply the retailers, coster-mongers and others, but they are likewise often sold under the hammer at public auction.

tr
After emoval from the husk they are sorted into seven sorts or varieties, known spectively as large, milky, middle-size, small starters, milky grow nut reen, and dry. Those from Trinidad are the sweetest in flavour, an ostly preferred by the manufacturing confectioners, biscuit- thing l others, though the Ceylon nuts run them very close in quality. re largely used in the north and west of England, and they are peels off demand at holiday times at fairs, on race-courses, and such the nuts, gs in all parts of the kingdom. The husks, after the nuts acked, are stacked in the yard in the open air, until they are water, to s onversion into fibre; for this purpose they are first passed h a powerful "crusher," or "back-breaker," driven by steam some plac arge revolving corrugated wheels which flatten the husks, n extent make them more pliable; but after this severe sea-shore t ringy is the nature of the husks that, somewhat like a sponge, the Laccadi ly assume their original shape on emerging from the crusher. hrown into huge stone tanks, each holding many thousands, Chetlat undergo several hours' steaming and soaking. Great care and wor re required to know how long to keep them in the tanks, husks from different countries requiring more or less time according to circumstances, such as age, thickness of outer cuticle, substance of fibre, and other peculiarities known to the manufacturer. In the tanks the husks swell considerably, and have to be kept down by heavy pressure.

After the husks are sufficiently soaked, they are ready for the mills, which are technically known as "Teasers" or "Devils," and consist of cylinders or drums, each being studded on the outer circumference with about 3,000 fine or thick 3-inch steel teeth specially tempered. The mills vary slightly according to certain requirements. They are driven by steam, and revolve with great rapidity, requiring the utmost care and constant attention of the workmen. Each husk is divided longitudinally into thin pieces, and each piece is passed into the mill separately by the workman between two steel rollers, the workman retaining a firm grip of it so as not to allow it to pass out of his hands, but the few moments he holds it there, the drum with its numerous steel teeth is revolving and combing out the irregular fibre and refuse. After one half of the slice of husk is thus cleaned the workman reverses it, passing in the other half. The continued feeding of these mills gives such strength of wrist and dexterity to the workman that what appears a very dangerous operation is gone through with wonderful rapidity, and each slice of husk is passed through three of these mills in succession, occupying but a few seconds from the time that the crude husk is passed into the mill until it comes out a perfectly cleared bundle of light brown separated fibres; these bundles are next laid out in drying rooms on heated iron tables to perfectly dry them, when they are ready for making brushes and brooms of various kinds.

But to return to the mills. It will be seen that the principal attention has been given to the long clean fibres used for brush-making, but there are other products to which I have not yet alluded. If a cocoanut husk is cut through transversely, it will be found that immediately under the outer woody coating the long brush fibres, if we may so call them, are deposited to the thickness of about half an inch; nearer the centre, and immediately surrounding the nut, the fibres are more irregular, somewhat matted, and mixed with soft brown refuse. In the process of passing through the mill and separating the brush fibre, this finer fibre and refuse is thrown out at the back, from whence it is collected and placed on elevators, and carried automatically into the mouths of double rotary screens, or "willow," peculiarly made for the purpose, a spindle fitted with arms or rods running the entire length, and after many revolutions and much tossing about

the fibre is separated and falls out at the lower ends clean and ready to be dried. This fibre is used for matting, and is not only supplied by the firm in large quantities for mat-makers, but also to the Government for mat-making in prisons; it is further largely used for stuffing mattresses, saddles, &c. The refuse, by a special process of the present proprietor, is separated into two different qualities, the ordinary coarse kind being used for general horticultural purposes, and the granulated for conservatory use and potting.

Enormous quantities of this cocoanut fibre refuse are produced by the firm; and I was informed that it was no uncommon thing for them to despatch 20 tons in one consignment, and that the material is sent to all parts of the world, including America, Africa, Australia, Sweden, Germany, France, Holland, &c,—the latter countries using it extensively for bulb growing. It is not a little remarkable that this refuse cocoanut fibre should, in some cases, find its way back in a changed form to the countries from whence the nuts were originally brought.—*Planters' Gazette.*

Utilising Cocoanut Refuse.

In the concluding paragraph of his report on the Government Gardens and Parks on the Nilgiris Mr. M. A. Lawson, Government Botanist and Director, says:—Mr. J. W. B. Money of Deva Shola drew my attention last summer to an article entitled "Batiment de combat et la guerre sur mer" in the Revue des Deux Mondes, dated the 1st August 1886, by a M.L.P. de la Barriere in which he described, at length, how the refuse of the cocoanut, after the process of retting, might be used for backing the iron plates of ships of war. His mode of proceeding was simple enough, and is as follows:—He took a quantity of the powdered refuse before it was quite dry, and subjected it to pressure, when the natural vicidity of the macerated cellular substance of the cocoanut caused the mass to cohere, and the whole to form a plate which in general appearance was like a mill board, only much more brittle; owing to the hygroscopicity of this substance, if a hole is made through it, the parts adjacent to the puncture, absorb water, swell up, and immediately close the orifice. When on the West Coast last August, I brought away a sack of this refuse, and made a plate, eighteen inches square, by about ¾ of an inch in thickness, and placed it between two boards, and then fastened it to one side of a box, which contained a head of one foot of water. A bullet one-half inch in diameter was fired through it, but not a drop oozed out. This experiment was repeated three times with the same result; next a ¾ inch bullet was fired through the plate, when a few drops only made their way through; lastly, a bullet near an inch in diameter was fired through the plate, when a large jet of water shot through, but in the course of a few seconds the stream decreased in volume; and in less than a minute had ceased to flow altogether. Whether or no this material could be advantageously used for the purpose, which Monsieur de la Barriere has suggested, or for any other purpose, it is a matter worth considering; for, as Monsieur de la Barriere truly says in his article, millions of tons float away annually down our rivers in India. All the above experiments were carried out under the superintendence of Mr. Money on his estate at Deva Shola.—*Mail, 15th September* 1888.

Any convenient number of cranks may be used; when the strands are being laid together a short block with a groove for each is put in between them so as to regulate the twist and prevent entanglement. The strands are kept from getting en-

angled while spinning by pieces of wood or bamboo stuck in the ground in this way, viz., with a bar across to prevent

the strand from getting dragged on the ground and so soiled. A hook working in a swivel, to which all the strands are taken when the required length has been spun and it is desired to lay them up or twist them together, is attached to a board which slides along the ground and may be weighted, so as to give any required degree of tension on the strands. Coir is remarkable for its durability, and is used for the manufacture of various textile fabrics, brushes, cordage for the rigging of ships, nets, matting, stuffing of cushions, pads and mattresses, scrubbing brushes, fishing nets, &c. The coir of the coast differs from that of the islands in colour and strength. On an average, eight to ten nuts, according to size, yield a pound of coir. The value of coir from each tree per annum averages from 2 to 4 annas.

The leaf bud (or "cabbage" as it is called by Europeans) is extracted from young trees and cooked and eaten as a vegetable. The removal of it generally destroys the tree. The tender leaves are also used for plaiting mats, boxes, and other fancy articles; the mature leaves are plaited into double mats with the leaf-stalk in the centre; or the stalk is divided and the halves form separate pieces of matting. These are used for sleeping on, and for thatching, and are known as cadjans, and sold at 3 rupees per 1,000. The leaves are sometimes made use of for writing on, also as materials for fences, sails, buckets, books, fans, torches, and fuel. The ash yields an abundance of potash. The mid-ribs of the leaflets are made use of as brooms, brushes, and skewers. The stalk of the spadix itself is in every-day use as a chunam brush to whitewash houses with.

The reticulated web of the base of the leaf is in general use by the toddy-drawer himself as a strainer: a coarse kind of cloth is made of it; and it is also made into cradles. The soft parts within the stem of the cocoanut tree are cut out and pounded in a mortar and the resulting pulp is washed

in water, and as the farina settles, the water is drained off and the farina collected and dried in the sun. This is used as a substitute for sago.

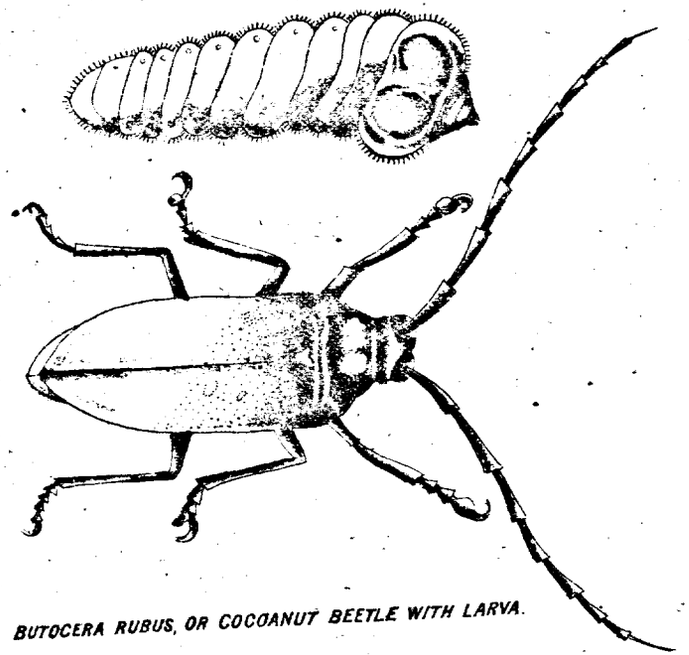
Wood.—Aged and unfruitful trees are cut down and the wood is turned to a great variety of useful purposes: it is hard, handsome, and durable; known under the name of Porcupine wood: it is used for veneering.

The hard stem is converted into drums, gutters, water-pipes, small boats, frames, furniture, rafters for houses, spear-shafts, shingles, walking-sticks, ladies' work-boxes, &c. The root-stem takes a high polish so as to resemble a gate. A cubic foot weighs 70 pounds and the wood is supposed to last 50 years. The roots of the cocoanut are masticated with the betel by natives in substitution for the areca nuts.

Irregularities.—Branched cocoanut trees are rare: when they do occur, the tendency is to fork at the base. Twin plants are occasionally met with. At a horticultural show in Travancore some years ago, a cocoanut was exhibited with six shoots growing out of a single nut; and in another instance, from one of the flowers of the spadix, a shoot of spring leaves was thrown out with a slight tendency to fructification from the flower and then converted into spring leaves, apparently forming a young shoot. The forked tree is of the usual size, but it never puts forth well-developed fruits; on the contrary the flowers terminate in vernal leaves. On an average each spadix or branch bears about thirty or forty such shoots at a time.

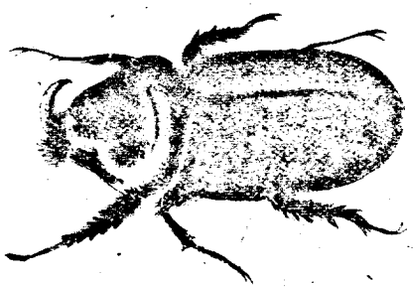
Diseases, Insects, Animals and other Injurious Influences.—The cocoanut palm in a state of health is of a light green colour, with well-formed fronds and a good stout upright stem, producing flowers and fruits between the fifth and tenth year. In swampy, clayey soils the stem is light, the fronds small and frequently ill-formed, and the plant sterile or very scantily fruitful, and young fruits when they do form do not mature. This may, on the other hand, be caused by want of moisture. If the soil be dry, hard, and

PLATE 8.



BUTOCERA RUBUS, OR COCOANUT BEETLE WITH LARVA.

PLATE 9.



ORYCTIS RHINOCERA OR RHINOCEROS BEETLE.

rid, the sap-bearing vessels shrink and eventually the plant itself perishes. Palms are thus subject to disease from two opposite causes. Again, a cocoanut palm from excessive development of some one structure is likely to lose its equilibrium as regards the whole plant. This is the result of something either in the climate or soil of the locality. The plant is either dwarfed, or developed into sappy luxuriance. It will require attention by regulation of the supply of manure and water.

Insects and Animals destructive to the Palm.—The cocoanut palm is subject to depredation at all times of its life. The *Calandra palmarum* of the genus of coleopterous insects, belonging to the family *Curculionidæ*, is one of the largest of the genus, being nearly 2 inches long. The larva lives in the pith or leaf-bud of the cocoanut and undergoes its transformations there, forming a cocoon with the fibres that surround the pith. The eggs are deposited in the plant, and the larva when hatched works its way into the heart of the plant, and on attaining 3 to 4 inches in length and about ½ an inch in diameter, it begins to form its cocoon, in which its transformation into chrysalis takes place, and subsequently it emerges into the perfect beetle and escapes; and, if it has not destroyed the plant, it has done so much damage as to retard its growth very materially.

The *Butocera rubus* or "*Curuminga*" of the Singhalese is another beetle which penetrates the trunk of the cocoanut tree near the ground and then deposits its eggs. Its grubs when hatched, eat their way upwards through the centre of the tree to the top, where they pierce the young leaf-buds, and do incredible damage. The larva of one species of *Dynastidæ*, the *Oryctis rhinocera*, called by the Singhalese "Gascooroominga," makes its way into the younger trees, descending from the top, and after perforating them in all directions forms a cocoon of the gnawed wood and dust in which it reposes during its transformation into a chrysalis till the arrival of the period when it emerges as a perfect beetle. Natives are always on the look out in infested localities for the larva of these beetles; and the moment they

see any thing like a hole in the stem of the cocoanut palm—often indicated by the débris which is thrown out and surrounds the opening—they thrust into it an iron needle from 6 to 8 inches long with a prong about ½ an inch long near the end. With this they generally succeed in transfixing and extracting the larva.

Rodents.—The muridæ or rat family are extremely destructive. In certain localities they infest cocoanut trees, building their nests in the hollows of the base of the frond and feeding on the tender leaf or young kernels, and also on the mature nut. In the latter they bite a hole on the top, where the nut is attached to the stalk and feed on the kernel. It is difficult to get at these rats; at the Laccadives and the neighbouring islands, people get up rat hunts occasionally; a few men climb up the trees, and the whole of the islanders turn out with sticks and clubs. As soon as the rats on the trees are disturbed, they either spring to the ground or rush down the stem, when they are chased and killed. Sometimes over a thousand are killed on such occasions. After witnessing one of these hunts, I suggested smoking the trees. This was not feasible; but a chatty with some damp straw stuffed into it was placed over the opening of each rat hole, and through a small hole bored at the bottom of the chatty, pieces of live coal were forced and blown upon. The smoke was thus sent into the hole, and most of the rats smothered in them. A few, half-smothered, escaped from the counter-openings; these were soon killed. The people were well pleased with this mode. I also suggested that a few good terriers should be kept; after a little training, all the men would have to do would be to turn the rats out of the trees, and the dogs under them would despatch the rats. Unfortunately these islanders were all Muhammadans, and do not care for dogs. I do not remember meeting with a single dog of any kind on any of these islands during my visit to them in February 1873. In the province of Travancore, it is said that the "flying squirrel" or *Pteromyes petaurista* takes up its abode in the cocoanut groves near woods or forest trees, and attacks the nut at night, doing

PLATE 10.

PARADOXURUS MUSANAC, OR TREE OR WOOD DOG.

much damage. The common striped palm squirrel or *Sciurus palmarum*, attacks the blossom chiefly; they are met with in most districts, but the damage they do is small, as they only resort to cocoanut trees in the absence of other food. The flying fox or *Pteropus Edwardsi* is said to do much damage to the young fruit in Travancore; but this is beyond my personal knowledge. If the fact be so, the damage must be confined to that province. The wood-dog or tree dog "mara nai" of the Tamils, and the *Paradoxurus Musanga* of scientists, the "Toddy cat" of Europeans, does much damage to the young nuts; it gnaws a round hole through the husk at the tenderest part near the stalk, and feeds on the tender albumen which it scoops out with its fore paws. It cleans out the shell of its kernel in the most perfect manner. These animals commit their depredations always at night, and the number of empty shells picked up every morning under the trees shows the amount of damage done. Squirrel and "wood-dogs" can be readily taken in traps, baited with fruit for the former and raw meat for the latter. If one had the patience to sit up at nights, tree-dogs might be shot. The value of exports of the produce of the cocoanut palm for 10 years from the Madras Presidency alone exceeds in

	Rs.
Cocoanuts	145,20,430
Kernels	127,46,550
Oil	305,61,465
Coir	237,95,040

The double cocoanut or the *Lodoicea Seychellarum* is notable for its growth in the Seychelles Islands, where it is found growing naturally, and nowhere else in the world; the tree attains a height of 80 or 90 feet. It has been recently introduced into Ceylon and other localities where a few plants may be met with as curiosities under garden cultivation. The double nut is preserved whole, and as they have a capacity of six to eight pints, they are used as water vessels: By slicing in different directions, they are converted into plates, dishes, drinking vessels, &c. The Muham-

madan fakeers and Roman Catholic sanyasies use the shell as a scallop. The leaf bud is eaten like the cabbage of other palms, and the down from the young leaves is used for stuffing mattresses, pads, cushions, &c. The petioles are converted into baskets and brooms, and the young canes are plaited to form hats.

NOTE.—*Extract from the* "MADRAS MAIL," 31*st March* 1886.

"Messrs. Ferguson, in the last issue of their *Ceylon Hand-book*, have given the total number of cocoanut trees in the world as 'perhaps 280,000,000 bearing fully 10,000,000,000 nuts every year.' South America, supposed by many to be the original home of the cocoanut, heads the list with 1,000,000 acres under the cocoanut palm; Ceylon is second, with 500,000 acres; British India and dependencies third, with 480,000 acres. It is surprising to learn that Ceylon, a comparatively small country, grows more cocoanut palms than the whole of British India. The export trade of Ceylon in all products of the cocoanut palm is said to be worth £8,000,000 per annum as against £700,000 for the export trade of India."

DATE PALM CULTURE

AND

MANUFACTURE OF DATE-SUGAR.*

THE wild date, known by the scientific name of *Phœnix Sylvestres*, is common to most parts of India, and, as a rule, is never cultivated, but grows freely in low or broken grounds, as it loves humid banks of streams and rivulets, where it may be seen forming groves in the Carnatic, Mysore and the Deccan as well as other parts of India. It thrives best in rich alluvial soils, that are not subject to submersion, and in sandy loams on the slopes and ridges of higher grounds. Advantage is taken of its growth to turn it to profitable account, and its most valuable production is the sap or juice, popularly known as toddy or palm wine, which is drawn from the stems during the cold season. The juice, extracted, is either used as a drink, in its fresh state, or when slightly fermented as toddy, for its intoxicating properties; or it is used for the purpose of distilling the common country arrack, and the manufacture of raw sugar, or jaggery, which is subsequently converted into date-sugar.

The sap, when fresh drawn, has a mawkish sweet taste, and it acts as an aperient on many persons, when using it for the first time; but this is lost with fermentation, when it acquires intoxicating properties. As a stimulant, it is largely consumed by most of the lower class of natives. Each tree produces about 250 pints or at an average 200 pints during the season, of which 12 pints are equivalent to one pound of jaggery, and 4 pounds of jaggery when refined, will produce a pound of good sugar.

The tree begins to yield sap at from 5 to 10 years depend-

* This paper was originally contributed to the Guide to the Eurasian and Anglo-Indian Villages.

ent mostly on the moisture and quality of the soil a continues productive for many years after, if the smalles care be given it; but unfortunately the free and careless manner in which the tree is cut soon proves so destructive, that it is often killed in a few years. The fruit is a small oval plum covered with a sweetish pulp when ripe, and is often collected and taken about native villages for sale, mostly by women, and sold by measure for a few pies or bartered for rice or grain to children but when the trees are tapped for their juice, the fruit is almost worthless as it contains little or no pulp. The green fruit is eaten by natives with their betel in substitution for the areca nut.

The petioles or leaf-stalks are in demand for the manufacture of baskets, boxes, hencoops, strong fence mats, &c., whilst the leaflets are in general use for the plaiting of hats, mats, and a great variety of bags and baskets. Some very superior articles, of the above description, are prepared and sold at the various weekly fairs in Malabar, whilst the flower spathes are converted into brushes of various kind.

More recently the date or fruit itself, has received much attention and is now converted into what is known as "Date Coffee." A large and influential Company has now started, with a large capital, for the manufacture of *Date Coffee*, which is now in the market for sale. Date plantations, as a rule, are self-grown from the dropping of the seeds from the parent trees or birds and animals, who devour the fruits for its pulps and drop the seeds uninjured, as it passes through them, at distant places, where they readily germinate, but it would be better to grow a regular plantation, for which purpose, the seeds of the best varieties should be planted in a nursery. There are several varieties of the date found growing in Southern India, one, a stemless plant is found growing on low hills up to an average height of 4,000 feet above sea level; another dwarf variety is to be seen growing about the low or scrub jungles in the plains; but the *Phœnix Sylvestres*, or wild date, in a fair soil attains to the height of 30 to 40 feet and forms a very handsome

tree, when not too severely mutilated on account of its leaf-stalks, leaves or for its sap. Seeds put down in the nursery at one season, will be ready for transplanting in the following season; and if they are put out according to the nature of the soil, if dry and arid at 15 to 20 feet, but if moist at 20 to 25 feet apart, they will need little or no care, except protection from trespass by man and animals. The young trees are liable to destruction on account of their leaf-stalks and leaves. Cattle will also devour them if not protected. In dry localities, they will be the better for being watered during the hot weather; in fact irrigation will hasten their growth and about 5 years from the time they were first planted out, they will have attained between 4 and 5 feet in height when well grown and be ready to be tapped for the sap or toddy. The date is a *diœcious* plant, as the sexes are on different flowers borne by separate individuals; and if it is intended to cultivate the fruit, it would be necessary to see that both the male and female plants exist on an estate, so that the female flowers may be fertilized to form fruit. The tender tops or shoots of the plant are eaten as a luxury either raw or cooked; and during seasons of scarcity the stem is cut, split into pieces, dried in the sun and beaten in mortars to extract the large amount of farinaceous substance they contain and the farina or meal, so obtained, forms a sort of inferior sago. It is boiled into congees or made into cakes, and eaten by the poor.

Addendum.

"The Arabian date-palm thrives in India and grows from the seed of the imported fruit as sold in the bazaars. The seed of the fruit in pulp germinates more freely than that of the dried fruit. Off shoots, which sprout round the foot of the female tree, may be transplanted, when one foot high and watered daily for two or three years. The soil should be soft and the base of the plant surrounded with good farm yard manure. When watered plentifully, the offshoots spring up quickly and bear fruit within four or five years, but when the soil is hard and watering scanty, the plant

takes twelve years to fruit. Seedlings are of slow grow The number of bunch blossoms, varies from twelve t twenty-four, but it is seldom that more than twelve are allowed to remain for fruit. At this period the blossoms of the female tree are impregnated by depositing a sprig or two from the male into a branch of the female blossom and lightly tying them up with a string. The blossom of the male tree is of a reddish tinge, while that of the female is milky white. It is averred, however, that when the date-palm grows thick together, the winds scatter, the pollen of the male blossom, and that the female tree thus gets impregnated. The blossom of the male tree does not turn into fruit. In Persia, the fruit begins to form in May and is perfectly ripe by September. At first it is green in colour and in two or three months it gets either red or yellow, when it is fit to be eaten. About the fourth month, it becomes soft and juicy, but it becomes fit for preservation only in the fifth month, when it is taken off the trees and exposed to the sun, to throw off its extra juice. It then hardens and is packed for exportation. The juice is gathered and used in lieu of sugar. There are more than a hundred varieties of this palm. Those that are imported into London from Egypt, called Tafilat, though large and fine looking, have a tough skin and are far less succulent and nutritious than those brought from Bussorah and the Persian Gulf. The branches supply fuel and material for hutting. The fruit branches are used as brooms and the leaf turned into ropes and matting. The stem is used for house building. Toddy is also extracted from this palm, when it will yield no fruit. Sugar is largely manufactured from the juice of the common date palm. The fruit is cheap and nutritious and is used as an article of food. One pound of dates, contains as much nutriment as half a pound of meat. They may be minced and fried in a little ghee or made into an omelette with eggs."

"There is an indigenous date, common to the Mulnaad of Mysore, which grows wild, over extensive tracts, and is only occasionally used for drawing toddy. The great advantages

of this hardy tree is not known in this district, whereas in Bengal, the husbandmen depend, more upon date-sugar cultivation than upon any other branch of agriculture, and several large towns and villages are altogether supported by this industry. The date-tree however, is not chance-sown in Bengal, nor is it entirely free from all cultivation as in Mysore."

The following description, taken from the valuable work of Dr. W. Hunter, 'The Statistical Account of Bengal' will show how the existing topes of date may be utilized, greatly to the benefit of the cultivator and of the Government.

"Sugar-cane requires the best land, paying the highest rent occupies it throughout the year and leaves the soil exhausted at the end. It also demands constant weeding, with irrigation and heavy manuring. The date-tree will grow on almost any dry ground. It requires very little or no attention or tillage, and although it yields no return for the first 6 or 7 years, it goes on giving an annual supply of juice for the next 25 or 30 years. A peasant can scatter a date seed here and there throughout his holding and in seven years he finds himself in receipt of a steady income from the trees. Rows of dates form favourite boundary lines of fields and holdings."

"*The Planting of the Trees.*—High ground is selected for the plantation and it is kept perfectly free from undergrowth, and the turf, from time to time, is ploughed up while the plants are maturing, the land can be cropped with oil seed and other dry crops. This lessens the original outlay and the young palms are much benefitted by the tillage between the rows. They are laid out in rows with 12 feet between each tree. Lime is a valuable manure for all saccharine plants and is usually added when it is deficient in the soil. If the trees are tapped before the end of seven years, they do not attain a full and healthy growth."

"*Tapping.*—At the end of the 7th year tapping begins, and is continued annually from 25 to 30 years. There are in

the date palm two series or stories as it were of leaves, crown leaves which rise straight but from the top of the trunk; being so to speak a continuation of it; and the lateral leaves, which spring up out of the side of the top part of the trunk. When the rainy season has completely passed away, and there is no more fear of rain, the cultivator cuts off the lateral leaves for one half of the circumference, and thus leaves bare, a surface measuring about 10 or 12 inches each way. The surface thus laid bare, is not the woody fibre of the tree, but is a bark formed by many thin layers."

"After the tree has remained for a few days thus exposed, the tapping is performed by making a cut into this exposed surface in the shape of a very broad √, about 3 inches across and a quarter or half inch deep. The surface inside the angle of the √, is then cut down, so that a rectangular surface is cut into the tree. From the surface exudation of the sap takes place and caught by the sides of the √, it runs down to the angle, when a bamboo of the size of a lead pencil is inserted in the tree to catch the dropping sap and carry it out as a spout."

"*Periods of Tapping.*—The tapping is arranged throughout the season by periods of six days each. On the first evening, a cut is made, as above described, and the juice is allowed to run during the night. The juice so flowing is the strongest and best. In the morning the juice collected in a pot hanging beneath the bamboo spout is removed and the heat of the sun causes the exuding juice to ferment over and shut up the pores in the tree. So in the evening a new cut is made, not nearly so deep as the first, but rather a new paring and for the second night, the juice is allowed to run. This is not so good or so abundant as on the first night. The third night no new cut is made, but the exuding surface is merely made quite clean, and the juice is still less abundant and less rich than on the second night, and towards the end of the season, when it is getting hot, it is unfit for sugar manufacture, but is sold simply as "drop-

ping." When trees are tapped for toddy, they are prevented from flowering and fruiting, as in the latter condition much saccharine matter would be assimilated in the fruit."

"After three nights of activity in the tree, it is allowed to remain for three nights at rest, when the same process again begins. Every sixth day, a new cut is made over the previous one, and thus towards the end of the season the cut is 4 inches below the surface. The cuts during one season, are made about the same place; but in alternate seasons alternate sides of the tree are used for the tapping; and as each season's cutting is thus above the previous seasons, and on the opposite side, the stem of the tree has, if looked at from the side, a curious zigzag appearance. The age of the tree can, of course, be at once counted up by enumerating the notches, and adding six or seven, the number of years passed before the first year's notch. When the trees are 40 years old, they are worth little as produce bearing trees. The notches are always on the east and west sides of the tree and very rarely on the north and south sides."

"*Produce of one Tree.*—The produce, from a good tree, will average ten pounds per night (excluding the quiescent night) The cold and clearer the weather, the more copious and rich the produce. In Bengal, the tapping is begun in November. In December and January the juice flows best, beginning sometimes as early as 3 P.M. and it dwindles away in the warm days of March. If the cultivator begins too early, or carries on too late, he will lose in quality and quantity as much as he will gain by extending the tapping season. During the whole of the tapping season, the cultivator keeps his grove perfectly clean and free from jungle or even grass."

"*Boiling.*—The boiling is done by the ryot himself and usually within the limits of the grove. Without boiling, the juice speedily ferments and becomes useless; but once boiled down into a syrup, it may be kept for very long periods. The juice is therefore boiled at once in large pots, placed on a perforated douce, beneath which a strong wood

fire is kept burning, the pared leaves of the trees being us among other fuel. The juice which was at first brilliant and limpid becomes now a dark brown, half viscid, half solid mass, which in Bengal is called *gur* (crude sugar); and when it is still warm, it is easily poured from the boiling pan into the earthenware pots in which it is ordinarily kept."

"*Produce of Crude Sugar.*—It takes 7 to 10 seers of juice to produce one seer of *gur*. The tapping season extends over 4½ months or about 67 tapping nights. These at 5 seers each produce 335 seers of juice, which will give about 40 seers or 1 maund of *gur*, the value of which is ordinarily about 2 Rs. An acre of grove containing 190 trees will therefore produce Rs. 300 to Rs. 400 worth of *gur* if all the trees are in good bearing."

"It is not all kinds of pottery which will bear the continuous hard firing required for boiling down the juice, and therefore an unusually good quality of clay must be used in their manufacture."

"*The Refiners.*—A cultivator, after boiling down his juice into *gur*, does not ordinarily do more; but sells it to the refiners, who complete its manufacture into sugar. The earthen pot is transferred along with the *gur* that is in it; separation is, in fact, impossible, and the refiners have to smash the pots to get out the *gur*."

"*Manufacture of Dhulwar Sugar*—There are several methods of refining, and two or three sorts of sugar produced. The *dhulwar* sugar—that soft, moist, non-granular, powdery sugar, used chiefly by natives and especially in the manufacture of native sweetmeat."

"The pots of *gur*, received by the refiner are broken up and the *gur* tumbled out into baskets which hold about a maund each and are about 15 inches deep. The surface is beaten down soas to be level, and the baskets are placed over open pans. Left thus for 8 days, the molasses passes through the basket, dropping into the open pan beneath, and leaving the more solid part of the *gur*—namely, the

sugar—in the basket. *Gur* is in fact, a mixture of sugar and molasses and the object of the refining is to drain off the molasses, which gives the dark colour to the *gur*."

"This 8 days standing allows a great deal of the molasses to drop out, but not all of it; and to carry the process further a certain river weed, called *sáolá* "*Hydrilla verticillata*", is placed in the baskets so as to rest on the top of the sugar. The effect of this weed is to keep up a continued moisture, and this moisture, descending through the sugar, carries the molasses with it, leaving the sugar comparatively white and free from molasses. After 8 days exposure with *sáolá* leaves, about 4 inches on the surface of the mass will be found purified; and these four inches are cut off and *sáolá* "*Hydrilla verticillata*" applied on the newly exposed surface. This and one other application will be sufficient to purify the whole mass."

"The sugar thus collected, is moist and it is therefore put out in the sun to dry, being first chipped up so as to prevent it from caking. When dry it is a fair, lumpy, raw sugar, and weighs about 30 per cent. of the original mass, the rest of the *gur* having passed off into molasses. Dishonest refiners can get more weight out of it by diminishing the exposure under *sáolá* weed so as to leave it only 5 or 6 days instead of 8. The molasses is less perfectly driven out and the sugar therefore weighs more. Of course it has also a deeper colour, but that is in a measure remedied by pounding."

"*The Droppings.*—The "first droppings" gathered in the open pans in the manner already described, are rich in sugar and are used for mixing up with food or reserved for a second process of sugar manufacture. In this second process the first droppings are first boiled and then placed underground in large earthenware pots to cool. Unless thus boiled they would ferment; but after being boiled in this fashion, they, on cooling, form into a mass somewhat like a *gur*; but not so rich. After this the previous process is again gone through, and about 10 per cent. more weight in sugar is

obtained. The sugar is, however, coarser and darker in color than the first. The following is a much more speedy process, but the sugar will soon ferment and therefore should be immediately used. Taking the cool *gur*, the refiner squeezes out the molasses by compressing the mass in a sack and then drying and breaking up what remains in the sack, he sells it as sugar. The liquid which remains, after all the sugar has been squeezed out, is molasses."

"The sugar produced by these methods, is soft yellowish sugar. It can never be clean as whatever impurity there may be originally in the *gur*, must always appear in the finished article. Another objection to it is, that it tends slightly to liquify and cannot, therefore, be kept for any considerable time. The sugar obtained by the following process is much cleaner, has a granular structure and is a more permanent article. The price is Rs. 10 a maund, whereas the soft costs only 6 rupees a maund."

"*Manufacture of Paka Sugar.*—In this process the *gur* is first cast upon platforms, and as much of the molasses as then flows off, is collected, as first droppings. The rest is collected, put into sacks and squeezed and a great deal of the molasses is thus separated. The sugar which remains behind is then boiled with water in large open pans and as it boils all scum is taken off. It is then strained and boiled a second time and left to cool in flat basins. When cooled, it is already sugar of a rough sort and *sáolá* leaves are put over it, and it is left to drop. The result is good white sugar, and should any remain at the bottom of the vessel still unrefined, it is again treated with *sáolá*. The first droppings and the droppings under the *sáolá* leaves, are collected, squeezed again in the sacks and from the sugar left behind a second small quantity of refined sugar is prepared in exactly the same way, by twice boiling. The droppings from the sacks are not again used for further sugar manufacture. About 30 per cent. of the weight of the *gur* is turned out as pure paka sugar."

"*Another method of manufacture.*—This method is peculiar

to Resabpur in Bengal. The *gur* is first boiled in large open pots, and into each potful is put a handful of *bichh*; it is then left to cool, and in doing so it coagulates and is afterwards treated with *sáolá* leaf and thus refined. The lost droppings under the *sáolá* leaves are burnt; and this forms the *bichh* used in the manufacture, the effect of which is apparently to make one boiling do, instead of two. The droppings from this first process are collected, boiled with *bichh* and cooled as before, then squeezed in sacks, mixed with water, boiled to drive off the water and after cooling, purified with *sáolá* leaf."

"The date is popularly considered a slow growing tree and it generally is met with of stunted growth; but this is entirely owing to the conditions under which it is ordinarily found growing. The trees one meets with, are all chance sown, and are so badly treated, that the wonder is they ever arrived at maturity. Under cultivation, they grow both rapidly and yield enormously. They will also stand transplanting; and the trees now growing in the Napier Park, Madras, will prove for more remunerative than growing fuel."

THE MUSACEÆ OR PLANTAIN ORDER.*

Musa Sapientum, Linn.—Plantains. Herbaceous. Stem simple, thickly clothed with the sheathing petioles of the leaves: leaves forming a tuft on the apex of the stem: spike of flowers compound rising from the apex of the stem: each division enclosed in a large spathe with *male* flowers at the base: *female* or hermaphrodite ones at the upper end: perianth with six superior divisions, five of which are grown together into a tube, slit at the back, the 6th is small and concave: style short: fruit oblong, fleshy, obscurely 3-5 cornered with numerous seeds buried in pulp: flowers yellowish-whitish.—*Drury.*

Note.—Musa Sapientum is the plantain and the Musa paradisiaca or Banana is a variety of it the name paradisiaca having been given it from an allusion to an old notion of its being the forbidden fruit of Scripture; and fanciful writers have supposed it to be the grapes brought by the spies of Moses from the promised land. One bunch of which was borne upon a pole by two men.

The Musa Sapientum popularly known as the plantain, is derived from the Spanish word *Platano.* In Tamil it is called *Vallei* or *Vazhei,* Telugu *Ariti,* and Hindustani *Mauz* or *Koyla.* From the Hindustani term Mauz the Generic name Musa is believed to be derived.

There are several species of the plantain found growing in Southern India, and the following may be enumerated:—

1. Musa paradisiaca, or Plantain.
2. M. sapientum, or Banana.
3. M. Cavendishii, or Mauritius Plantain.
4. M. textilis, or Manilla Hemp.
5. M. superba, or Hill Plantain.
6. M. rubra, or Red Plantain.
7. M. ensete, or Ornamental Plantain.
8. Heliconia bucciuata, or Flowering Plantain.
9. Ravenala speciosa, or Traveller's tree.

* This Essay was contributed to the Madras Agri-Horticultural Society, at the special request of the late John Shaw, Esq., the Honorary Secretary, by Dr. John Shortt.

The *Musa paradisiaca* is the most general. The natives enumerate a large number of varieties. I will only describe those that are well known and more generally met with in Southern India, with their Tamil names.

a. Monthen—மொந்தன்.* This is a large and nearly straight fruit, generally about 9 inches in length and 5 to 8 in circumference. Color green, when ripe light yellow, the fruit is three or five sided and well ridged at each angle or side, the skin or rind is thick and fleshy. The fruit when ripe is sweet, but has no flavour, and is believed by the natives to possess cooling properties when eaten. The green fruits are curried to a large extent and also prepared into sweets with sugar. The Monthen plantain is well known from its size and form and readily recognized, and is met with in most districts. The tree attains the height of from 15 to 20 feet. *Vide* drawing of fruit.

b. Samai Monthen—சமை மொந்தன். A variety of the above fruit, differing only in size, and averages about 6 inches in length. The green fruits are curried and the ripe eaten. The tree resembles the last in general form and height.

c. Ladam, synonymous with *Nadam—வாடம்.* In this variety the fruit averages about 6 inches in length, when ripe it has a greenish yellow color, although round it is ridged or slightly angled, its rind thick, but not quite so thick as that of the Monthen. The fruit is sweet, and the flesh has a very light straw color, scarcely observable at times, sometimes it has a mealy or cottony taste, and is generally cooked into curries and eaten when ripe. The tree attains from 12 to 15 feet in height.

d. Pachai Ladam—பச்சை வாடம். In this variety the fruit greatly resembles that of the Ladam, is long and curved, and retains the greenish color even when ripe. It is believed to possess cooling properties. The green fruits are cooked into curries and the ripe eaten. The tree attains to 15 feet in height.

* Synonymous with Bonthen.

e. Rustali—ரஸ்தாளி. This variety is generally kno as "table plantains." The fruits are round and slightly curved, and much esteemed as a fruit. It is not generally used for cooking, but only eaten when ripe, the rind is thin and the fruit becomes yellow as it ripens, and is of moderate thickness, averaging 6 inches in length and 4½ in circumference. The rind is often dotted with black spots, and portions of the pulp eats gritty owing to small nodules of hardened flesh or pulp having a rust colored tinge being invariably present, but the fruit is nevertheless sweet and tasty and much appreciated as a table fruit. *Vide* drawing of fruit. The plants attain 15 to 18 feet in height.

f. Puvaly—பூவாழை. Popularly known as the "Guindy plantain," and considered the best variety; it is not used in cooking, the fruits are considered too valuable for such purposes; the average fruit is round and small sized, a good bunch may contain over 1,000 fruits, the taste of the ripe fruit is luscious and sweet with a most delicious flavor, the rind thin, almost as thin as paper. It is the best variety of plantain, and is always in request for the table. *Vide* drawing of fruit.

g. Karuvalay—கருவாழை. The fruit of this variety is quite round and well shaped, its color when ripe is dark green. The average length 6 inches and 4 to 5 inches in circumference. This is a wild variety, and is only found growing in jungles and hills, and its use is confined to the preparation of certain medicines. The fruit may be eaten when ripe, and the green fruits cooked into curries.

h. Raja Valay—ராஜ வாழை. This variety is believed to be indigenous to Mysore, and introduced from thence into other districts. The fruit is yellow when ripe, averages 4½ inches in length and 3 in circumference, round, with a thin rind, and is supposed to excel all other fruits in its flavor and taste, is always eaten ripe, seldom cooked into curries. *Vide* drawing.

i. Anai Komban—ஆனைக் கொம்பன். This is the largest, and a coarse fruited, wild variety, of plantain, the fruit

ing nearly 1½ feet in length, is seldom cultivated except as a curiosity. The color is light yellow, the rind thin. It is unfit for food, although sometimes the ripe fruit is eaten by the poor.

j. Aduku Valay—அடுக்கு-வாழை. This is a small fruited plantain, scarcely exceeding 2 or 3 inches in length, derives its name from the number of the fruits and the close manner in which they are "packed;" a good bunch contains upwards of 2,000 fruits. The fruit is round, sweet, and of a yellow color. The rind is thin, and the fruit eaten when ripe, but not used for cooking. *Vide* drawing of fruit.

k. Kathali—கதலி. This variety is common to the Tinnevelly and Malabar Districts. In Malabar it is abundant and considered sacred, used chiefly as offerings to deity. The fruit is tasteful and has a yellowish color. The size of the fruit varies from 3 to 4 inches in length, according to the nature of the soil on which it is grown, and about two inches in circumference. It is never used for curries, being considered too sacred for such purposes.

l. Nenthiramcoy—செந்திரம் காய். This is a peculiar fruit and confined to Malabar, Travancore and Cochin. The size of the fruit is 16 inches in length and 6 inches in circumference. Slightly curved, pointed at both ends, 4 sided, well ridged on two and faintly ridged on the remaining two sides. Flesh salmon coloured, rind thick. The fruits are extremely tasteful, and it is always preferred when procurable. The green fruits are curried and the ripe eaten.

m. Payan Valay—பயன் வாழை. In this variety the fruit is small and has some slight resemblance to the Monthen plantain; the color is of a greenish yellow, and the rind thick. It is believed to possess medical properties and to cool the body, in consequence of which it is appreciated. The ripe fruits are eaten and the green curried. It has a local name of *Sambirana* in the Salem District. *Vide* drawing of fruit. The tree attains 15 to 20 feet in height.

2. *Musa sapientum* or *Banana.**—I found a single plant growing in the Lal Bagh, Bangalore, of this species. Mr.

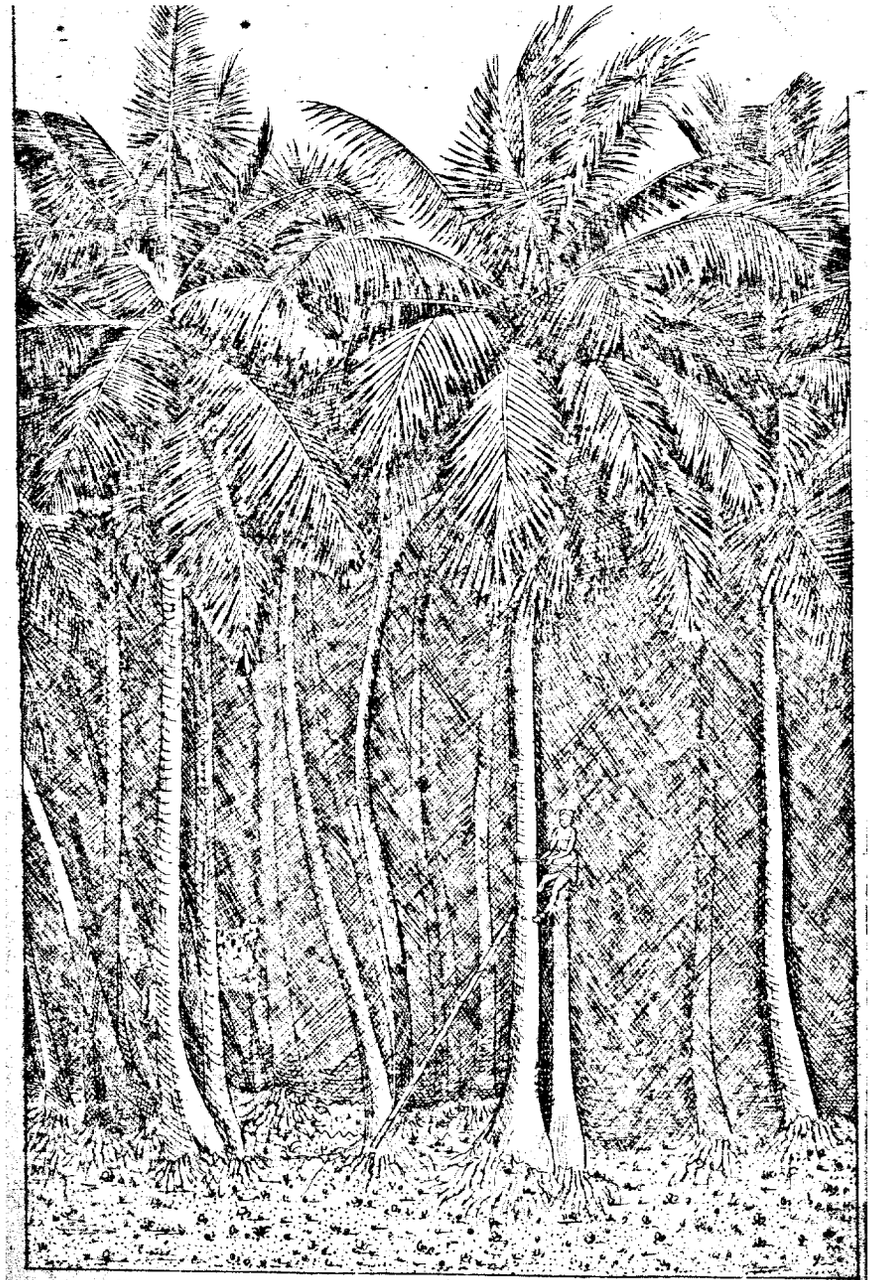
* Banana is a West Indian term.

Cameron, the Superintendent, tells me that the plant grows lofty and attains about 30 feet in height, and as far as I could see, I did not recognize any difference from the ordinary plantain.

3. *Musa Cavendishii (Chinensis)*—சீனாக்கு வாழை. Commonly named the "Mauritius plantain." This is a dwarf species, the plant grows robust and compact: by some it is believed to have been introduced from the Mauritius, by others from China. It is met with in most districts. I have seen it in the northern as well as in most of the Southern Districts. The plant seldom exceeds five feet in height, frequently it is much under that height, very sturdy with leaves overlying each other closely; it thrives well in the plains as well as on the hills, up to a height, of 5,000 feet above sea-level. Is very productive, and produces an enormous bunch of fruits, when well grown, that pits or holes have to be dug to enable the bunch to descend below the level of the soil uninjured. Each fruit averages from 7 to 10 inches in length, is of uniform thickness, and ripens of a pea green color. The flesh or pulp has a straw color, having a resemblance to the color and flavor of the Red plantain. It is sweet and well tasted, the rind moderately thick. A bunch of these plantains was sent me by a friend from a neighbouring Estate on these hills (Shervaroys) which was brought in by two coolies, and weighed (90) ninety pounds.

4. *Musa textilis* or *Manilla hemp*—நார் வாழை. The fruit of this species is small, resembling in general appearance that of the Rustalli. It is not fit for food from being filled with seeds, but Mr. Thompson, the Superintendent of the Governor's Garden at Guindy, tells me that the fruit contains some pulp which is sweet and well tasted. There are about half a dozen plants growing at Guindy, and the largest of these was 10 feet, but I believe it attains from 25 to 30 feet in height. It yields the finest and best kind of fibres which the natives do not utilize. A variety of this plantain * has been imported into Southern India in conse-

* The true Manilla hemp.



TODDY DRAWER EQUIPPED FOR WORK CLIMBING A COCOANUT TREE.

ience of its fibres, it has not met with general acceptance, as the fruit is considered worthless and not fit to eat. The absence of a machine, and the want of interest in the extraction of the fibres, causes it to be neglected.

5. *Musa superba* or *Hill plantain*—காட்டு வாழை. This is the wild plantain, an ornamental and handsome plant when well grown. The stem is formed above the soil and is exceedingly stout, strong, and conical, exceeding 10 feet in circumference above the surface of the soil, where it is bulbous, and 5 feet at the summit immediately below the leaves. Leaves petioled, but not sheathing, is found in abundance about the hills in Travancore, Pulneys, South Canara, and other hill ranges up to a height of 5,000 feet above sea-level. I brought a number of bulbs in 1872 from the "Mukh" in South Canara, and distributed them to the Madras Horticultural Gardens, the Lal Bagh, Bangalore, and introduced it on the Shervaroy Hills, where I have at present a number of plants, two of which are in fruit now. In a couple of months, I hope to have an abundance of seeds for distribution. *Vide* drawing of fruit and seeds, and separate drawing of plant.

The plant attains a height of from 15 to 20 feet, and is very handsome and showy. The flower stem rises perpendicularly and then curves down, the flower bud is large, much shorter and stouter than that of the common plantain, having the shape and form of a bullock's heart. The fruits form clusters around the peduncle like the ordinary plantain, the berry is oblong and about the size of a duck's egg. Smooth and slightly ridged, three celled when ripe, nearly dry, having no pulp and filled with numerous black seeds, about the size of a small marble each. It is propagated from seed and suckers, the suckers are rare and occasional, and are not thrown up so plentifully as in the ordinary plantain. It is met with now about many gardens in Madras.

6. *Musa rubra*, or *Red plantain*—செவ்வாழை. This is a tall plant, attaining some 20 feet in height, and producing

a dark red colored and rather large sized fruit, averaging from 7 to 10 inches in length and of a uniform thickness: it is a very fine fruit with a rich flavor and buttery consistence. The plant is readily distinguishable from the dull red color that pervades every part. The fruit ripens of a yellowish red and is greatly appreciated, generally Europeans object to its strong flavor. It is grown about Madras and along the Eastern Coast, and is largely cultivated in the vicinity of Sadras, more especially at the village of Voyalore for the Madras market, where it is always procurable. I have also seen it flourish at Combaconum in the Tanjore District. The fruit is generally eaten ripe and never cooked, as it is considered too valuable for such purposes, and is believed by the natives to possess cooling properties. The rind is thick and fleshy, and the pulp has a light straw color, peculiar flavor, and luscious taste, that is satiating. An ordinary bunch of these plantains weighed 50 pounds and the fruit spike contained 6 divisions, each division carrying from 11 to 17 fruits, each fruit weighed 6 ounces and measured 7½ inches in length and 6 inches in girth. The bunch contained in all 90 fruits.

7. *Musa ensete* or *Abyssinian plantain.*—A single young plant of this species is growing in the Lal Bagh, Bangalore. It is said to be the largest of all plantains and the finest for decorations, and in general appearance it resembles the Musa superba, except that it does not become bulbous at the base, and attains a much greater height. This plant was pointed out to me at the Lal Bagh, Bangalore, by Mr. Cameron, the Superintendent.

8. *Heliconia buccinata*—ஓலைவாழை. A small plant resembling the plantain and now common about Madras gardens as an ornamental plant. I have not seen it in flower.

Urania speciosa or the Traveller's Tree—சீமைவாழை, also known as the *Water tree*, is now found growing in many gardens about Madras, and it is particularly distinguished for the fan-shaped form the tree take from the spreading of their leaves and attaining the height of 20 to 30 feet. A tree in the Madras Horticultural Gardens is at present

shing out its flower spathe, and some trees in the Governor's Garden, Guindy, one in fruit, from whence I obtained the specimens depicted in the accompanying drawing. It is readily propagated from seeds, and I have the plant on the Shervaroy Hills. The fruit grows in clusters like the common plantain, is 4 inches long and 2 wide, flat, and slightly convex in the upper, and concave in the lower side, edge sharp, and the upper half an inch wide, and ridged at the edges. It is covered with a thickish rind containing a canine tooth-shaped hard shell, within which there is a deep blue cottony substance in which the seeds are imbedded. The seeds are flat, concavo-convex, having one end slightly turned in. *Vide* drawings.

Exclusive of the varieties named above, most districts have local names for the plantain. In a garden at Comalesperanpettah the other day the owner pointed out to me the following varieties that were growing there. 1. *Monthen;* 2. *Pay Monthen;* 3. *Bengal;* 4. *Mauritius;* 5. *Guindy;* 6. *Rusthali;* 7. *Chukrakahly;* 8. *Ootheroo;* 9. *Red;* 10. *Kurry;* 11. *Musa superba.*

In the Tinnevelly District the following varieties are said to exist. 1. *Tholuvam Valay;* 2. *Kalkathali Valay;* 3. *Puvillatchum Valay;* 4. *Nalkathali Valay;* 5 *Atham Valay;* 6. *Payam Valay.*

In the Salem District. 1. *Puthemantha Valay;* 2. *Pee Valay;* 3. *Sivala;* 4. *Payan Valay;* 5. *Putcha Valay;* 6. *Woothira Valay;* 7. *Vunwangoy.*

In the Madura District. 1. *Kurpuram Valay;* 2. *Attucomben Valay;* 3. *Namaram Valay;* 4. *Malai Valay;* 5. *Mail Valay;* 6. *Vayal Valay;* 7. *Poolachoondum Valay;* 8. *Sambul Valay;* 9. *Vellai Valay.*

In the Lower Pulneys. 1. *Navarumpalam;* 2. *Poovampalam;* 3. *Puchaipalam;* 4. *Kulvaruspalam;* 5. *Attucombenpalam;* 6. *Kedanpalam.*

The size of a plantain is no criterion of its being a variety, for under vigorous cultivation the size and flavour of the fruit changes wonderfully. I have seen the small Guindy

plantain grown in a grass farm at Kilpauk, Madras, under the stimulus of night soil from the European barracks in the Fort, attain almost the size of a red plantain, averaging 7 to 10 inches in length, that it was difficult to recognize the fruit from its size and flavor. The same may be said of all varieties of the plantain.

The plantain grows in every part of India, and from about 5 to 6,000 feet above sea-level, the fruits are greatly esteemed by all classes for its easy cultivation and large produce, furnishing good, healthy, nutritious food. Its value is enhanced when it is known that every part of the plantain tree can be utilized. The roots and sap or juice is used in medicine, the sap possesses astringent properties from the tanic acid it contains, and has been used as a substitute for marking ink. It stains cloth a dark color, which it is difficult to wash out.

The underground stem, the tender shoots, the terminal flower bud, when it has become sterile, the peduncle and the green fruits are cooked into curries, and are much esteemed for such purposes, and sold in the bazaars. The spurious stem abounds in fibre which has been used for textile purposes, and cordage. The coarse or large fruited plantains yield the strongest fibre, the smaller kinds the finest fibre. It also supplies good materials for paper, &c., and a species of tow for stuffing or packing purposes, and the dried petioles or leaf stalks are cut into squares and used to keep snuff, drugs, &c., whilst the dried petioles are the most handy materials within the reach of the gardener or ryot, for tying fences, bundling grass, hundred and one other useful purposes it is put to. The leaves are used as plates by the natives to eat their rice off, and are always sold in the bazaar, for such purposes, realizing from 1 to 3 pies each. They are also used to dress blisters and other raw surfaces, to keep butter cool, and cheese from becoming dry. The dried leaves are also used for packing cigars, fruits, &c.

The fruit is greatly esteemed not only as a luxury, but to afford food, a good plantain is a most delicious fruit.

In some districts it is dried and exported; a trade is carried on with the dried fruits from the more Southern Districts to Ceylon. It is also exported from Bombay to other parts of the peninsula. The skins of the fruit are used to tan and blacken leather. The plantain tree is considered an emblem of plenty from the number and variety of useful products it yields, and in consequence it is used on all social and festive occasions by the natives to ornament their dwelling. It is also by some considered an emblem of sovereignty. There are many varieties of the plantain. Travancore and Malabar alone produce 40 different varieties.

Cultivation.—The plantain produces its fruit within the year, and as it is considered a most exhaustive crop, it requires transplantation once in every three years. The plan followed is to put down suckers during the month of August in large square pits 3 feet deep and 6 feet apart. It requires water and strong manure, the best is fresh horse or cattle dung; as suckers show themselves, they should be removed, leaving only two of different sizes to replace the parent stem, for, as soon as the first stem has ripened its fruit it dies, and should be cut out, leaving the larger of the two suckers to take its place, and in like manner the third supplies the place of the second when it comes to its turn to be cut out, after having perfected its fruit, when they should be removed from the locality altogether to another.

The native ryot values the produce of the plantain tree at one rupee each plant a year. The fruit, as a rule, is removed long before it attains the stage of maturity, and is then forced to ripen.

The green fruits are simply cut down and smeared with fresh lime (chunam) and hung up to ripen, or the clusters or spike divisions are separated from the peduncle or spike, and placed into a large pot packed in straw, on the mouth of this a smaller pot filled with straw is reversed and luted on to the lid of the larger one, with a composition made

of cowdung and clay, and then a small hole is made at the bottom, now uppermost, of the little pot, into which a live coal is forced, and the gardener or ryot applying his mouth to the opening blows into it to ignite the straw within, and force the smoke down into the larger pot among the fruits. This is done for 15 or 20 minutes twice a day for three or four days, guided by the stage of maturity, the green fruits had attained when packed to ripen, when the pot is opened on the third or fourth day, the fruits are found quite ripe and fit for removal. In some localities and much more rarely, the fruits are packed in straw and buried two or three feet under ground to ripen for a few days. The best plan is not to remove the bunch or spike from the tree till a few of the topmost fruits have ripened, when the bunch should be cut down and hung up in the house, in the course of a day or two the whole bunch will have ripened and turned yellow.

Forcing the immature fruit to ripen *destroys its flavor.* Few fruits are equal to a well ripened plantain of the best variety. Plantains grown in cold climates lose their sweetness and flavor and eat insipid and mealy. This is the case with fruits grown in Hot Houses in England I believe.

I also find this to be the case generally in Hill stations 3,000 to 4,000 feet above sea level during *the cold season.* The fact is the low temperature does not admit of the conversion of the starch of the fruit into sugar, and therefore it eats insipid and mealy.

The plantain is universally considered a most wholesome fruit, and is never absent at meals in most well-to-do families.

Plantain trees are liable to be blown down by strong gusts of wind, the weight of the fruit helps to bring it down,—lofty trees more particularly suffer in this way. They should be planted in sheltered localities, and even then, as the fruit forms, most of them have to be supported by stakes to prevent their breaking down.

A good bunch of plantains, if of the larger kind, will contain over a hundred fruits, whilst the smaller kind over

a thousand fruits, and weigh from 50 to 60 pounds each bunch.

"*Bananas or Plantains.*—In the Kadur District the Banana or plantain abounds. There are at least half a dozen varieties, and some of them are very delicious; but the only use to which they are put is to supply the desert at table. The consumption in this direction is but small, and consequently we come across them in the bazaars in a rotting condition, and unwholesome as food. Why cannot the excess be turned to some good account? Exporting them will be of no avail, for in most towns the supply quite meets the demand, and their fate there would be no better than here. Some of our Gowdaw cultivators have tried to turn the plantain tree to some use by making it serve the purposes of shade for coffee plants with what result we cannot say, for these people do things in a haphazard sort of way and keep no statistics. We learn from various sources that the fruit is put to various uses in parts of Africa. We need not confine our remarks to a single district; but may say that India abounds in bananas, or plantains, and it has been a subject of some curiosity to us why the fruit has never been employed in the distillation of fermented liquor. The common prickly pear has been utilized for this purpose in Malaga, and with considerable advantage to the distillers. We suppose it is the absence of any attempt to utilize indigenous products, due to a want of enterprise and depreciation of every thing Indian that it has never occurred to any one to extract alcohol from plantains. Other countries have not been so backward, however, for we are told by a contemporary that missionaries in the Congo region have discovered that a beverage can be made from bananas which is a preventative of malarial fevers; and adopting Paul's advice to Timothy they take a glass of this drink at regular intervals for their "stomach sake." Acting upon this hint, the Banana Liquor Company have produced a beverage as commendable for its wholesome qualities as for its delicious flavour, and this has secured a popularity almost as wide as it deserves. The sparkling banana liquor

is prepared from Jamaica bananas in either an alcoholic or non-alcoholic form, but even as a temperance drink it will keep for practically any length of time. It can be used with equal advantage as an ordinary liqueur, or diluted with hot or cold water or soda water. Mixed with the latter it makes a delicious and—judging from the experience of Congo missionaries —a particularly healthy beverage for hot climates. For the sterner temperature of northern regions, including England, it will probably be best esteemed in conjunction with brandy or other spirits. So combined it makes a splendid punch—milk-punch—it should be said if Dr. Richardson's remark that "bananas resemble milk in their composition more than any other fruit or vegetable" may be relied upon. The banana liquor was sold with great success at the New Orleans Exposition in 1884-85 and again last summer in the West Indian Court of the Colonial Exhibition."—*Bangalore Spectator.*

CASTOR OIL PLANT

OR

RICINUS COMMUNIS N. O. EUPHORBIACEÆ.*

THE castor oil plant (*Ricinus communis*) being synonymous with *Palma Christi* and *Pentadactylon* (from the shape of its leaves) belongs to a genus of a *pentalous dycotyledonous* plants, of the natural order *Euphorbiaceæ*. The Greeks called it Croton, a name now applied to a closely allied genus. The Romans remarking the striking resemblance in the seeds to the vile insect known as the Tick, which infests living animals, named it Ricinus, which name in Entomology is used for a genus of *Acari* containing the creature called Tick.

There are several varieties of castor oil plant. Recently some foreign varieties have been introduced from Italy chiefly. They may now be seen growing on the Government Farm, Sydapet.

The known varieties at present are —

1. *Ricinus communis, fructus major* (lamp oil).
2. do. do. do. *minor* (castor oil).
3. do. do. do. *major, var. rubra.*
4. do. do. var. *Armata.*
5. do. do. do. *Sollinger.*
6. do. do. do. *Arcuatus.*
7. do. do. do. *Rugosus chunveanus.*
8. do. do. do. *Subrisides.*

Of these several varieties, the two first known as the small and large seeded castor oil, are in general cultivation

* This paper was originally contributed to the Agri-Horticultural Society of Madras by Dr. John Shortt.

all over the warm countries of the world, in the south Europe and the east and west Indies.

In Southern India the castor oil is generally cultivated as an annual, with dry crops either of grain or pulse, and rarely alone, in almost every district, requiring no particular attention as a field crop.

The plant flourishes in a soft, loamy soil and requires ordinary ploughing and manuring; after a few showers of rain in July or August, the land is first ploughed and the seeds hand-sown in parallel rows: the seeds are planted at a distance of one foot apart from each other both ways, and they germinate in a week or ten days whilst the soil is turned up with a plough, some three weeks after, and in about four months, the plants begin to fruit. An acre of land will require from five to six Madras measures of seed.

It thrives in the plains as well as on the hills to about 5,000 feet above sea level. It grows rapidly into a tall lanky plant from 8 to 15 feet in height, generally forming a large terminal spike about a foot in length, springing from the terminating branches at the summit and sometimes two or more small side branches form, carrying smaller spikes of about 6 to 8 inches in length; each spike carries from 100 to 150 capsules which are armed with long flexible prickles, and are trilocular or 3-celled and about the size of a large marble when matured; the capsule bursts elastically expelling its seeds, usually 3 in number, to a little distance from the plant.

There are two sub-varieties of the large seeded or lamp oil castor plant, differing in their coloration and size of seed. In one the stem petioles and veins are of a purplish red colour and the seed larger than the other, in which the different parts of the plant are green and the seed somewhat smaller. As soon as a capsule on a spike ripens, it is cut down with the green fruits before they have fully matured to prevent loss by the bursting of the capsules and scattering of the seeds and placed out in the sun to dry to separate the seeds from the shells.

The small seeded variety grows into a large umbrageous tree 30 to 40 feet in height with a sturdy looking stout stem. Trees on my Estate now measure four feet in girth, one foot above the soil.

It is a handsome tree, and seeds freely, yielding 15 lbs. of seeds per tree per annum. The Sanscrit proverb in the 1st Book of the Hitopadesa says: "That where there are no trees, even the castor oil plant, ranks as a forest tree." It grows sufficiently large to produce specimens of wood, but is chiefly remarkable for the beauty of its large spreading leaves and the value of its seeds, which yield the medicinal castor oil. The stem suffers constant damage from white ants which are exceedingly partial to this tree; they eat through the heart wood of the living tree, leaving but a layer of new wood, alburnum, and bark, the hollow thus formed being filled with the debris of the white ant. The first blast of wind tears to pieces its branches or snaps off the stem. The bark is also constantly infested with insects which perforate it in all directions. The oil is chiefly used as a mild purgative in medicine and its utility as such has been known from the most remote ages and the seeds have been found with Egyptian mummies in Scarcophagi. In the arts it is used in the manufacture of soap, but its cost and smell preclude its general use. The clearness, limpidness and absence of offensive smell can only be obtained, not from superiority of seed, but from repeated decolorization with animal charcoal and exposure to the sun's rays, but these qualities when obtained partially destroy its medicinal qualities and efficacy.

The oil is obtained by two methods, either by expression or boiling. Years ago an oil press was established in Stringer's Street, Madras, by the late Doctor Gay, where the cold drawn castor oil was obtained by expression filtered through horse hair bags. The oil was considered good and was patronized by Government. The test of its purity is its being able to be dissolved completely in cold alcohol.

The large seeded variety furnishes the lamp oil of the

bazaars, which is so expressively termed *velookoo yennie*, Tamil.

The mode of extraction of the oil varies somewhat in the different districts. Boiling is the chief mode. In some districts the seeds are subjected to pressure in the common native wooden mill known as *Checkoo*, to crush the oil out.

Not only is castor oil used in medicine, but the juice of the leaves is given internally to increase the flow of milk. Cattle are fed with the leaves with the same object, most cows eat the leaves freely and readily. Externally the leaves are applied to wounds and bruises, when it acts as a detergent. The husk of the capsule is used as fuel and the oil cake forms an excellent manure and is valued on account of its regenerating properties which it imparts when applied to plants 1,400 lbs. of seed yield 480 lbs. of raw oil as follows :—

1st	Sort	...	...	318 lbs. of oil.
2nd	,,	...	...	88 ,,
3rd	,,	...	...	74 ,,

The cost of the oil is Rs. 76-1-0, viz. :

	RS.	AS.	P.
1,409 lbs. seed at Rs. 3-3 per bag of 164 lbs.	27	3	4
Husking, selecting, kernels, cooly hire ...	3	11	9
Preparing and boiling	2	7	1
Filtering and sundries	2	8	0
Overseer's pay, godown rent, &c. ...	1	6	2
300 empty quart bottles, corks, &c. ...	34	4	8
Cleaning and packing charges... ...	4	8	0

Or an average of annas 4 $\frac{17}{300}$ per quart of first, second and third sort oil = 4d. per lb.

From my own personal experiments, one pound of oil is obtained from three pounds of oil seed. The process consists in first scorching the seeds in an earthen pan over a fire, and then pounding them in a mortar to reduce them to flour. Two bottles of water are boiled, and into the boiling water, the pounded castor seeds are thrown and the

mixture is well and constantly stirred with a wooden ladle for a time till the oil gradually rises to the surface, and is skimmed off. A fresh supply of boiling water is added to the mass in the vessel and it is boiled for the second time to remove any remnants of oil it may contain. The whole of the oil obtained is now boiled to evaporate any water it may contain and the oil is then ready to be bottled for use. Care must be taken to see that the oil does not get burned in boiling.

The average out-turn per acre of seed is about 5 cwt., and 12 measures of seeds equal to 27 lbs. produce 3 measures or 7 lbs. of oil. A measure of oil weighs 144 tolas or $3\frac{3}{4}$ lbs.; thus 27 lbs. of seeds produce $11\frac{1}{4}$ lbs. of oil and the percentage may be reckoned at 40 to 45 per cent.

ORYZA, THE RICE.*

A GENUS of monocotyledonous plants, belonging to the Nat. Ord, Graminæ, the grasses and deriving its name from the Arabic word for rice Aruz. Two species have been described, but there is only one of any use O. Sativa, the common rice. Rice in the husk is called paddy, *Nelloo* in Tamil, *Dhan* in Dukhanie and *Oodloo* in Teloogoo, whilst rice itself is known as *Arisee* in Tamil, *Chawul* in Hindustanie and *Beum* in Teloogoo.

Rice is raised in immense quantities in India, China, and most eastern countries in the West Indies, Central America and the United States. In this Presidency the two great rice crops are the Car and Sumbah, the former is reaped in three and the latter in six months. Whilst a large variety of rice is grown and the natives prefer the small grain *Sheroga Sumbah*, whilst Europeans the large grain, such as the Carolina, the grains of which are not only large but clear and translucent. Rice is generally grown on the sea board and in the alluvial valleys of great rivers and is the common staple food on the sea board. In the Gangetic valley, in Lower Bengal and in Burmah, rice is extensively grown and becomes one of the staple articles of food of the people as well as a chief commodity of export. Rice is generally grown in wet land, but one species, the black paddy, is sown on dry lands and derives sufficient moisture for its growth from the monsoon rains without artificial irrigation, the average product per acre varies according to soil from 1,200 measures to 400 or 3,600 to 1,200 lbs.; an acre of irrigated land will produce enough food to feed from three to seven persons for a whole year. Rice is the grain which is said to support the majority of the human

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ce. Rice is husked whiter than that from the boiled paddy, consequently the former is termed "Table rice" and is that which is generally laid on our tables. It is preferred more on account of its color but is believed not to be so conducive to health as the rice from boiled paddy. People unaccustomed to the use of table rice or rice from the unboiled paddy invariably suffer from derangement of the stomach and bowels after eating it; this fact is well understood by the natives.

It is necessary that paddy should be kept at least six months before it is cooked to allow time for the complete consolidation of the grain. If paddy that has been recently harvested be used before that time, it invariably causes derangement of the bowels, no matter whether it be rice from the unboiled or boiled paddy: the more recent the age of the paddy, the more liable is it to derange the bowels.

For the cultivation of the Oriza Sativa or Rice, the ground is squared off into beds, varying in size generally averaging from 30 to 40 yards in length, and breadth, marked off by ridges or small bunds about two feet high and one broad.

This bed after being freely saturated with water, is thoroughly ploughed up and manured with wood ashes, or the usual rubbish from dung heaps. Frequently green herbs and shrubs are ploughed into the soil, the favorite shrub for this purpose being, the *Madar* or *Catotropis gigantea*. This plant is eagerly sought after during the cultivating season by the ryot. In the Cuddapah District, the leafy twigs of all trees are used for the purpose and one rupee is paid for every cart load. The ground thus prepared is covered over with water, and allowed to stand from two to four inches over the soil, to favor putrefaction, and create a "Puddle." In a few days, it is again ploughed up into a deep muddy mixture.

A piece of board tied on to the yoke of a pair of bullocks, is drawn over the puddle to equalize it. It is now ready to receive the seed.

The rice or paddy as it is termed is prepared for sowing by being steeped in water until it begins to germinate which generally occurs in, from two to three days, when it is conveyed to the field ready for sowing.

The seeds man takes as much seed as he can conveniently carry in the cloth around his waist and enters the field. As he passes from one end to the other, he scatters the seed broadcast, whilst an assistant carries a supply in a basket and walks along the bund to replenish the seeds man as the quantity becomes exhausted. The next day as soon as it is found that the seed has settled on the soil, the water from the field is let out, and the soil allowed to dry for some three or four days, by which time the seedlings will have sprung up, and have attained about two inches in height, when the field is irrigated, and the water allowed to stand a couple of inches above the soil and is so maintained till the harvest is gathered.

In some varieties of rice, the dry field is ploughed up immediately after a shower of rain, and the seeds sown. When the sprouts are between four and six weeks old, the field is irrigated for the first time and the water supply maintained till the grain ripens, and the stalks are ready for the sickle.

Nurseries are frequently prepared in the manner previously described, and the seeds sown. When the plantings have attained the age of six or eight weeks, they are transplanted into fields, prepared to receive them. The mode of preparing the soil is invariably the same.

During the 1st and 2nd months the fields are hand-weeded by women and boys, when should the plants be found crowded together at any place, they are removed so as to leave from four to six inches of space between each plant. If the seeds have failed at any part of the field, fresh plants are put in so as to complete the stand.

Should at any time the plants grow lanky, from eight to ten inches of the tops are cut away by the sickle, which by

resting their rapid growth, renders the plants much more fruitful.

1. Cado Caloothan; 2. Vella Sumba; 3. Seeroomany Sumba; 4. Pompaluy Sumba; 5. Esaracova; 6. Pall Sumba, and 7. Theeroovarungom Sumba; 8. Neeroala Sumba. These varieties of rice take six months to ripen their grain. They are generally sown in July or August and the grain is gathered in January or February.

1. *Vaday Sumba.*—This variety takes five months to ripen its grain. It is sown in August and the grain is reaped in December.

1. *Vallay Car.*—This variety is grown in four months. The seeds are cast in August and the grain is reaped in November.

Rice is in general use.—On being boiled with a sufficiency of water till the grain becomes soft, when the superfluous water is strained away and the rice allowed to cool, it is fit for food. It should not be overboiled into a pulpy mass, but the grains should be soft and not adhere to each other.

Rice flour is also in use for the preparation of cakes, &c.—For this purpose, the rice is either steeped in water and then pounded in a mortar and the flour subsequently dried in the sun or the grain itself is dried in the sun and then ground in a mill.

Rice cakes under the name of "Oppers" are in general use among most of the lower orders of Europeans, East-Indians and Native Christians. The rice flour is mixed with water and allowed to ferment over night. This process is frequently assisted by the use of toddy or the cocoanut tree sap. The next morning, it is baked into cakes. Frequently cocoanut milk is added to improve the flavour of the cakes, different kinds of sweet cakes are prepared from rice flour.

There is also a difference in the quality of new and old rice as the following experiments will show :—

New Rice.—Twenty-four and a half ounces of this rice

boiled in six pints and twelve ounces of water, took 90 minutes to cook. On straining the rice, the conjee water was 3 pints 8 oz. with a specific gravity of 1·005. *Weight* of the rice when boiled 64½ oz. The grains of the boiled rice are soft and inclined to be pulpy. If kept cold, twelve or sixteen hours, it parts with a quantity of fluid and becomes quite soft and unfit for food.

Old Rice.—Twenty-four and a half ounces of this rice boiled in six pints and twelve ounces of water, took exactly one hour to cook. The strained conjee water measured 3 pints: specific gravity 1·001. The rice weighed (after being boiled) 64½ oz. The grains of the rice were firm and fit for food, after 30 hours' keeping, and it had not parted with its fluid nor had become soft.

It will be seen that the new rice is boiled in half the time it takes to boil the old. The conjee water exceeds that of the old by 8 oz. and has a greater specific gravity; although the weight of both old and new rice is the same when boiled.

The new rice is sold in the bazaars generally in the months of January, February, March and April. In these months, bowel derangements prevail in the district, as also in the jail when the new rice is supplied.

MAIZE.*

Zea maize or Indian corn as it is popularly termed belongs to the Natural Order Graminæ the grasses. There are only two species known, both of which are exclusively American.

It is a native of America and by some authors considered indigenous to Africa and Asia.

It is not much cultivated in India as a field but as a garden cultivation, small quantities have been grown from time immemorial in most parts of India. The Tamil is *Mukka Cholum* and the Hindustani *Boota*: *Botanical characters*; herbaceous plants with round jointed pithy culms, saturated with saccharine juice; leaves, narrow, alternate with a split sheath and nominal ligules at its summit, monœcious, male flowers surmount the plant in panicles; female flowers spike or locustae, sheathing axillary, situated at some distance below the male flower. Flowers have chaffy, oval, bivalved, glumes enclosing, 2 flowers in each; stamens 1-6. Anthers versatile, ovary superior, one celled with 2 lodicules; ovule 1, styles 2 with fine long hair like filaments; stigma feathery, fruit caryopsis, embryo cuticular, external lying on one side at the base of the farinaceous albumen, germination endorhizal.

Agricultural terms.—The male flowers are termed *tassils*; female flowers, spike or ear; seed stalk, cobs, its covering husk; the filaments of the cob silk, the seed corn maize and the culms, stalks.

Commercial terms.—The seeds are called "Indian corn" when ground corn flour and there are preparations of it known as *Polenta* and Maizena.

* Contributed to the Agri-Horticultural Society, Madras, by Dr. John Shortt.

Varieties.—The best varieties of maize when well cultivated is very productive and its value as human food is well known, being considered superior to rice and other dry grains of India. An acre of maize in a good soil will produce 1,500 to 2,000 pounds of corn without any particular care being given to the plants and furnish 2 to 3 tons of fodder rich in saccharinic matter and proves a valuable fodder for cattle and horses.

If the soil be well cultivated and freely manured, it will make a good return; care must be taken to preserve the seeds from damage from insects or from the destruction of squirrels and rats. The seeds should be sown at a depth of from 1 to 2 inches and in rows at about three feet apart or at the rate of 30 lbs. an acre. In harvesting the cobs should be well matured and the outer covering or skin retained till the seeds are hardened and dry. Four varieties are occasionally met with in various parts of India; the large eared, small seeded pinkish, red eared and small grained black corn. The large white eared variety is the best and most largely produced, the others appear more the result of accident and are only occasionally found among the others. Porter says: "There are almost endless varieties, but the first principal distinctions are white and yellow."

Soil.—The best soil for the growth of Indian corn is garden soil, but it grows well on any soil when treated horticulturally; when grown as field culture, clay loams are best. At most places it grows in both a sandy loam and gravelly soil.

Preparation of the Soil.—The soil should be well turned up and freed of weeds and manured freely with rotten stable manure, the ground levelled, clods crushed and drawn out into parallel trenches about a foot apart. For field culture, the soil is ploughed up in the usual way manured, &c.

Sowing of Seed.—As a garden cultivation the seeds should be dibbled in at the distance of one foot apart on the edge of the ridges, next the trenches at a depth of 1 or 2 inches

and sparingly watered, subsequently it should be irrigated once in fair and twice a week in dry weather. Each hole should receive one or two seeds.

As a field culture the first shower of rain is taken advantage of, and the seeds are sown broadcast at the rate of 30 lbs. per acre.

Sprouts.—The sprouts will show themselves between the 5th and 9th day; from the time of their germination up to that of the tassels crowning their summits the plant cannot be readily recognised from varieties of cholum or shorgum, except by a practised eye.

Weeding.—When the seedlings are a week old, the earth should be loosened and the weeds removed, the plants will now stand between 4 to 5 inches in height; two and sometimes three weedings will be necessary ere the harvest occurs which will be in four months.

Insects, &c.—When the plants are young, they are liable to be destroyed by caterpillars, as they grow up. Cattle, goats and pigs should be prevented from entering the plantation or they will cause an incredible amount of damage in a short while. As the cobs begin to form, they will have to be protected from jackals, wild pigs, porcupines, field rats, squirrels, crows, parrots, &c.

Harvest.—When the cobs are well matured, they are broken off the stalks successively to prevent damage from rodents and birds, for all the cobs do not ripen at the same time. The stalks are cut when the harvest is complete and stacked to serve as fodder for cattle.

Threshing.—This operation is usually performed much in the same way as for other millets and cereals, viz., by being trodden under foot by cattle and the corn collected and winnowed to free it from chaff as well as from the broken seed stalks. If in small quantities women and children are employed to free the corn from the cobs with their fingers. Sometimes a flat piece of iron stuck to a bit of wood is held by the feet and the cobs after the first row of corn being removed, is drawn or scraped

over the iron to free the seeds; and a similar plan to the latter is followed in America, where a machine which much lessens the labor is also used.

I have seen Indian corn as a garden culture growing in most out-stations in Southern India and have also grown it myself. About a mile from Vellore on the great Western trunk road side, is situated a village called "*Totta Pallium*" where Indian corn is grown as a field culture on the same grounds year after year on rather a large scale. These fields can be seen distinctly from the road side as they are located in a valley immediately below the road; some portions of the cultivation are irrigated and others not. The corn stalks attain from 8 to 10 feet in height and the produce of each varies from 3 to 5 cobs.

It grows remarkably well at Palmanair and produces largely; two of the best cobs, I have ever seen, were grown at Palmanair; one was 12 and the other 10 inches long and covered from end to end with good sound seed; on another I counted 600 corn grains and that was by no means a picked cob. Indian corn grows well in most districts and produces 3 or 4 and sometimes 5 cobs on each stalk, but the average is 2 cobs per plant.

The green cobs are broken and sold at from 1 to 4 annas the hundred; these are purchased by women and are either boiled in the husk and retailed or they are freed of the husk, and toasted on a charcoal fire and sold in the bazaars: at Vellore 2 or 3 boiled or roasted cobs are sold for the pie during the season elsewhere 1 or 2 are given for the same money. The Hindoos preferring them boiled, and the Mussulmans roasted.

The following is the composition of maize:—

Moisture	12·90	per cent.
Nitrogenous matter	9·23	„
Starchy matter	68·75	„
Fatty or oily matter	3·63	„
Mineral constituents	3·93	„
Total...	100·00	

Maize has been considered deficient in nutritive qualities, but in countries where maize forms the chief article of food, the classes who most use it are generally robust and cattle fed on it speedily grow fat. In North America, maize is the principal grain in use and in parts of Africa it supersedes the use of rice. In America it is grown on the poorest lands and with very indifferent cultivation. Maize is prepared in several ways. It is made into puddings, the meal is mixed with wheat flour for bread; the dry grain loosely ground is sometimes boiled and eaten like rice and the corn is given to horses and cattle. It is not in such universal use, but in Oude it is rather extensively cultivated and the flour is made into bread and is called "Chabena." The stem and leaves when dry are chopped up and given to cattle. The grain is sold at 30 seers for the rupee; it is also common in Burmah and in Bengal and Orissa; the young cobs and corn are considered great delicacies at dessert, the cobs smeared with butter and toasted over a slow charcoal fire and the corn sweetened and boiled in milk. In fact "Boota" is a standing dish during the season, at dessert in most stations where it is grown.

The natives make it into porridge and cakes like other millets.

It has lately been brought into extensive use in England under the name of "*Polenta*" and "*Maizena*" which however are not the corn itself but the starch-like arrowroot to which they are considered superior in their qualities. I have tasted the meal which is of a beautiful white color and somewhat crispy; it has a most luscious taste and is somewhat satiating.

Maize germinates in four or five days, after sowing and attains about 6 inches in a fortnight and flowers at 6 weeks, attaining a height of 6 to 7 feet; the crop is harvested in about 4 months. One Madras measure of the corn weighed 2 lbs. 12¾ ounces, when thoroughly seasoned. Twenty averaged cobs yielded from 7 to 7½ pounds of maize,

valuing the straw at rupees 10 per ton and the grain at 50 rupees per ton (about 15 measures per rupee).

As food maize is superior to all the dry grains in use in Southern India and valuable for farm stock, horse, cattle, sheep, pigs and poultry eat it freely and thrive on it well.

The following Description is from a valuable Pamphlet by W. Robertson, M.R., A.C., Superintendent, Government Experimental Farm, Sydapet, on the Experiments with Queen'sland Maize under Dry Cultivation.

On the 9th of October 1869, 240 pounds of yellow maize was received from Sydney: it was a good fresh sample of the "one-hundred-and-twenty-day variety," and contained 82 per cent. of vital seed. Dried at 212 degrees Fahrenheit, seventy-eight grains weighed an ounce. It was distributed as follows :—

	Pounds.
To Collectors	68
Sown in vacancies in general crop ...	15
Do. for experimental purposes ...	157

2. *Soils.*—The soils of the different experimental plots are very similar in composition. As they have already been described in former reports, I would only remark that they are very poor and hungry, and contain on the average nearly 90 per cent. of sand.

3. *Preparation of the Seed.*—To prevent squirrels, rats, crows, &c., destroying the seed, it was all tarred. The process is as follows :—Take one and a half pints (about half a Madras measure) of hot water, and add about one-twelfth of a pint (about one-fourth of an ollock) of tar; stir well together. After allowing the solution to cool, pour it through about twenty measures of maize; mix together until the seed assumes a dark mahogany color, and then dust it with sand, saw-dust, or dry earth, to prevent the seeds adhering together. In America, it is usual to steep the seed for ten or twelve hours before it undergoes this

process; but I have not found steeping to answer here, excepting during dull or showery weather, the dry condition of the soil and the great heat of the sun being injurious to the vitality of the seed when in a softened condition. Whether this arises from the rupture of the cells by the too rapid escape of moisture, or from the silicious coating of the seed having been destroyed, rendering it less able to withstand the effects of a high temperature, I am unable to say. However, I have not found it beneficial to steep seed before sowing, when there is less than 10 per cent. of moisture in the soil, or when the temperature in the shade exceeds 80 degrees.

The areas of the different plots, the quantities of seed sown, and the dates of the sowings are as follows :—

	Area in yards.	Date of sowing.	Actual amount of seed sown.	Seed sown per Acre.
			POUNDS.	POUNDS.
Plot 1	5,774	October 12	36	30
„ 2	10,647	„ 18	54	25
„ 3	6,044	„ 31	40	32
„ 4	4,918	„ 26	27	26
Total ...	...	...	157	...

4. *Cultivation.*—The land being in good order, a deep ploughing, and a single cultivation, at right angles to the line of the plough, was sufficient to prepare it for ridging. Ridging was performed by the double mould-board plough. The drills were placed thirty-six inches apart. The manure was spread in the open furrows between the drills; to Plot 1 it was applied at the rate of twenty-five tons per acre; to Plot 2 at the rate of fifteen tons; and to Plot 3 at the rate of twenty tons. To Plot 1 in addition, two cwt. of bone-dust was applied. No manure was applied to Plot 4, the soil being in good condition, having carried no grain-crop since it was reclaimed from the jungle. After spreading

the manure, the ridges or drills were split through the centre by the double mould-board plough, the soil falling on the manure on either side and forming new drills. These drills were then consolidated and reduced to half their height by a single operation of the chain-harrows. A uniform seed-bed being formed, a gang of coolies then passed along the drills, making holes about two inches deep and ten or twelve inches apart; into these holes the seed was deposited by a gang of coolies following. Another turn of the chain-harrows completed the work.

The after-cultivation consisted of two hand-hoeings and three bullock-hoeings. So effectual was this cultivation that, after harvesting the maize, it was only necessary to plough once to prepare for gram, no weeding or any other cultivation being requisite. Estimating a pair of bullocks, driver, &c., to cost 12 annas per day, and a cooly rupees 5 per month, the average cost per acre will be nearly as follows:—

	RS.	AS.	P.
1 Ploughing	1	0	0
1 Cultivating	0	6	0
Collecting weeds	0	12	0
1 Chain harrowing	0	2	0
Ridging	0	8	0
Spreading manure	0	6	0
Splitting ridges	0	8	0
1 Chain harrowing	0	2	0
Seed 28½ lbs.	0	10	0
Preparation of seed and sowing ...	0	12	0
Cultivation during growth—			
2 Hand-hoeings	2	0	0
3 Bullock hoeings...	1	8	0
Scaring birds	0	8	0
Total Rs...	9	2	0

The farm-yard manure was worth 1 rupee per ton, and the bone-dust 2½ rupees per cwt. As these were only "four months' crops," and as they would appropriate only

very small proportion of the manure applied, it would be *unfair* to debit them with a whole cost of the manure. In this country there is no reliable data for calculating the duration of a manure: in England it is usual on heavy soils to charge farm-yard manure over four years; and on light soils over three years. However, I am not acquainted with any cultivated soils in England so poor as those constituting this Farm, and will, in these calculations, assume that the fertilising effects of fold-yard manure will only continue to operate during two years, and of bone-dust during three years.

5. *Observations during growth.*—The plants appeared above ground four or five days after sowing, and in a fortnight after, were six inches high. At the end of six weeks they began to flower, when their heights varied from six to seven feet. The weather was favorable during the early growth of the crop, and during the month of November especially so. The temperature in the shade ranged from 72 to 78 degrees, and showers were very frequent. Rain fell on twenty days in November, the total fall being 8·35 inches: during December the weather was not so favorable, though the showers between the 11th and 16th were very beneficial. Rain fell on nine days during this month, the total fall being 5·24 inches. No rain fell between the 25th of December and 15th January, and in consequence the crops suffered severely, many fine plants withering from the deficiency of moisture—the fact, that nine-tenths of the soil consisted of sand must be remembered. On the 16th of January a severe storm of wind and rain broke over this district, and the whole of the plants in Plots 1 and 2 were levelled to the ground: considerable damage was done to the plants on Plots 3 and 4. However, on these the cobs were just beginning to form, and the destruction was not so complete. It was deemed absolutely necessary to cut down at once the whole of the crop on Plots 1 and 2. Before this storm took place, the appearance these crops presented was very fine: the plants were from ten to eleven feet high, and many of the stalks at half their height were four inches in

circumference, and the crops were level and uniform throughout.

6. *Harvesting.*—Only about a month having elapsed since the bulk of the plants on Plots 1 and 2 were in flower, much the greatest proportion of the cobs were green and immature when this storm occurred—indeed, not 5 per cent. of the cobs were fit for gathering. It was useless, under the circumstances, to leave them longer in the field; we therefore commenced gathering the cobs on the 17th. They were easily broken off with the hand; they were then carted to the shed, and peeling commenced immediately afterwards. The outer skin was entirely removed, and the inner skin merely turned back so as to expose the grain to the free action of the air. By means of the inner skin, the cobs were tied together in pairs; they were suspended over ropes stretched across the rooms where they remained until fit for shelling. The cobs being so thoroughly soaked by the heavy rain, it was necessary, in order to prevent the corn moulding or sprouting, to dry them as rapidly as possible. Under ordinary circumstances, in a dry climate like this, I would prefer to leave the skin on the cobs until the grain is glazed and fully hardened. When the skin is removed too early, the grain dries very quickly, and the sample is shrivelled and inferior. Neither would it be necessary to suspend the cobs over lines, as was done in the instances recorded; if well matured and gathered during favorable weather, very simple precautions will suffice to prevent the corn heating. The fresh cobs before peeling weighed as follows:—

——	Actual Weight.			Weight per Acre.		
	TONS.	CWT.	LBS.	TONS.	CWT.	LBS.
Plot 1	3	3	24	2	12	13
„ 2	3	5	102	1	9	92
„ 3	0	17	28	0	12	105
„ 4	1	1	14	1	0	59

After the removal of the cobs, the straw was cut down, and after drying, was stacked. When perfectly dry and fit for stacking it weighed as follows:—

——	Actual Weight.			Weight per Acre.		
	TONS.	CWT.	LBS.	TONS.	CWT.	LBS.
Plot 1	3	6	64	2	4	16
„ 2	3	15	11	1	14	0
„ 3	3	4	103	2	11	10
„ 4	3	8	49	3	7	39

The straw was very rich in saccharine matters—indeed it was so sweet, that I frequently noticed the coolies with pieces in their hand eating it as they would eat sugarcane. It was stacked for consumption during the hot season. All kind of stock are particularly fond of it. The average cost per acre for harvesting, &c., was as follows:—

	RS.	AS.	P.
Gathering cobs	1	8	0
Carting do.	0	6	0
Peeling, tying, hanging, &c.	1	8	0
Shelling cobs, &c.	0	8	0
Reaping and sheafing straw	1	0	0
Carting, &c.	0	12	0
Total Rs...	4	10	0

The shelling of the cobs was chiefly performed by a small Maize-sheller made by Mr. W. G. Ainsworth, Sydney. With this machine, two men can shell 450 pounds of cobs per hour. The cost of the machine is about fifty shillings in Australia. The work is done very satisfactorily. A large shelling-machine, made by Ransomes and Sims, was occasionally employed, but the work done by it was much more

costly: it required three men to work it, and only husked 350 lbs. of cobs per hour. This machine cost £10 in England. It does not separate the corn satisfactorily.

7. *Yield of Grain, &c.*—The grain was not weighed until it was thoroughly dried—indeed, not until it was in a condition fit for packing: the returns are, therefore, 15 or 20 per cent. lower than they would have been had it been weighed in ordinary marketable condition. The following returns show the weight of grain obtained:—

—	Actual Weight.	Weight per Acre.
	POUNDS.	POUNDS.
Plot 1	1,851	1,551
„ 2	1,877	854
„ 3	1,063	851
„ 4	850	836

As issued for seed the sample contained 96 per cent. of vital grain. One Madras measure weighed 2 lbs. 12¾ ounces; and when dried at 212 degrees Fahrenheit 85 grains weighed 1 ounce. When thoroughly seasoned, 20 average-sized cobs yielded from 7 to 7½ pounds of maize. I have no personal knowledge of the proportion of corn that average-sized, native-grown cobs yield. The following is the only instance bearing on the subject that has come within my *own* knowledge:—Being anxious to experiment with maize, a supply was obtained in the Vellore District: it consisted of 10,300 cobs of the yellow variety. After drying, the cobs were shelled, and the total yield of grain was only 338 pounds. Thirty cobs only yielded one pound of grain: thus one Queensland Maize-cob yielded more grain than 12 of the Vellore-cobs.

Financial Results.—Valuing the straw at rupees 10 per ton, and the grain at rupees 50 per ton (about 15 measures per rupee)—prices I would readily give for either straw or grain of similar quality—we have the following results:—

—	Value of Straw per Acre.			Value of Grain per Acre.			Total Return per Acre.		
	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
Plot 1...	22	1	0	34	9	11	56	10	11
„ 2	17	0	0	19	1	0	36	1	0
„ 3...	25	8	0	18	15	0	44	7	0
„ 4...	33	8	2	18	10	0	52	2	2

The following is the average cost of production:—

—	Cost of cultivation per Acre.			Proportionate value of Manure per Acre.			Cost of Harvesting per Acre.			Total per Acre.		
	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
Plot 1	9	2	0	14	2	8	4	10	0	27	14	8
„ 2	9	2	0	7	8	0	4	10	0	21	0	0
„ 3	9	2	0	10	0	0	4	10	0	23	12	0
„ 4	9	2	0	...	...	...	4	10	0	13	12	0

The matter will stand thus:—

—	Plot 1 per Acre.			Plot 2 per Acre.			Plot 3 per Acre.			Plot 4 per Acre.		
	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
Value of straw and grain	56	10	11	36	1	0	44	7	0	52	2	2
Cost of production, &c.	27	14	8	21	0	0	23	12	0	13	12	0
Profit per Acre.	28	12	3	15	1	0	20	11	0	38	6	2

The large profit made on Plot 4 is due altogether to exceptional circumstances. The yield of grain from Plots 1 and 2 would have been much greater had not the effects of the storm caused the crop to be harvested before being matured.

In forming any conclusion on the results of these experiments, the wretched nature of the soil must not be lost sight of. Not only is it very poor in the elements of plant-food, but it is physically a bad soil. It parts with its moisture too rapidly, and during hot weather becomes very hard and compact. However, if such soils—and there is a large area of similar soils in an uncultivated state in this district—will under maize give a profit of 25 rupees per acre, the profit from maize cultivation on *good soils* must be large.

In the district enjoying the north-east monsoon, maize can be harvested in ample time to allow of a gram-crop being obtained before the hot season commences. Indeed, I question whether gram can be grown under more favorable circumstances than after a well-cultivated maize-crop; the best gram now growing at the Farm is on the land where the maize was grown. The profits from the gram-crop will be sufficient to pay rent and other charges not debited to the maize.

Nutritive Value of Maize.—As a food for the people maize is greatly superior to ragi, cumboo, cholum, &c. Many natives are extremely fond of it: though we protected our crops with the greatest care, it was impossible to prevent a large number of cobs being carried away. In America and several other countries maize forms the staple food of the people; and it is not less valuable as a food for farm-stock. Horses, cattle, sheep, pigs, and poultry eat it and thrive on it. A paragraph has recently been going the round of the Agricultural Newspapers, stating that the London Omnibus Company cleared £50,000 last year by substituting maize for oats in feeding their horses, and that the horses have done their work better, and have had less disease amongst them than when fed with oats. I have not had an opportunity of experimenting with maize to any extent in feeding horses in this country: I have, however, used a considerable quantity in feeding working-bullocks, and in the manufacture of mutton. Amongst other experiments, the follow

g were made to determine the relative feeding-values of gram and maize when given to working-cattle and feeding-sheep :—

—	February 2.	February 12.	February 22.	March 4.	March 14.	March 24.
Working-cattle.						
Weight of the pair fed *on maize.*	POUNDS. 1,762	POUNDS. 1,765	POUNDS. 1,799	POUNDS. 1,806	POUNDS. 1,806	POUNDS. 1,823
Weight of the pair fed on gram.	1,765	1,789	1,767	1,759	1,786	1,768

The animals were fed per day as below :—

1 Pair ... { 6 lbs. of maize. / 5 „ of tour. / 100 „ of cholum fodder.

1 „ ... { 6 „ of gram. / 5 „ of tour. / 100 „ of cholum fodder.

To be quite sure *that the animals were similarly worked,* I gave one animal in each pair gram, and one animal in each pair maize. Thus—

1 Pair ... { 1 bullock... ... ... Gram. / 1 „ ... ... Maize.

1 „ ... { 1 „ ... ... Gram. / 1 „ ... ... Maize.

For the first few days the maize was not readily eaten: however, at the end of a couple of weeks they ate it freely, and continued increasing in weight until, at the termination of the experiment, they had increased 71 pounds in weight. The other pair ate gram from the first, but they never made the progress made by the pair fed on maize; and at the termination of the experiment had only increased 3 pounds in weight.

Two lots of sheep, containing 6 wethers each, were put up to feed on the 2nd of February last. Each lot had as much gram-fodder as the animals could eat. Besides the gram-fodder, lot 1 consumed daily 3 pounds of bran and 6 pounds of maize, and lot 2, 3 pounds of bran and 6 pounds of gram : the results are as follows :—

Date of Weighings.	Fed on Gram, Average Weight per Head.	Fed on Maize, Average Weight per Head.
	POUNDS.	POUNDS.
February, 2	38·75	37
„ 12	39	37·33
„ 22	40·83	37·33
March, 4	43·83	39·66
„ 14	44·33	42·80
„ 24	45	45

As in the case of the cattle-experiment, so in this case the maize was novel to the animals, and was not eaten readily during the early part of the experiment. However, as soon as the animals got to like it, they made greater progress than those on gram. At the termination of the experiment, those on maize had increased 8 pounds per head, while those on gram had only increased 6·25 pounds per head. Satisfactory as these results are, I believe they would have been more so had the maize and gram been crushed and mixed together before being distributed to the animals. Gram and maize serve different purposes in the animal economy : the former is a flesh or muscle producer, while the latter is a heat or fat-former.

SUMMARY.

1. The seed is preserved from the attacks of squirrels, crows, &c., when perfectly tarred.

2. It is only advisable to steep the seed when the weather is dull and showery.

3. The seed is best sown on drills about three feet apart with intervals of ten or twelve inches between the seed. It may be planted two inches deep, at the rate of 30 pounds per acre.

4. Maize should always be *well* manured : from fifteen to twenty tons per acre may profitably be applied.

5. The cobs should be well matured before being gathered. If the weather during the harvesting of the crop be favourable the skins are best kept on the cobs until the seed is perfectly hardened and glazed.

6. From 2½ to 3 tons of dry straw per acre may be expected ; it is rich in saccharine matters, and is valuable for all kinds of farm-stock.

7. On good soils 2,000 pounds of grain may be grown per acre without extraordinary management.

8. One average-sized Queensland cob yielded more grain than 12 of the cobs grown in the Vellore District.

9. The average cost of production may be estimated at rupees 25, while the gross return will vary according to the quality of the soil from rupees 50 to rupees 60 per acre.

10. The profit may vary from 25 to 30 rupees per acre according to the quality of the soil : the better the cultivation, the larger the profits.

11. Queensland maize is only a 4-month crop, and may be harvested in time to allow of a crop of gram being grown before the commencement of the hot season.

12. Maize is valuable as a food for the people, more so, indeed, than ragi, cholum, cumboo, &c., generally cultivated in this district.

13. Maize is valuable for all kinds of farm-stock. A pair of working bullocks fed on maize increased 71 pounds in weight, whilst another pair fed on a similar quantity of gram only increased 3 pounds.

14. Sheep yield more mutton when fed on maize than on gram.

15. Maize can be sold at 50 rupees per ton, and leave a handsome profit to the cultivator.

16. The large quantity of straw yielded by a crop of maize renders this crop particularly valuable in a country like this.

17. Maize can be profitably cultivated on a soil so poor as one containing 90 per cent. of sand; but the better the soil, the better will be the crop.

18. Maize, for feeding purposes, is best given crushed, and mixed with some other food.

MILLETS.*

Millets.—A genus of Monocotyledonous plants belonging to the Natural Order Graminaceæ and composed of a large number of grasses with flat leaves and flowers in panicles.

The following millets are cultivated without irrigation; they being simply dependant on the rains and dews. All the millets prefer a light good soil well drained. The ground is ploughed up after a good shower of rain, in rather an indifferent and careless manner generally, and the seeds are thrown in broadcast in the months of July or August and the harvest is gathered either in November or December.

1. *Setoria Italica* (Panicum italicum) or Tenney reaped in four or five months.
2. *Panicum Milaceum* or varagoo reaped in six months.
3. *Pencillaria Spicata* or cumboo reaped in four months.
4. *Shorgum Vulgare* or cholum reaped in five months.
5. *Panicum Miliare* or shama reaped in three months.

All these grains are in general use as food. Of these, Panicum Milaceum or varagoo, Panicum Miliare or shama, Panicum Milaceum Var. Caday Cunny, are cooked by being boiled like rice and partaken of as food. These as well as all the others are ground into flour in a stone mill and the flour prepared into cakes. They are mixed with water and boiled into a thick gruel or porridge termed *cooloo*; made or boiled into a very thick paste or "stir about" termed *cullee*; these are the usual modes of cooking. Sometimes two or three kinds of grain are mixed and cooked in either of the ways detailed above.

* Notes contributed to the International Exhibition, of Works of Industry and Art, at the London Exhibition of 1862, by Dr. John Shortt.

Eleusine Coracana or Raggee.—This grain of which there are two chief varieties is often irrigated. The seeds are either thrown broadcast into the fields previously ploughed and prepared for the purpose like other dry grains or nurseries are made by forming large square beds 6×12 feet or smaller to facilitate irrigation. They are manured and the seeds sown in them and as the seedlings attain from 6 to 10 inches in height, they are transplanted from the seed beds to the fields which are previously squared and irrigated and into the soft saturated soil, the seedlings are planted and irrigated, once a week or oftener as required. It is extensively cultivated under wells during the hot season and requires a richer soil than the other dry grains, whilst it is the most prolific of cultivated grasses and is grown throughout India often making a return of a hundred-fold. It is known by the Tamil name of *Kayvaru;* Hind. *Raggee* and on the coast as *Natcheenee* and in English as the *Crow-Foot Grass.* It is in general use and forms the staple food of the Mysoreans, it is very wholesome and nutritious; of late years, it has been most successfully grown in Eurasian colonies and the husk has been carefully removed and the flour ground by an English Mill, has been used as a substitute for corn-flour to which it is pronounced by some to be superior in taste and flavour. The straw furnishes good fodder for cattle which they freely eat and thrive on. A fermented liquor termed *Bojah* is prepared from it and is freely used by Mahomedans and Mahrattahs as an intoxicating or exciting drink. The millets form the chief diet of the inhabitants of Mysore, the Northern Circars, Carnatic and Deccan by most of whom, they are freely eaten. The grain has a resemblance to the mustard seed in size and colour.

THE PULSES.*

Natural Order Leguminosæ.

The pulses comprise the order of leguminous plants, or the pea and bean family and are largely cultivated for food purposes, being used by both man and beast, supplying to the rice eating Indian the nitrogenous flesh forming material to his otherwise non-nutritious food.

1. *Lablab Vulgaris,* known in Tamil as *Mochaycottay* of which there are two chief varieties with white or purple flowers and large horizontal pods, containing 3 to 4 seeds. The tender pods are cooked into curries with the usual condiments. The dry pulse or cotyledons with the testa removed are used for cooking curries, the pulse itself is boiled with salt and freely eaten at all times and seasons when procurable. It is generally grown as a field cultivation and the seeds are sown with the different millets. Cattle are fed with the seeds and greedily eat the straw. As soon as the millet with which it has been sown has been harvested, this pulse is left on the field to ripen its pods. The seeds are sown in July or August and gathered in January.

2. *Cajanus Indicus,* known as the pigeon pea and in Tamil as *Thovaray,* and *Toor* in Hindustanee, is sown in July or August and gathered in January. It is sometimes sown alone, but more frequently with the different varieties of the millet. The green pods are cooked into curries. The dry pods are collected from the plants and beaten with sticks to separate the pea from the pods. The seeds or pea is then collected, mixed with red earth and steeped in water till germination takes place. It is taken up and dried in the sun for a couple of hours and ground in a large wooden

* This paper was also a contribution to the International Exhibition, of Works of Industry and Art, at the London Exhibition of 1862, by Dr. John Shortt.

mill to break up the seeds when it is freed of the testa. The cotyledons are now called dholl and the testa pootoo. The dholl is in very general use cooked into curries; sweet cakes are also prepared from it. The object of mixing red earth is to give the dholl a good bright colour and the testa or Pootoo is used to feed cattle more especially milk cows to increase their supply of milk.

3. *Phascolus Mungo* or blue gram, known in Tamil as *Oolundoo*, in Hindustani as *Moong*, is extensively cultivated by the natives; is sown in July or August and gathered in January: it is eaten boiled and it is ground into meal for the preparation of sweet cakes. It is also used to feed horses and horned cattle.

4. *Phascolus radiatus* or green gram known as *Putchay Pyroo* in Tamil, is also extensively cultivated as an edible pulse; it is boiled and eaten and is also cooked into curries. It is boiled in a chatty over the fire, pounded in a mill, the husks separated and the cotyledons used in curries, &c., in lieu of dholl. The flour of this pulse, is in general use as a detergent. Many people in this country prefer it to soap for washing their persons with. It is said to possess refrigerent properties and has the power of softening the skin when used as a wash, at the same time, removing grease and dirt from the skin. It is grown as a dry cultivation and the seeds are mixed and sown with the millets.

5. *Dolichos catiang.*—The small fruited Dolichos known in Tamil as *Caramuny Pyroo* is also sown with millets as a field cultivation; the tender pods are cooked as curries, and the pulse is cooked and eaten alone or mixed with other grains.

6. *Phaseolus max* or black gram, known in Tamil as *Karoopoo Pyroo* used much in the same way as the other pulses; it is sown in July or August and gathered in January.

7. *Phaseolus Aconitifolius.*—The aconite-leaved kidney bean, known in Tamil as *Tulka Pyroo* and *Moot* in Hindustani. It is grown as fodder generally and is eaten by the natives, being considered a small pleasant tasted pulse. The tender pods as well as the gram are cooked into curries.

THE MANAGEMENT OF SOILS,

UNDER CHINCHONA, COFFEE OR TEA.

In the consideration of this subject, it is necessary to understand, that coffee and Chinchona belong to the same natural order, *Chinchonaceæ* and that this extensive order, furnishes many important products, possessing tonic stimulant and febrifugal properties.

The genus Chinchona as at present constituted includes all the species, which yield barks, suitable for medicinal use; whilst tea belongs to the natural order *Ternstræmiaceæ* of which *Thea* is the genus and includes the various species and varieties that produce the commercial tea. The plants of this genus, possess stimulating and slightly narcotic properties and it is remarkable that *Theine* and *Caféine*, have been found identical as regards their stimulating and rousing influence on the brain especially in those unaccustomed to its use.

This group of plants, comprising coffee, Chinchona and tea are grown in common at different elevations, ranging from 2,000 to 5,000 feet above sea level, but under varying conditions of soil, climate, elevation and aspect at localities far apart from each other and in the consideration of the soils suitable to their growth or in view to maintaining their fertility, it is necessary, that we should consider, the predominating elements required for each of their growths successfully.

I will here give the analysis of tea and coffee separately, as these plants belong to different orders. The judicious planter will so conduct his operations as to bear in mind the various conditions of climate, season, rainfall and soil: he will bear in mind that there is a certain range of tem-

perature adapted to each of these plants, beyond the limit of which, they will not thrive or become productive.

	*Analysis of Tea.**	*Analysis of Coffee.†*
Potash	39·22	15·76
Soda	·65	18·98
Magnesia	6·47	4·26
Lime	4·24	26· 7
Oxide of iron	4·38	9·22
Protoxide of Manganese	1·03	„ „
Phosphoric acid ...	14·55	13·28
Chlorine	·81	8·35 (Sodic Chlorine)
Sulphuric Acid ...		2·79
Silica	4·35	1·29
Carbonic Acid ...	24·30	„ „
	100·00	100·00

From the above Chemical analysis, it will be seen that there is not much difference in these plants and that they are amenable to the same treatment, as far as their success is concerned; for it is a recognized fact that certain plants thrive only in such soils, where the necessary minerals required for their structural formation exist and these are to be found in the ashes of the plant. All the elements required for their successful growth exists, but in varying quantities and it thus becomes incumbent on the planter to supply these to the soil in the form of manure to enrich it, although we are ignorant as to how the different mineral elements, essential to the vitality of the plant exist in their organism; and that they are not combined in the form in which they are obtained from their ash, is admitted. Our ignorance in this respect, however, in no way affects what the progress of science has shown to be the most eligible form for adding them, when required to the soil; the soluable condition is that which is aimed at or

* The Tropical Agriculturist, Vol. II, No. 3, September 1st, 1882, page 259.

† Dr. Shortt's Hand-book to Coffee Planting, page 52.

ae nearly approaching it and our object must be to supply in the shape of manure, the various elements, required for the health and successful growth of these plants and this we must carry out in one or other of the following modes.

These plants require a damp or moist climate and they thrive at elevations where the solar heat is modified to a certain extent and therefore we find, that they flourish on the top or sides of hills and raised valleys where they can obtain the necessary amount of moisture for the greater part of the year, at the same time, they require a certain amount of heat to enable them to elaborate the materials required for their constitution and to maintain health and produce the different products, such as beans in coffee, alkaloid giving barks in Chinchona and leaves in tea for which they are especially grown.

In the management of such estates, the depth and quality of the soil, the aspect and age of the plants and the variety and amount of shade, they will require, will have to be decided on the merits of each of the different localities.

As regards tillage, care must be taken to loosen the soil freely and turn it up frequently to produce its oxidation and aid in its mechanical improvement. Not only individual estates but individual plants also in most estates should receive consideration, more especially when placed under varying conditions of season and plant growth. The law which permits a rest once in seven years to corn-fields and fruit trees, should not be forgotten as an overbearing and insufficient nutrition to plants, tell their own tale; when it is remembered that year after year, these plants remove large quantities, from the soil, of the elements that enter into the composition of the products of each and they must eventually tend to exhaust and impoverish the soil; under the circumstance, the object of the planter, should be to feed the plants with suitable food in the shape of manure, to maintain its quality and fertility by restoring the materials removed from the soil by each crop, and in the choice of manures, he should be guided by the estate, age and requirements.

MANURAL SUBSTANCES.*

MANURES have not received the attention they deserve and systematic manuring is ignored altogether by the agriculturist in India. Native farmers or ryots are totally ignorant of Agricultural chemistry, high farming or perfect tillage. They still follow out the practice of their forefathers of using such rubbish as they can readily obtain without expense; and it frequently happens that manuring is altogether ignored should it prove expensive either to procure manural substances or to convey them to the required locality. These difficulties might with a little attention to the subject be easily overcome. Manure is as essential to the plant as food to an animal. Therefore to secure not only success, but also a largely remunerative return it is essential that in all agricultural operations special attention should be paid to careful manuring which in quantity and quality should be suitable to each particular plant whether cereal, millet or pulse, &c. The native ryot from practical experience thoroughly understands the benefits that accrue from free manuring, and has recourse to such manure as he can procure in the most inexpensive way possible, although the resources at his command are frequently ample, as far as the material is concerned, if he would only give the subject the necessary attention. Manure consists of the straw which has served for litter, of the remains of plants, of the fluid and solid excrement of man and animals. These excrements derived from food contain all its constituents as demonstrated by chemical analysis, by the presence of the ash of bread and of flesh in the excrement, in about the same quantity as that found in

* This Essay was originally published in a Number of the Madras Revenue Register, by Dr. John Shortt.

the food of men and animals (and which have contributed to the formation of the blood and flesh forming elements), but they also contain in a much larger proportion nitrogen of the seeds, &c., consumed.

In the solid and liquid excrements are found the nitrogen and ash constituents of bread and flesh consumed as food, and these contain the several constituents in the same or nearly the same fixed relative proportions as in seeds.

We shall now consider the different substances available as manure in this country, and with that view divide manures into three classes, viz., Mineral, Vegetable, and Animal. We shall consider each of these separately.

Mineral Manures.—There are a variety of mineral substances available as manure. To begin with decaying granite well pulverized makes a good manure from the various minerals that enter into its composition consisting chiefly of quartz feldspar, mica, and sometimes hornblende. The proportions of the first three are believed to be three feldspar, two quartz and one mica. The ultimate elements of these comprise silica, alumina, potash, soda, lime, magnesia, lithia, iron, and manganese in small but varying quantities.

Lime is always procurable and forms a valuable manure either to use occasionally as a top dressing, or to form an element in the manure, the decomposition of which it facilitates while it renders the manure pit less noxious than it would otherwise prove. It is also useful in decomposing and improving soils, and when properly applied it improves the land permanently, and contributes an essential element in the constitution of most agricultural products. Burnt shells, old mortar, gypsum, refuse of soda-water sulphuric and nitric acid manufactures; burnt earth, broken bricks and tiles, silt and sands from tanks and river beds, marls, soda, potash, and magnesian earth, road dust, house sweepings and coal ashes (are available for manure) also salts, muriate, carbonate, sulphate, nitrate and acetates of potash and soda, sulphate of ammonia, phosphate and

super-phosphate of lime, tartrates, and acetates of iron, &c most of which are procurable in large quantities in India. These have not however been utilized hitherto, because the natives do not understand them and because they rest satisfied with their immemorial custom of using only such substances as their forefathers have been accustomed to and whose practical value they themselves have ascertained.

Vegetable Manures.—Wood ashes are valuable on account of the minerals they contain, and they are the principal ingredients that enter into the constitution of agricultural products be they cereals, millets, pulses, or other products. We find lime, soda, potash, phosphoric, acid, phosphate and sulphate of lime and magnesia (standing for the most part in the numerical order in which they are given) exist in wood ashes. They are known to form a most valuable manure, and are readily procurable in this country, where woods and jungles abound and where recourse to fire is frequently had to keep down the exuberant growth of weeds and shrubs and where also it sometimes becomes necessary to cut down trees. The efficacy of wood ashes consists in the large amount of saline and mineral matters, that enter into their composition. Although there may be some slight difference in the quantities of inorganic constituents of different trees, yet they will be found to have general, resemblance to each other, and thus firewood ashes will prove highly beneficial in this country where wood ashes can be readily procured independently of burning jungle, by the daily use of wood as fuel in preparing food, &c. The effect of wood ashes is considerable; besides their fertilizing property they are a good substitute for lime, being cheap and abundant. Some years ago I had an analysis made of wood ashes from the jungles which I subjoin, as the wood and shrubs of these jungles, here referred to, are much the same as that met with

n most villages and country around. The quantitative analysis of this ash gave the following results as to its composition in 100 parts:—

Silicious earth	30
Sulphate of Lime	10
Sulphate muriate of soda	8
Carbonate of Lime	40
Oxide of Iron	4
Loss	8
Total...	100

Weeds of every description green, dry, or burnt are valuable as manure. The natives prefer those that contain milky juices, and for that reason the Mudar plant (Asclepias gigantea) milk hedge (Euphorbia tiruculli), &c., are in much use. In South Canara the Nux Vomica leaf and twigs are in great requisition for manuring rice fields; in the Cuddapah District the small branches and leafy twigs of trees in general are sold for one rupee the cart load and are generally taken advantage of by the natives to manure rice fields with, and in many parts of the Northern Districts as well as in Malabar, the greater part of the straw with the stubble roots is left on the rice fields and subsequently ploughed in; but in the Southern Districts, the straw is not only cut quite close to the soil, but the stubble roots are also subsequently picked out in order to be used as fuel. All decayed wood and barks of different kinds, the refuse of indigo vats and tan pits are valuable as manure.

All weeds, prunings, &c., in fact all decomposable vegetable matter in a state of decay constitute humus or vegetable mould and as such should prove peculiarly acceptable to the agriculturist. The cost of a cwt. of weeds in most districts will not exceed one or two rupees. All the weeds on the Estate and those growing on the road sides and hedges in the immediate vicinity should be collected and

conveyed to the dung pit to add to the supply of manure The better plan would be to procure weeds and other vegetable refuse and put down a layer of 12 or 18 inches deep in the first instance, and then to cover it over while in the green state with 6 or 8 inches of soil, thus forming a square heap of several layers in thickness. To keep the mass in position it might be walled round with stakes four or five feet high, plaited with twigs and branches when procurable in the vicinity. This, in a little time, would be sufficiently decomposed to be fit for use, and by covering in the weeds when green, none of the volatile gasses will escape, and the moisture will favor or hasten its decomposition. The earth from its absorbent power will soak up every portion of the moisture from the green or fresh weeds, and thus be rendered doubly valuable. The best kind of soil to use for the purpose will be silt from the swamps, tanks, or nullahs should any exist in the vicinity. This soil should be carefully taken up to the extent of 8 or 12 inches in depth annually and laid while fresh or moist over the vegetable matter, and any kind of common soil laid on this to the extent of an inch or two. This plan will answer extremely well. It is certainly surprising to see the amount of vegetable matter lying about unutilized, the agriculturist forgetting that vegetable refuse and the leaves shed by trees by accumulation and decay promote the luxuriance of our best forest lands. Whilst trees drive their roots to some depth into the soil and draw their nourishment therefrom, they elaborate the same into leaves, and when these leaves have answered their purpose, they shed them and thus return them to the soil. These fallen leaves instead of being utilized as manure, are taken away to be used as fuel, or are allowed to lie about to be scattered by the winds, or washed away by the rains. No better manure can be secured than fallen leaves, for by a little forethought, and the addition of some lime or common

salt, they could be rendered invaluable for manuring purposes.

Green manures are frequently used for rice fields, chiefly by native agriculturists, being buried by them in the puddle created in rice swamps. All kinds of weeds, and shrubs, and the leafy twigs of trees are the best. The proper time to use them is when they are about to flower when they should be ploughed into the soil. Plants obtain from the atmosphere most of their carbon, which is the chief ingredient in all of them, and when they are ploughed into the soil, they impart to it more decomposing matter than they ever derived from it. Weeds of every description, grasses, clipping, &c., come under this head and might with advantage be dug or ploughed into the soil in their fresh state; but care must be taken to prevent them from breeding insects, as from the great heat resulting from their decomposition, they may prove injurious to living plants. This however is not the case when they are given to the soil in which they undergo the necessary changes, and are prepared to nourish seeds or plants subsequently. The addition of quick lime about 1 or 2 pounds to every cooly load which is often necessary would aid in producing rapid decomposition. The addition of the same quantity of common salt (muriate of soda) will prove also a valuable adjunct.

Charcoal.—This substance is invaluable as a manure. From its great absorbent power and retains in the soil, not only moisture, but also the various volatile gases that would otherwise be dissipated. This property of absorption renders it doubly valuable for while it holds and keeps back noxious gases, acting as a powerful disinfectant and absorbs, if exposed to air, both air and moisture in the vicinity of plants, becomes gradually dissolved by its combination with oxygen thus forming carbonic acid, which when supplied to the roots increases their luxuriance and produc-

tiveness. This fact has been practically demonstrated by Savants.

Poonac or oil cake is useful as manure.—The following kinds are available, but are seldom utilized in this country as manures in agricultural operations, viz., cake made from gingilie seeds (see Sesamum orientale) Eloopai (Bassia longifolia), Castor oil (Ricinus communis), Lamp oil (Ricinus communis fructibus majoribus), Mustard (Sinapis nigra), Cotton (Gossypium), Neem (Azadirachta Indica), Pinnaekai (Calophyllum inophyllum), Ground nut (Arachis hypogœa), and Cocoanut (Cocos nucefera). All these oil cakes possess more or less the same properties. The cake made from gingilie seeds, cocoanut and ground nut are in use for cattle as food, and in most places can be purchased at from three to seven rupees the cwt. Of the other varieties eloopai is in use as a soap in washing, and acts as a good detergent in cleansing the skin; the rest are either used as fuel or thrown on the dung heap and may be purchased for a rupee or two the cwt.

These several oil cakes chiefly consist of water, oil, sugar, albuminous compounds and ash; and the ultimate elements of the ash comprise silica phosphates, and free phosphoric acid all of which are invaluable to the agriculturist.

Animal Manures.—Farm yard manure. By this is meant the dung and urine of cattle, sheep, goats, pigs, &c., with the refuse litter or straw rubbish, &c. These should be carefully preserved and used as manure. With reference to the kinds of manure "the best is the excrement of birds, then comes that of man, and lastly that of cattle, the last always varying in quality. Ass' dung is the best, then follow sheep's dung, and that of goats, horses and cattle; the least efficacious of all is the dung of swine.

No attention is given by natives generally to the proper

collection, and preservation of the dung and urine of animals. Although most of them keep cattle, and some have small herds, their droppings are not carefully collected for preservation, and used as manure. They have no separately built cow houses and even when they have, no precaution is taken, and so the urine is absorbed into the soil and runs to waste. The cow house, if one exists, has not its flooring so constructed as to save the urine, nor do natives go to the trouble even when they can afford the expense of furnishing litter or straw to absorb the moisture of the cow house. The dung is more frequently converted into sun dried cakes under the name of bratties, and used as fuel. Although some natives keep poultry, no attempt is made to collect their dung. Pigeon and poultry dung is very valuable as will be seen by the following analysis taken from M. Giardin's work on Manures:—

	Fresh dung of pigeons.	*Fresh dung of poultry.*
Water	79·00 ...	72·90
Organic matter acting as manure	18·11 ...	16·20
Saline matter acting as a stimulant	2·28 ...	5·24
Gravel silicious sand	0·61 ...	5·66
Total...	100·00	100·00

The dung of doves (pigeons) says Morier is the dearest manure which the Persians use, and as they apply it almost entirely to the rearing of melons, it is probably on that account that the melons of Ispahan are so much finer than those of other cities. The revenue of a pigeon house is about a hundred tomauns per annum; and the great value of this dung which rears a fruit that is indispensable to the existence of the natives during the great heats of summer will probably throw some light on that passage of Scripture where in the famine of Samaria, the fourth part of a cab of dove's dung was sold for five pieces of silver. "Since this

paper was written, I have used pigeons' dung to old and decaying English fruit trees. The effect was most wonderful, the youthful appearance these trees put on and the vigour with which shoots were pushed out, change the appearance of the trees completely.

The dung was procured at Madras, collected from the pigeon cotes of several friends, and with cooly hire, the transport to the Shevaroy Hills cost one rupee the cwt., and I had no occasion to regret the experiment. I am not aware of rabbits dung being utilized in this country to any extent as a manure, but it has been used with great success in other countries, and it has been found profitable to keep rabbits in such a manner as to preserve their dung for manural purposes. Urine of all animals is extremely valuable as manure. It contains in a state of solution large quantities of the essential elements of vegetables requisite for the health and well being of agricultural products. It should be remembered that urine readily decomposes by a putrefactive process, and therefore if not used mixed up with solid manure it may with advantage be used in its recent state diluted with water. The species of urine that contain most albumen gelatine and urea are the best manures. The following table giving the constituents of the different kinds of urine is taken from the table of analysis, comparative values and equivalents of manure.

(Translated from the French of M. M. Boaessingault and Payen.)

Names of Substances.	Normal Water.	Nitrogen in 100 parts of the substance dried.	Nitrogen in 100 parts of the substance in its normal state.	Values.		Equivalents.		Remarks.
				Substance dried.	Substance in its normal state.	Substance dried.	Substance in its normal state.	
Farm yard Manure. ...	79·3	1·95	0·40	100·	100·	100·	100·	It is a matter of surprise now the urine of men and animals (horses, cattle, goats, pigs, &c.) is allowed to run to waste in this country from the natives not understanding their value.
Solid excrement of Cows.	85·9	2·30	0·32	117·9	80·	84·78	12·5	
Do. of Horses.	75·3	2·21	0·55	113·3	137·5	88·2	72·7	
Urine of Cows.	88·3	3·80	0·44	194·9	110·	51·3	90·9	
Do. of Horses.	79·1	12·50	2·61	641	652·5	15·6	15·3	The horse drank very little, urine very thick.
Mixed excrement of Cows.	84·3	2·59	0·41	132·8	102·5	75·28	97·56	
Do. of Horses.	75·4	30·2	0·74	156·9	185	64·56	54	Result calculated.
Excrement of Swine. ...	81·4	3·37	0·63	172·8	157·5	57·86	63·4	
Do. of Sheep.	63·0	2·99	1·11	153·3	277·5	65·2	36	
Do. of Goats.	46·0	8·93	2·16	201·5	540·	49·6	18·5	
Pigeon's Dung.	9·6	9·02	8·30	462·6	207·5	21·4	4·8	From Bechebrun.
Urine of Public Urinals.	9·57	17·566	16·853	900·3	4213·25	11·1	2·37	Dried in stove.
Do. do. do.	96·889	33·108	0·715	118·5	178·8	8·4	55·94	Ammonia included.

Night Soil.—This is a most valuable and powerful manure if properly applied. A powerful manure made from the contents of necessaries and mixed with charcoal, gypsum, &c., is known by the name of Poudrette.

If proper arrangements were made and proper sites prepared as latrines at different parts of our rural villages, and the people were compelled to resort to them when requiring to relieve themselves, instead of creating a nuisance as is now done, by the practice of resorting to the open or anywhere, a most valuable supply of manure would be at the disposal of village communities. Although night soil differs in composition from other descriptions of manure enumerated here and is extremely liable to decompose, it contains a large amount of carbon, hydrogen, nitrogen, and oxygen, all of which are essentially necessary for plant life; and in whatever state applied, either fresh or decomposed it supplies food for plants in abundance. Quick lime or charcoal will readily destroy any bad smell that may arise from it, or a layer of fresh soil one inch thick will be found sufficient not only to absorb and retain the gaseous matter, but also to remove all offensive smells.

Liebeg gives the following ultimate analysis of fæces (night soil) by Playfair :—

Carbon	45·24
Hydrogen...	6·88
Nitrogen Oxygen	34·73
Ashes	13·15
	100·00
Water	300·00
Total...	400·00

Berzilius gives :—

Water...	73·3
Albumen	0·9
Bile	0·9
Mucilage, fat and other animal matters ...	16·7
Saline matter	1·2
Undecomposed food...	7·0
Total...	100·00

According to Playfair 5½ ounces of fæces are allowed daily to each soldier on an average; they contain 75 per cent. of water, and the dry residue contains 4·524 per cent. of carbon and 13·15 per cent. of ashes, but if we make allowances for the vegetable diet of natives and even take it at one-half the quantity given here, we can see at once the advantage gained by a village community in proportion to its size and number. For instance, if we start at 50, we shall have about 9 pounds of night soil added to the dung pit.

Our own personal experiments with the natives give on an average three ounces of fæces daily to each individual.

As regards the so-called farm yard manure in this country, it depends entirely on the amount of the incombustible materials formed in the ash of plants and its value is accordingly determined.

Bones prove valuable in consequence of the large amount of phosphate of lime they contain which forms a most essential ingredient in the composition of agricultural products. The natives, however never, as a rule, take advantage of bones as a manure. In order to render them effective, they have to be crushed first and then digested with sulphuric acid. To do the former a crushing mill of some simple construction is necessary, and in the use of the latter, much care is required. It must not be entrusted to any, but intelligent hands, to prevent accidents; there being risks in which agriculturists may not like to involve themselves. Sulphuric acid is manufactured by Messrs. Barrie & Co., at Madras, from whom it can be procured in any quantity at 4 annas per pound. The acid can be sent to any part of the country, and is usually put into green stoppered bottles, well secured with dammer and straw ropes. Bones can be reduced to powder in a much simpler way without the aid of sulphuric acid. Caustic potash will be found equally efficacious as a manure. To effect this, the bones should be packed into casks or cisterns in layers of 6 or 8 inches deep, and covered over with a layer of fresh wood

ashes to the extent of two or three inches, bones and ashes forming successive layers till the cask or cistern is filled. Care, however, should be taken to see that the outer layer be one of wood ashes which should be laid on much thicker than any of the others. It should be at least 8 inches deep, so as to prevent any of the volatile elements that may become liberated from escaping. This should be done as wood ashes become available and the packages allowed to lie for a season, when should they be emptied, the bones will be found in a state of powder, or in so friable a state as to be crushed into powder by the hand. This powder should be distributed to the plants.

Bones according to Beryilius contain 55 per cent. of the phosphates of lime and magnesia. But bones will be found to differ materially in their constituents, according to the different animals from which they are taken.

According to the analysis of Foureroy and Vauquelin ox bones are composed of :—

Decomposable animal matter	51·0
Phosphate of Lime	37·7
Carbonate of do.	10·0
Phosphate of Magnesia	1·3
Total ...	100·0

M. Merat Guillot has given the following estimate of the composition of the bones of different animals. The bones of old animals are proportionally more valuable than those of young ones, as in the former the quantity of earthy matter is greater which renders them brittle, while the young owe their toughness to the greater quantity of animal matter :—

Animals.	*Phosphate of Lime.*	*Carbonate of Lime.*
Bone of Calf ...	54 ...	.....
,, Horse ...	67·5	1·25
,, Sheep ...	70· ...	5·
,, Elk ...	90· ...	1·

Animals.	*Phosphate of Lime.*	*Carbonate of Lime.*
Bone of Hog ...	52· ...	1·
,, Pullet	72· ...	1·5
,, Hare ...	85· ...	1·
,, Pike ...	64· ...	1·
,, Carp ...	45· ...	5·
Horses' Teeth ...	85·5 ...	2·5
Ivory ...	64· ...	1·
Hart's Horn ..	27· ...	1·

The remaining parts of the hundred must be considered as decomposable animal matter. Human bones, according to Marchaud and Berzilius, consist of :—

Cartilage insoluable in Muriatic acid	27·23
Soluable in Muriatic acid	5·02
Vessels	1·01
Basic Phosphate of Lime	52·26
Fluoride of Calcium	1·00
Carbonate of Lime	10·21
Phosphate of Magnesia	1·05
Soda	0·92
Chloride of Sodium	0·25
Oxides of Iron and Manganese and loss ...	1·5
Total...	100·00

Thus it will be seen at a glance how essential the constituents of bone are to the Agriculturist. That phosphates are of the greatest importance to agricultural products, will become apparent at once, for they enter not only into that of their straw, or stems but as a manure, their fertilizing influence is perennial. Bones are readily had for the trouble of collecting them and the more so, as they are not sought after in India to undergo the process of boiling as in England on account of the grease they contain, and any expense in pulverizing them will be made up by the increase of fertilizing power they give to the land. Grinding, crushing, rotting and burning are the usual modes ; but to render these more largely productive, Professor Von Liebeg

recommends the use of sulphuric acid. Pour over crushed bones or bone ashes half their weight of sulphuric acid diluted with four parts of water and digest for 24 hours—add one hundred parts of water. Although bones digested with sulphuric acid form an extremely valuable manure, it is scarcely ever had recourse to in this country except perhaps in a very few exceptional instances by European planters, as its manufacture would be attended with much labour and expense to the Agriculturist. It is necessary, therefore, that he should take advantage of such substances as are in his immediate vicinity, and which will prove equally valuable. Animal charcoal when procurable is as valuable as vegetable and might with advantage be brought into use in the manufacture of manure, nay all animal substances from the putrid carcase to the dung are exceedingly valuable.

Fish manure is scarcely ever utilized in this country; but recently some attention has been given to the subject on the Western Coast with a view to exportation owing to the high price now asked for guano. Large quantities of fish oil are manufactured along this coast, and the refuse if properly conserved and utilized would prove an invaluable source of manure owing to the amount of ammonia they contain, and in this respect fish manure approaches guano. Not only the refuse from oil making, but refuse fish with the offals is now wasted and thrown away to rot on both our eastern and Western Coasts which, if collected and conserved in each coast district, would not only become a valuable source of manure supply, but will eventually become a good marketable commodity and a source of livelihood to many poor people in these parts.

Artificial Manure.—These have of late been attracting notice among the planting communities owing to the rapidity with which they renovate feeble or sickly plants. The great drawback however to their general use arises from their evanescent nature, rousing the plant rapidly for the time being, as it were, without stability to support it for any length of time subsequently. Planters frequently prefer

artificial manure as from its concentrated state it can, with facility, be distributed without the expense of much labour. But it is liable to be washed away by repeated showers of rain, and thus half its value lost after much expense and trouble have been expended on it; whereas cattle or farm yard manure is more lasting and would prove equally valuable if the farm stock be fed and fattened, instead of being grass-fed and kept at so low an ebb as is just sufficient to keep them alive. The super-phosphate of lime obtained by digesting bones with sulphuric acid would, in our opinion, prove much more valuable as a manure than guano. The process for preparing this substance has already been detailed in this essay.

Manure pit.—Every Agriculturist should maintain on his Estate one or more manure pits in proportion to its size and extent, according to the requirements of the estate. The bottom and sides of these pits should be either metalled or fixed with stones, or what is better built pucka with brick and chunam into a cistern and covered with thatch. Into this pit not only the dung and urine from the cowsheds, but the contents of privies and latrines should be emptied, all vegetable and animal refuse, washings of meat, fish, &c., weeds, decaying wood, &c., should be thrown in and once a week or fortnight a fine layer of charcoal or quicklime must be dusted over, and a layer of about one inch of soil be spread over all. By following this system, the pit will be completely deodorized and at the same time decomposition will be facilitated, so that in a few months a valuable supply of manure, rich in fertilizing properties and containing all the elements necessary for any produce either field or garden, will become available.

If it is necessary to prepare manure on the spot, the best kind may at once be manufactured by mixing equal parts of wood ashes and rotten farm yard manure to which if procurable, a twentieth part of pigeon's or poultry dung may be added. This manure can always be prepared on the spot, and will be found on analysis to carry the elements necessary for the nourishment of all agricultural products.

Lime when procurable should be added in small quantities. As an artificial manure that known as "Perindorge's Receipt for Manure" (*vide* Dr. Shortt's Hand-book to Coffee Planting in Southern India, page 72) would prove very valuable as it can be prepared in any district and will be ready in about twenty or twenty-five days from the commencement of the preparation. Thus there will be made a heap of most valuable manure which will suffice for four acres, at the rate of from 400 to 500 bushels of manure per acre, increased or decreased in proportion according to the more or less exhausted condition of the soil. The object of Perindorge's process is, in the first place, to hasten decay in the vegetable matter, by artificially exciting fermentation, and the chemical changes dependent on that action. This effected the other materials which the vegetable matter does not possess in sufficient quantity are then added, and in a manner that prevents their dissipation and loss. The whole mass is thus brought into the condition most suitable to be taken up by the roots of plants. Cattle manure is, of course, the best form in which nutriment can be furnished to all agricultural products, and the compost made, according to Perindorge, is a tolerably close imitation of cattle manure.

It must be borne in mind that cattle discharge no materials as manure either excrement or urine which they have not previously taken in with their food. The vegetable matter which forms the basis of this artificial manure is however equal in quality to what cattle generally consume although rather deficient, but not altogether wanting in some materials. These manures are in a manner not only most economical, but also calculated to preserve the agriculturist from loss. The cattle manure used is intended not only for its own inherent value, but for assisting by a well known chemical law, the assimilation of the other materials, to the same condition as itself. A few cattle will sufficiently answer this purpose although the amount of their manure if used alone would be of little avail. The cow is a small laboratory in which chemical changes are

continually going on, and Perindorge's manure is the making of an artificial imitation of a cow on a large scale. Rather it should be said that it closely resembles so much farm yard manure that it consists of a supply of carbonacious matter in the condition most suitable for supplying the fields with this prime necessary, with the salts (both of excrement and urine) universally, equally, and in sufficient quantity diffused throughout the mass. If the necessary attention be paid to this particular kind of manure after the manure detailed here, it will be found rich in fertilizing properties and a few cwt. to an acre supplied annually will add more to the productiveness of most agricultural cultivation than cart loads of rubbish we have frequently seen used under the name of manure. In the use of manure, care should be taken that it is not allowed to be exposed for any length of time, by which the essential ingredients will be volatilized and thus the most valuable part of it be lost, but the soil should be well prepared, and as soon as the manure is deposited be ploughed into it immediately.

The manure from the pit should have rotted thoroughly before it is taken up, for if used whilst in a state of fermentation it may do harm to living plants. The manuring of soils should be carried out annually, unless the crop is of a very exhaustive nature, when it should be carried out after each successive crop has been harvested.

CULTURE AND PREPARATION OF VANILLA.*

VANILLA planefolia and Claviculata, a genus of Monocotyledonous plants belonging to the *Natural Order*, Orchidaceæ, the name of which is derived from the Spanish word "Vaynilla," a knifé or scissors' case, the fruit having the appearance of the sheath of a knife of which there are five varieties,—whilst the *Epidendrum Vanilla*, the fruit of which is believed to be the Vanilla of Commerce.

Vanilla is a creeper and flourishes in hot and moist climates. There are two kinds in the country easily distinguished. The small vanilla is generally met with and come originally from Mexico; it is the best kind, the large vanilla with large thick leaves, is an inferior kind, the pods of which fall off before reaching maturity.

Vanilla sets its suckers at the base of trees which serves it as a support or protectors, or at the foot of walls and fences. The sucker ought to have at least 3 joints or nodes and some 4, 5 and even more according to the kind of supports they cling to.

A plantation of 2,400 suckers, growing at my place last year in the month of May, reached the height of 10 and 12 feet and fruited the same year and are now very healthy but, I should mention, that the vines were cultivated and attended to, immediately after shooting out.

Any tree is good as a protector with the exception of those which shed their bark; the best are the mango;* black wood;† dragomner,‡ &c.

* Mangifera, Indica.
† Dalbergia, latifolia.
‡ Dracœna-draco.

* This Essay was originally translated for the late "Neilgherry Excelsior," and subsequently submitted to the Agri-Horticultural Society, Madras, and published in their Proceedings of the 3rd March 1875, page 17. This paper is a fresh translation of M. De Floris (of the Isle of Reunion), Pamphlet on Vanilla, by Mrs. A. J. H. Shortt, with notes by the Editor.

The pignon d' Indé* for exception cannot be grown alone as on account of its wintering and losing its leaves at the time the vanilla is in bearing, the sun striking just at that time upon the vanilla pods, dry and wither them very much; therefore, it is better to plant other trees amidst the pignon d' Indé, so that their leaves may help to afford shade, when the vanilla has no leaf protection from its own stem. Trees used as supports, ought to be planted 5 feet by 4 east and west, or 6 by 5, according to the space of land one possesses. They might even be planted 6 × 6 to give more air and ventilation.

* Indian Pine apple.

The system of 5 by 4 which I adopt in my new plantations of long dragon* trees, is the one I prefer; it is essential to make the cables or vines, go from east to west, to prevent too great crowding and knotting together on the same tree or support, and it is well to place a stake or fence between the trees to allow the vines to creep from one tree to another, thus avoiding the shaking of branches and falling of leaves upon the vines; this shaking of branches can be avoided also by pruning often.

* Dracœna-draco.

For vanilleries already formed and of which the supports are already far apart, the vines must be made to descend when they climb out of reach: they should be rolled over their own forks or prongs, to the height of a man or better still, put strong hooks into the trees to hold the vines. within reach, to facilitate the fruitfulness and crop. Even then with all care, it happens that these hooks are too high and ladders have to be used. The best months in the plantation are March, April and May, but one can also take advantage of October, November and December taking care to water the plants if the weather be dry. The trees ought to give enough shade, but if not, it is necessary to put artificial shade and to water them more frequently than if they had their natural shade. They ought to be planted on the opposite side to the sun to escape its heat.

The longer the sucker, the more joints or nodes ought to be placed in the earth.

A node, when the vine has 3 of them, 2 when it has 4 and 4 to 5 when you plant a long vine.

These vines ought to be laid down in the ground, the base at the side of the tree, well fastened with one, two or several ligatures, according to its length; avoid using twine as it ends by strangling the plant. The string or fibre of vacoa* is the best to use. If the sun is very hot or moderate, it is good to use a mould in making a plantation. Farm yard manure is prejudicial, unless well rotted. Young plants with roots may be planted in farm yard soil provided it is well rotted or putrified. Vegetable manure is less heating, composed of leaves and grasses is very good, even preferable, but it must be well rotted, as vanilla roots especially the young ones are very tender and delicate; watering must be seen for the first few days after planting, especially in dry localities.

* The screw pine or Pandanus Odoratissimus. Ed.

Plants planted in winter, pine away, lose heart and often perish. The earth is trodden down over each plant after being well watered to avoid the action of the air which is very injurious. In a plantation of vanilla, the growth of shelter trees is so contrived, that the plants get as much, even more sun than shade. The pods, that have too much shade, become long, thin and ripen with difficulty, whereas, those that have sufficient sun, are large, round, firm and contain plenty of aroma. It is preferable that vanilla be not exposed to wind and that it receives heat. A wall of stones or rocks must be placed round each tree, which serves as a support to retain the manure, which is covered with pieces of flat rock to prevent the escape of the manure, to keep the roots moist and to prevent the rain exposing the roots and to keep animals away. Manure placed under the rocks, is renewed once a year, a little while before flowering.

The seeds may be placed in seed plots, in prepared soil

a little shaded, at a distance of 5 to 6 inches, one from the other by the side of fences upon which, the new shoots readily climb.

Fecundity of Flowers.—In the vanilla flower, the male organ is separated from the female organ by a cuticle, which prevents the natural fecundity—it is necessary then when the flower is completely in bloom, to remove with a small instrument, this cuticle and by a gentle pressure of the thumb and index finger to help the communication of the two organs.

The operation of fecundity, takes place from 8 to 9 o'clock in the morning to 3 o'clock in the afternoon, or even be prolonged to 4 or 5 o'clock; but the pods produced thus do not acquire the size and length of those produced, during a seasonable time. The instrument* used for this operation is ordinarily 3 or 4 inches long, thin and rounded at one end, not triangular or it will wound the organs of the flower and cause the pollen (colored dust in the anther) to fall and sometimes cut the male organ in two. The coton† or nics (the terms used by us) of the palm, the latimer‡ and the cocotier,§ is the best for the instrument used; after using and to find it again every morning, run it through a vanilla leaf. Ladders are used to get at the flowers out of one's reach to produce fecundity. The organs of the flower, ought not to be too much pressed and this operation ought to be skilfully performed by an experienced person.

* A piece of bamboo. Ed.

† Cotton or down.

‡ American palm.
§ Cocoa tree.

Vanilla flowers in June and the pods form in September. In elevated and cold regions, the plant flowers and the pod grows more slowly. It is best to produce fecundity with the first bloom and to pick off the later flowers when those have well fecunded and produced 5 to 6 pods.

To obtain good fruit, leave 5 to 6 pods on each cluster. When the vanilla is loaded with flowers, not sometimes a fine vine has only a very few clusters, in that case, one can

bring together 8, 10 or even 12 flowers, the tree can easily nourish as many.

Crop.—The vanilla crop begins, when the pods are mature, they turn out a yellow color, a sure sign that they are ready for plucking. When the pods are gathered green, they dry with difficulty, get mouldy and often rot in damp weather. They even (the very green ones) become white and of no use. It is necessary to watch for the proper time and get the crop picked by intelligent people. The crop is picked every 2 or 3 days to prevent the more advanced pods from cracking. Sometimes some pods are overlooked or hidden by leaves; these are soon found out by the scent they give. The cracked pods, are usually the finest and best, but it is necessary to close them again by a simple operation; the parts split is soaked in lukewarm water and tied up with bands of cloth tightly; some people gather vanilla by taking the pods in the middle or by the tail and dragging them off; thus the vanilla is damaged and often the entire cluster pulled off, green pods and all. Others pick off the pod with their nails, but then the pistil is damaged and the uniformity of the parcel is done away with, and there is difficulty in selling the pods. Near the end of crop, if the last pods ripen altogether, the whole cluster can be taken off.

Preparation of the Pods.—At each gathering, the pods are detached from the clusters and put in a basket; this basket is plunged into hot water, not boiling from 18 to 20 seconds: to ascertain, if the water is hot enough, one can put in one's finger and feel or wait till the smoke arises and the water makes a little noise, this is just before it begins to boil.

Take the pods in the basket, and put them out on dry grass or mats to drain; a quarter of an hour after, they are exposed to the sun for 6 or 8 hours or even for some days, upon tables covered with wool, till they become faded and brown: place them every evening in chests lined with wool, that they may ferment or stew. Becoming faded

and brown after being exposed to the sun, they are kept in the shade, in an airy locality on shelves, covered with wool to hasten the drying; prevent moisture above all, to preserve them when dry, supple and fit for sale.

They are kept on these shelves, till quite cured and ready for the market; whilst in the sun, in the afternoon, and whilst still hot, it is necessary to press them firmly between the fingers to make them spread out a little and to distribute equally all over the pod, the essential oil and seed which is more abundant in the lower part of pod, to render them glossy and supple and ready for the purchaser: this takes place for some days during their exposure to the sun, when they become withered and put by to dry. One can easily find out when the pods are dry, as they become black or rather chocolate-colored and there is no humidity remaining, even in the pistil which always dries the last; the dry pods are chosen and put into white iron boxes, where they remain dry and supple. This work is executed every two or three days or even oftener, according to the number of men employed and especially towards end of crop. They are then put up in packets of the same length, containing 50 pods each and tied in the centre or even a little nearer the end or tail which is apt to open, without this precaution; dry string, supple and strong is used for tying the packets.

Packing up.—Packing is done, in white iron boxes, the length of the pods and height of the packets which they are to hold; each box contains 60 packets or 6 rows of 10 packets. This packing is similar to that, done in Mexico and is insisted upon, in the trade. The iron boxes have a placard on each, indicating the number of parcels, length of pods, their net weight and the weight of the boxes. They then (if sent to France) are put into a wooden box, large enough to hold them, and to prevent the iron boxes from rusting, they have to be covered with saw dust.

Rime or Hoarfrost.—The rhime (white and sparkling or benzoic acid) forms upon the pods, when they are shut up

in closed vessels, after being packed three or four months. Several purchasers demand vanilla, like this, in preference; others don't like it; some demand that it should arrive quite fresh in France: the only way to do this, is to make it rimed before exposing it for sale.

It does not concern us, I think, to judge this delicate question or to prevent the rime from forming eventually, unless it interferes in any way with the beauty of the pods and their perfume.

For those who grow large quantities of vanilla, it is necessary to have fixed tables with light posts, so that when the pods are exposed to the sun, in case of rain, they might be quickly spread over with water-proof or tarpauling.

Vanilla yields after being dried, about the 50th part. A vanillery which produces 500 kilos, can be carried on by six workmen who will also suffice for fecundating the flowers; during the slack months, they can be put to other work.

Vanilleries are renewed every eight or ten years: this depends on the strength of the suckers planted and also the locality where they are placed.

There are still other details, which may be observed but, I think, I can dispense with them as these notes contain the essential knowledge to obtain good results.

Note.—In 1873 the late Mr. New, of the Lal Bagh, Bangalore, showed me some well grown vanilla plants in the Government Gardens; they were grown in leaf mould and sand and trained to thin stone pillars, placed 3 feet apart and 7 feet in height with cross pieces on the top to form a lattice work for the plants to cling to, and there were at the time several large bunches of vanilla pods on them, approaching a state of maturity. The vanilla is a shade-loving plant, but sickens readily when exposed to the direct effects of the sun. Mr. New succeeded in growing a fair crop.

ARROWROOT.

The consideration of this subject may be conveniently divided into two parts, viz.:—

I. The cultivation of the plant.
II. The manufacture of the farina.

It may not be out of place, before considering those divisions, to give a brief general history and a short account of the plants, from which the arrowroot is obtained. Arrowroot is the popular name of the different species of the genus *Maranta*, one of which, the *Arundinacea*, or starch plant produces the arrowroot of the shops. It was first discovered in South America by Plumier, and subsequently traced to Vera Cruz, where it was found to exist in great abundance, and is now extensively grown in the West Indies and forms an article of export to Europe from thence. From the West Indies it found its way to Ceylon, and eventually to India and is now grown in most of our colonies, the Tenasserim Provinces, Burmah, &c., &c. The generic name Maranta was given it by Plumier in honor of an Italian Botanist of that name, who lived in the 16th century.

1. The Arrowroot tribe or *Marantaceæ*.

(*a.*) The *Maranta arundinacea*, or West Indian Arrowroot, as it is popularly termed, is now cultivated in most parts of India, and the starch is greatly appreciated as a nutritive medicinal food, it forms an article of commerce in India and yields the largest amount of farinaceous matter; in consequence of which it is preferred to other species of the plant.

(*b.*) *Cana glauca* and *Cana coccinea*, also furnish farina similar to arrowroot, in the West Indies, to which the name

of *Tous les mois* or *Tulema* is given. Many other species of this tribe yield starch.

2. The East Indian Arrowroot, or *Zingiberaceæ*.

(*a*.) The *Curcuma Augustifolia*, or East Indian Arrowroot, is indigenous to India, and is found growing wild in most of the hilly parts of the Deccan, and is also cultivated for its farina or starch. The tubers of this species much resemble those of the West Indian Arrowroot; and as such it is largely exported.

(*b*.) *Curcuma leucorrhiza* also furnishes a species of arrowroot which is common to many parts of India. Many other species of this order also produce starch.

Arrowroot is the starch or flour that constitutes one of the proximate principles of vegetables, the term being synonymous with farina or fecula, otherwise called amylaceous food; but the original name of arrowroot has been derived from *Maranta galanga*, a plant, the root of which was, in use as an antidote against the virus, communicated by poisoned arrows among Indians, one of the distinguishing features of arrowroot, is to assume a blue color on the application of iodine. The starch granules of the *Maranta Arundinacea*, are aggregated grains having a common centre, with a succession of rings, superimposed on each other and gradually increasing in size from a point which has been called the *hilum*. Manufactured Arrowroot has a dull, white color, it forms a glistening powder, and consists of small lumps which are readily broken up when pressed by the fingers, as it crackles between them. It is insoluble in cold water, but with the aid of heat is capable of conversion into soluble gum and sugar. Its starchy character is easily seen by the microscope, consisting of small granules concentrically laminated into very fine rings, which gradually increase in size, from the summit or hilum to its outer circumference, and when carefully dried it can be preserved for use for a long time without spoiling in any way, which is a great advantage.

I. Cultivation of the Plant.

Arrowroot is known in Tamil as *Kuva mavoo*, and in Hindustani as *Tikhor*. The different species have the same vernacular names, and are now extensively cultivated in most parts of India. It belongs to the natural order *Marantaceæ* or Cannaceæ, the Arrowroot order, and is a herbaceous plant, closely allied to *Zingiberaceæ* or the Ginger order, from which it differs in the absence of aroma. It is a herb with a rhizome, simple sheathing, leaves parallel, veins diverging from the midrib, and flowers composed of membranous spathes. The perianth or calyx of which envelopes only a single flower, and is immediately contiguous to it, but irregular and in three rows the outer (calyx) 3-lobed, the middle (corolla) 3-parted, with a segment, differing from the rest in having one of the lateral stamens fertile (the other two being abortive), the single stamen having a petaloid filament, which bears a 1-celled anther (the other antherine lobe being sterile) and in the style being petaloid and in the embryo, not being contained in a vitelus. Fruit, a 3-celled triangular capsule or berry, containing a single hard rough seed. *Maranta Arundinacea* is a small herbaceous shrubby plant, growing in groups or clusters, and perennial, having a thick fleshy rhizome or underground stem creeping horizontally under the soil, giving off buds above, and roots below, the rhizome itself being white and scaly; it contains the fecula in abundance, which gradually pushes out of the soil and forms a new plant, for the nutrition of which the starch is intended, thus forming successive groups or clusters of plants.

Arrowroot is largely grown in Travancore, in Malabar and other districts in Southern India. The farina is manufactured in a rough and rude way, attention is not given to the cultivation of the plant, to increase the quantity and quality of the starch. The mode of culture followed by the native producer, is to roughly plough up sufficient and level the land square, and plant out the rhizome or root stalks, at about one foot apart either way, before the

commencement of the rains and little or no attention is given them. As a rule manure is seldom used nor are the plants irrigated, except perhaps in exceptional instances; whilst crop after crop is taken off the same soil.

For the proper and scientific culture of arrowroot, care should be taken in the selection of the soil. The best on which it luxuriates is a soft, loose sandy soil, or a somewhat porous loamy one, so as to admit of the rhizomes forming readily and to enlarge to their fullest extent. The land should be well ploughed and freely manured with rotten farm yard manure, and after being well mixed with the soil, levelled and formed into beds of a convenient size, so as to admit of the plants being irrigated when necessary, and the plants should be planted out 2 feet apart either way, but we prefer on these hills* to place out the seed stalk in lines, 2 or 2½ feet apart either way and when they have attained a height of 6 to 8 inches, to dig a trench one foot wide between every two lines, about half a foot deep; the soil thus obtained is used to ridge up the line of plants. This plan will also prove useful if it become necessary to irrigate the plants, which can be done by the medium of the trench between the lines, if care is taken to keep the ridges along the lines of plants well earthed up at all times. The plants should have plenty of room to enable them to form large clusters.

* Shevaroys.

For seed we generally prefer the root stalks with their fibrous roots broken up, and the stalks cut short to about 4 inches in length. The first inch or two of the rhizomes will also answer the purpose of seed, in fact any portion of the rhizome of the size of an inch, containing a joint, will answer the purpose equally as well. The rhizomes are fit to be taken up in about nine or ten months. They are planted out in the month of March and are taken up in the following January or February. After the plants are put out, they are hand-watered twice a week, till they become established, but where facilities exist, other modes of irrigation may be resorted to; and about once in a month the field should be weeded, the earth loosened freely around the plants, and the stalks kept well earthed up.

II. Manufacture of the Arrowroot.

The rhizomes are generally taken up from January to March as best suits the convenience of the cultivator, the roots are then found matured and fit to take up. The ridges are hoed on either side, and the plants pulled up by the stalks, then having the rhizomes attached, and are handed over to women and children, who remove them from the fibrous roots and stalks and free them of as much of the soil as is possible, and carry them in baskets to the store-room, where they are washed, cleaned, and have the scales peeled off; the white glistening rhizomes are then placed in other baskets to be grated or pounded. Graters are made of perforated tin after the plan of a nutmeg grater, but of much larger dimensions, so as to admit the hand and fore-arm passing through to hold on to the handle at the upper end. The rhizomes are rasped until the whole disappear in the form of pulp; or they are cut into pieces of one or two inches in length placed in stone or wooden mortars and pounded into pulp. This pulp is then transferred to vessels of clean water in which it is freely mixed by the hand, any lumps that may exist being broken up, and allowed to stand to allow the farina settling to the bottom when the floating fibres are collected and pressed firmly by both hands to squeeze out the fluid which is then thrown into another vessel containing clean water, to undergo a similar process. This operation is repeated three or four times to remove every particle of the farina from the fibres and the resulting white turbid fluid is allowed to stand, after it has been filtered through a clean piece of cloth, to exclude all the fibrous particles. The supernatant fluid is removed either by a syphon or by means of a tin or other pot, fresh water being added to wash the starchy matter that now lies like a paste at the bottom of the vessel; this is well stirred up, strained

again and allowed to settle. This process may be had recourse to, several times, to render the farina quite clean and pure when the water is drawn off for the last time. The farina or starch is now collected and placed on clean white pieces of cloth, tied up into bundles, easy to handle, and hung up to drain off the moisture. When this is effected, the wet starch is placed on other clean sheets, and placed out in the sun to dry, and when thoroughly dried, the lumps are broken up by hand and the farina is preserved for use.

The cost of production per acre is as follows:—

	Rs.
Land assessment	2
Ploughing 8 times at 8 annas per plough...	4
Seed stalks or rhizomes for planting ...	1
Cooly hire for planting	1
Weeding once a month and earthing up the stalks	12
Watering when necessary	12
Harvesting or taking up the rhizomes ...	3
Removing to store	2
Pounding or grating	3
Manufacture	5
Contingencies	5
Total Rs...	50

The average crop of rhizomes produced on an acre of land is 2,500 pounds of cormus, yielding 400 pounds of farina, the average is one-fourth the quantity of the cormus, but for safety, I have fixed it at one-sixth the quantity which at four annas the pound will realize rupees 100; the retail price of arrowroot is from 12 annas to one rupee the pound, and according to my estimate, deducting 50 rupees for cost of cultivation, there is a balance of Rs. 50 as the net profit. With care and attention in the cultivation and preparation of the arrowroot, the profit will be found to exceed the estimate greatly.

TAPIOCA.

Jatropha Manihot or *Cassava Manihot*, is the plant that produces what is popularly termed Tapioca, and in the consideration of the subject, we shall divide it into two parts.

I. The cultivation of the plant.

II. The manufacture of the Tapioca.

The Jatropha Manihot is indigenous to South America, where it is cultivated as the chief food of the Indians, and to the present time continues to be grown in large quantities. It forms a shrub of about eight to fifteen feet in height, with a woody knotted stem, containing protruding scars of the leaves, which grow alternately with long petioles and palmate, often stipulate leaves, divided into several irregular lobes, increasing in varying width and terminating in a point, having involucrate unisexual flowers with no floral envelope. The latter when present, is inferior lobed with a granular scaly or petaloid appendage. Stamens definite or indefinite, separate or united in one or more bundles, ovary one or more celled, ovules one or two suspended. Fruit usually in three-grained capsule, swelling out into three protuberances and divided into three cells containing one seed each. The carpels separating with elasticity sometimes fleshy and not opening spontaneously. Seeds albuminous and having often an external covering. Embryo with a superior radicle.

It has obtained its generic name in allusion to the medicinal properties of the plant. It is now extensively cultivated in all the tropical parts of the world and often produces large sized roots weighing over thirty pounds each, it is filled with a venomous juice which if taken internally, causes death. It is also called *Janipha* from its Brazilian

name of *Janipha* being synonymous with the names of Bitter Cassava, Tapioca, or Manihot plant. In Tamil it is known as *Murravullee* or *Alvullee*. It belongs to the Natural Order *Euphorbiaceæ* spurgewort tribe consisting of trees, shrubs or herbs. It is extensively grown in the maritime provinces of Ceylon, but it is inferior in its qualities to that grown in the West India Islands. From the roots a fine flour resembling arrowroot is prepared, but it is much sweeter and far more nourishing, and when boiled or baked with milk, it forms a most delicious food, partaking the nature of a rich custard.

I. Cultivation of the Plant.

The Manihot or *Cassava* plant is grown successfully on most soils, but it luxuriates in a sandy or loamy soil, and is considered a very exhausting crop, is never grown on the same land oftener than two or three times in succession, and it is generally propagated from cuttings, no care is bestowed on its growth; and the cuttings varying in length from one to two feet, are inserted in a superficial hole of three or four inches in depth, it is generally left to mature after the cuttings have been stuck in the soil at distances of two feet apart either way, the plant is so hardy, that generally in the course of a fortnight—more especially if there is a fall of rain—the cuttings shoot out and at the end of the year, the plants are ready to be dug up, and the roots taken charge of by the planter; but the roots do not suffer in any way, except that of containing a larger proportion of woody fibre, by leaving it for two or more years in the soil, the roots are then matured, and we have taken up on these hills* roots weighing thirty pounds each at the second year.

* Shevaroys.

Some care should be taken in the selection of the soil for planting the cassava and as already shown, a rich or loamy soil should be preferred, the woody cuttings two feet in length should be planted two to three feet apart either way just before the rains, and as soon as they have established

themselves, trenches should be drawn between the lines and the earth thus removed be banked up against the line of plants to form a ridge; the plants seldom require water except in exceptionally dry seasons and as they grow, they will, of themselves, shade the soil and keep down weeds, nevertheless, the plants should be freely hoed and the soil kept loose around them, but should they grow excessively luxuriant, the growth must be checked by breaking off the tops of the plants, this we find a capital plan here, to arrest their progress, and to give increased sustenance to the roots. Care should be taken to keep rats and insects away, rats do not feed on the roots, but they burrow about them and allow water to stagnate during the rains and cause damage to the roots. A variety of grasshoppers and other insects attack and destroy the leaves, more especially if the plants are grown in the shade.

II. Manufacture of the Tapioca.

The roots are dug out and washed free of the soil, and peeled of their dark epithelial covering and then grated or pounded in the same way as arrowroot, and the pulp thrown into large tubs and repeatedly washed whilst the fibres float on the water; the farina settles to the bottom in the form of a sticky paste, the water being renewed several times to wash the farina clean, it is then collected and placed in large sheets and tied up in bundles and hung up to drain, after which it is taken up and spread out on other sheets to dry in the sun, and when thoroughly dry, collected and stored in large tin canisters or other utensils. Care must be taken to see that the water in which the roots or farina are washed is thrown away, and that no animals have access to the same, for we had a pet lamb killed in about five minutes by drinking the wash water. Several coolies died of eating the raw roots, they became swollen and died of convulsions on a neighbouring estate. The roots when in season are washed and boiled, cut into sizes of three to four inches and sold in the bazaars, and hawked about by women in the streets, being sold one or more pieces for a pie or two.

By washing the farina or boiling the roots, the poisonous juice is eliminated or its effects destroyed.

Tapioca is the farinaceous matter contained in the roots which is washed out and converted into farina or starch. It is in general use as a healthy nutritious food for invalids, and it forms an article of commerce, but it is sold much cheaper than arrowroot owing to the large quantities that are imported into India from South America and elsewhere. The most favorite form in which it is procurable in the shops is in granules; this form is effected by placing the Tapioca after being drained, and when still moist, on hot iron plates, and freely stirring it with iron rods to break up the mass, when it takes that peculiar form of rocky irregular granules, so peculiar to this form of Tapioca.

The cost of cultivating an acre of Tapioca will be as follows :—

	RS.	AS.	P.
Pitting holes	1	0	0
Seed stalks	0	4	0
Planting	1	0	0
Digging up roots	1	0	0
Removing to stores	0	8	0
Pounding or grating	2	0	0
Manufacture	1	0	0
Land Assessment	2	0	0
Contingencies	2	0	0
Total Rs...	11	0	0

The average crop of roots to an acre may be fixed at 1,000 lbs. yielding one-sixth of farina, which will be about 150 lbs., this at two annas the pound will realize Rs. 18-12-0 from which deduct cost of cultivation Rs. 11, the balance Rs. 7-12-0 is clear profit to the cultivator. The estimate of cost and production is calculated at the lowest figure possible—but the Tapioca fetches a much higher price than here given in the market.

IMPHEE OR SORGHUM KAFFRARIUM,

Has been grown in India since time immemorial but was not known to Europeans in India until reintroduced in 1866 as the Planter's Friend, and of which there is a large variety, some of which are believed to yield sugar. I received a small supply of seeds from the Board of Revenue for experiment. The season for sowing Imphee had just gone by, nevertheless, I had a plot of ground 30 × 32 yards at the back of the Chingleput Dispensary, ploughed up for its reception. The soil was gravelly and greatly interspersed with stones and was both high and dry. The country cholum was cultivated on either side and the plants were pushing out their ears when on the 2nd January I had the Imphee seeds sown broadcast and as the quantity was small, the different varieties, of which there were some three or four, were mixed and sown together. The seeds sprang up well, but were subsequently thrown back by the want of rain, nevertheless, they attained about 3½ feet in height and began to push out their ears when between six weeks and two months old. The only difference between the Imphee and the country cholum grown near it, was that the former was rather the smaller, and on close examination, its leaves were found more linear than those of the country cholum. The flower spikes were also larger, being in shape like a pear with the rounded base uppermost; the panicles were looser, the peduncle with its pedicels supporting the seeds were covered with woolly glumes, the calyx slightly hairy, roots branched, culms erect round-jointed; the leaves linear and sheathing; flowers paired, one hermaphrodite and the other neuter. About the time the plants were in flowers, it rained rather heavily about the middle of March from which the stalks suffered. The sparrows, crows,

parrots and squirrels that had been first attracted by the cholum in the vicinity, when this was gathered, exhausted their force on the small plot of Imphee and committed much damage on the ears, the smaller birds picking out the grain from the ear, while the larger ones carried away entire ears to feed on at their leisure, nevertheless, twelve ounces of seed were collected, one-half of which was submitted to the Board of Revenue. As will be seen from the sample, the Imphee grown here is superior to the seed sown, in the size and fulness of the grain. The stalks were rather slender and juicy; the juice had an insipid sweetish taste. As the quantity of culms was small and the stalks had not attained any size, I did not deem it fair on this occasion to test its sugar-yielding properties, but hope to do so next season as I have the six pounds of seed sent by the Revenue Board and a portion of my own growth of this season in reserve.

C. Benson, M.R. A.C., in the Sydapet Experimental Farm Manual and Guide, page 41, gives the following account of "Imphee and Planter's Friend (Sorghum Kaffrarium) have been grown; they are supposed to have been originally obtained from the south-eastern coast of Africa. In America they are, by many, considered to be better sugar-producers than the Chinese sugar-cane, and all agree that their sugar is much more easy to crystallize. A few pounds of seed of the former were obtained from Sydney, and sown on the 30th of November 1870, but its growth was very unsatisfactory, it did not produce more than one-tenth of the crop Chinese sugar-cane yielded, whilst it required much longer time in coming to maturity. The canes were thick, but very short, and the presence of any more saccharine matter than is found in our common cholums could not be detected.

Planter's Friend was first tried in 1875, and the results were satisfactory; it has been found to yield from 4,000 to 12,000 lbs. of straw, besides a crop of grain per acre; it is, however, especially a fodder-producer and to obtain the

best results should be cut when in flower. The straw of this variety is very rich in saccharine matter. The results which have been obtained show abundantly that both 'Sorghum' and 'Planter's Friend' are most valuable fodder-producers; the former gives a heavier yield of grain than the latter, but it may be remarked here that the grain of both varieties is at present unsaleable at Sydapet for use as food for man; that of the Sorghum because of the difficulty in removing the husk; that of the Planter's Friend because of a bitter taste which it possesses. For the production of sugar neither crop has been investigated on this farm, but there is every reason to believe that it would be a most valuable addition to the crops of the country in this respect; occupying the ground only about one hundred days, it will, without irrigation, produce in that time about eight or ten tons of green sorghum fit for crushing. From an experiment made, with very imperfect means of extraction, it was found that the crude juice showed specific gravity of 1·90 or 12° density on the Beaumé scale, which is higher than the average commonly obtained in America. A supply of the seed of some of the best sugar-yielding varieties has been indented for from the United States, but unless some adequate means of crushing the cane and purifying and evaporating the juice be also supplied, it will not be possible to do much in this direction.

An account of the Wild plants and vegetables used as food by the people in famine times.

The following contains a list of most wild plants, their roots, leaves, fruits or seeds that are eaten by the poor during seasons of draught and famine. I give both the scientific, Tamil and Telugu, names in the list, believing that it will prove of interest generally. The collection was first commenced in Ganjam in 1870 and completed in 1877 during subsequent tours in the Bellary, Kurnool, Cuddapah, North Arcot and Salem districts.

2. The list is alphabetically arranged; many of the leaves and young shoots of those used as greens are much more frequently used as *Calavay Keeray* or mixed greens. This is a favourite mode of using them at all seasons, and they are in great repute even among well-to-do people. Women collect the wild greens both as an amusement and occupation, adding at the same time an additional dish to the family meal. Many European and East Indian families are partial to them, as they are said to be healthy and to have a slight laxative action on the bowels that they will frequently send their female servants out to collect them.

3. The tender pith and leaf-bud of the Hedge Aloe is only eaten by the poor from great pressure of hunger, as it is unwholesome and causes dysentery and diarrhœa.

4. Some of the Arum-tribe that are used on these occasions are not only unwholesome, but poisonous; to avoid their deleterious effects, they are repeatedly boiled ere eating. Of the various fruits they are eaten ripe as they come into season. The Banian, Peepul, and country fig furnish food not only to the poor people but to cattle also. The kernel of the mango and the tamarind stone are converted into meal and cooked into porridge, or baked into

cakes, but as they contain a large proportion of tannin, they are not healthy and are only resorted to during seasons of scarcity. The bamboo seed furnishes a kind of rice, which is generally collected by the poor *during* the season at all times to keep them in food. In most jungles there is always a succession of bamboo in seed every year. The fruit of the prickly-pear is eaten ripe; sometimes the green fruits are boiled. The tender leaves would furnish good vegetable for curry, but is not often resorted to as the prickly-pear possesses sub-acid or anti-scorbutic properties; it is very beneficial to the health both of man and beast. To Mr. H. S. Thomas, the Collector of Tanjore, the credit is due of first suggesting and subsequently demonstrating practically its value as cattle fodder by feeding his own cattle on it and exhibiting the same in public, thus proving its utility and it has been introduced to public notice by Messrs. Harvey and Sabapathy of Bellary since. It has not met with general acceptance in consequence of the trouble and difficulty of freeing the leaves of their sharp spines, but there is a spineless variety—*Opuntia delenii* or Nopaul with red flowers—which is met with about Madras. I remember seeing lots of it growing about the village of Karangali, in the District of Chingleput, some years ago. It would be worth while introducing this cactus into the several districts to form cattle fodder not only during seasons of scarcity, but at all other times.

Note.—This variety of Opuntia was introduced many years ago by the late Dr. James Anderson to feed the cochineal insect. Dr. Anderson used to supply Her Majesty's ships-of-war in the Madras roads with the green leaves, which in those days were used as an anti-scorbutic, after being boiled as an ordinary green vegetable.

W. R. C.

The *Guazuma tomentosa*, or Bastard Cedar, was introduced into Southern India from South America very many years ago, to be cultivated for supplying cattle with fodder; they are met with about Madras. The woody seeds are sweet from containing sugar, and they are eaten by the poor during seasons of scarcity, but cattle are partial to both leaves and fruits. This tree also yields good fibre,

and its extensive cultivation into the several districts is well worthy of attention with a view to supply fodder for cattle during seasons of scarcity. The Bassia, of which there are two varieties, from the fleshy corolla of which most of the semi-wild tribes distil their arrack, the flowers being sweet tasted are eaten raw, boiled or roasted, and the ripe fruits during the season. The kernels furnish a coarse oil, which is used as food. The palmyra tree is too well known for the various useful products it furnishes. The fusiform root of the germinating stone is boiled and sold in the bazaars during the season as the palmyra tubers or *Pannei Kulungu*, this is also converted into meal, and the stones of the fruit are carefully collected and put down to germinate for the purpose of securing the roots.

I will not extend these remarks further as the parts used and the mode in which they are prepared are given opposite each plant.

NOTE.—Since this letter was written, I have been to the North Arcot District on a tour of inspection, and at the Village of Poloor in that district saw several large clumps of the Nopaul or Nonspinous cactus growing in a tope. The Tahsildar being absent, I sent for the Sheristadar or Sub-Magistrate, and pointed out the Nopaul to him. I brought with me several specimens of the young plant, and, on receiving a note from Mr. Fernandez, of the Government Office, on the subject, I sent these plants to him to present to the Chief Secretary to Government.

At Vellore near the toll-gate, leading towards the Central Jail, I also saw several young plants of the Nopaul growing in a hedge with the common Spinous cactus.

In Madras there is a fine specimen of the Nopaul to be seen in a House No. 31, on the High Road, Royapooram, and another in the compound of Trinity Chapel, John Pareira's, both these plants were with flower and fruit when seen by me about two months ago.

A List of plants the various parts of which are used as food by the poor, during seasons of distress, to appease the cravings of hunger.

Scientific Names.	Tamil Names.	Telugu Names.	Remarks.
1 Acalypha Indica.	Koopay maynei.	Hurita munjari.	Grows wild, leaves used as greens.
2 Achyranthes aspera.	Nahi ooroovie keeray.	Ooteraynie.	Do. do. do.
3 Arua lœnata ...	Kunpolay keeray.	Pindie conda.	Grows wild, and cultivated, the leaves eaten.
4 Agati grandiflora.	Aghati keeray.	Agisi, Bakapushpam.	Leaves, flowers, and tender legumes largely consumed by the poor, sold in the bazaars at one pie the pound; when freely eaten, causes diarrhœa.
5 Æschynomen aspera.	Sudday keeray	Jilugu benda.	Grows wild, the leaflets used as greens.
6 Aloe vulgaris.	Kuthalay ...	Kalabanda ...	Grows wild, the leaf bud or cabbage and tender pith eaten. The common food of villagers during the famine.
7 Altenanthera sessilis.	Poonanghucunny keeray.	Madanaganti, Ponnaganti.	Grows wild, leaves used as greens.
8 Amaranthus campestris.	Siru keeray ...	Teseri kura ...	Grows wild, and cultivated, leaves used as greens.
9 Amaranthus frumentaceous.	Poong keeray.	Tota kura ...	Grows wild, and cultivated, leaves used as greens, and the seeds converted into meal.
10 Amaranthus spinosus.	Mooloo keeray.	Mulugoranta...	Grows wild, leaves eaten as greens.
11 „ tenuifolius.	Kattoo Siroo keeray.	Doggali kura.	Grows wild, used as greens.
12 „ tristis ...	Kuppei keeray.	Koyyatotakuru	Do. do. do.
13 Amorphaphallas campanulatus.	Kurruna kalungu.	Konda, muncha kunda.	Do. about hills and forests, and the tubers boiled and eaten.
14 Aponogeton monostachyon.	Kotee kalungu.	Nama	Grows wild, found in tanks, brooks, and nullahs; tubers boiled and eaten.
15 Arum lyratum.	Kondai rakis.	Konda rakis ...	The roots are eaten after careful boilings.

A List of plants the various parts of which are used as food, &c.—(continued).

Scientific Names.	Tamil Names.	Telugu Names.	Remarks.
16 Asystasia coromandeliana.	Midchy keeray.	Mukku mungera, Tappeta.	Grows wild, used as greens.
17 Atriplex heteranthera.	Thoyah keeray.	Thoya kura ...	Do. do. do.
18 Bambusa arundinacia.	Mungil arisee.	Veduru ...	Seeds of the bamboo furnish food (rice) to the poor and the growing young shoots cooked into curries.
19 Bassia longifolia.	Elloopei ..	Ippa ...	Grows wild, the deciduous fleshy corolla eaten either raw or roasted, and the fruits when ripe. The seed contains a bland oil used in cooking,
20 Bassia latifolia.	Caat elloopei ...	Ippe ...	Do. do. do.
21 Bergera Kœnigii.	Karaway pillay.	Kari vepa ...	Do. is also cultivated, fruits eaten.
22 Boerhavia procumbens.	Mookaretti keeray.	Ataka mamidi.	Grows wild, leaves and tender shoots used as greens.
23 Boerhavia repanda.	Mookooty keeray.	Maidinika ...	Do. do. do.
24 Borasus flabelliformis.	Pannei ...	Karatalamu, Tatichettu.	Fruits and leaf-bud or the cabbage is eaten, as also the fusiform roots.
25 Bryonia rostrata.	Appa kovay ...	Putribudinga.	Grows wild, fruits and leaves eaten.
26 Byttneria herbacea.	Aree keeray...	Aree kura ...	Grows wild, leaves used as greens.
27 Calladum esculentum.	Saimmay keeray.	Chama kura...	Grows wild, leaves eaten as greens.
28 Cantheum parvifolia.	Carray cheddie	Balusoo kura.	Grows wild, leaves and young shoots used as greens.
29 Cardiospermum halicacabum.	Moodacottan...	Budda kankarakoo, or Nella gooliaienda.	Do. do. do.
30 Caralluma adsendens.	Kullee Mooliayan.	Karallamu, Tatiti chettu.	Do. tender shoots used, cooked as vegetable.
31 Carissa corindas.	Kalakai ...	Wakay oka chettu.	Grows wild, fruits are eaten.

A List of plants the various parts of which are used as food, &c.—(continued).

Scientific Names.	Tamil Names.	Telugu Names.	Remarks.
32 Carissa diffusa.	Chothay kalakai.	Kalive chettu.	Grows wild, fruits are eaten.
33 Cassia sophera.	Poonaverie ...	Pydee tanghadu.	Do. leaves used as greens.
34 Cathartocarpus fistula.	Koonnay ...	Rela	Grows wild, the mucilagenous pulp from the pods eaten.
35 Celocia cristata.	Punnee keeray	Erra kodi, Juttu tota kura.	Grows wild, leaves and young shoots used as greens.
36 Ciscus quadrangularis.	Purundei codie	Nullerootigch.	Do. do. do.
37 Cleome pentaphylla.	Valay keeray.	Vaminta ...	Do. leaves used as greens.
38 Coccinia Indica	Covay kai ...	Donda, Bimbika.	Grows wild, ripe fruits eaten.
39 Colocasia antiquorum.	Shamay kilangu.	Chama dumpa.	Grows wild, and cultivated, leaves and leaf stalks eaten.
40 Colocasia nymphæfolia.	Karoonay kilangu.	Gadda kanda.	Grows wild, and cultivated, the tubers are cooked.
41 Commelinacommunis.	Kannang keeray.	Gangi Gadda.	Grows wild, leaves and tender shoots used as greens.
42 Cordia myxia ..	Vidi maram ...	Iriki, Nakerachettu.	Fruits eaten during the season.
43 Corchas olitorius.	Kaat thoothee, or Jews' Mallow.	Parinta ...	Grows wild, leaves, and tender shoots, used as greens.
44 Cucumis momordica.	Kaat velleri, Pythum kai.	Pedda doskay.	Grows wild, fruits eaten.
45 Cynodon dactylon.	Arogum pillo.	Garike	Do. tender leaves and shoots eaten
46 Desmanthus natans.	Sunday keeray	Nirta lvapu ...	Grows wild, the leaves used as greens.
47 Dioscorea alata.	Yams kalung.	Niluva pendalum.	Several varieties, grow wild, tubers eaten cooked.
48 Dolichos ensiformis.	Kaat Thumbuten kai.	Tamma ...	Grows wild, pods cooked into curries, ripe seeds eaten boiled.
49 Dracontium polyphyllum.	Kaat Curnay.	Adive kanda...	Grows wild, tubers eaten cooked.
50 Eleusine Ægyptica.	Muttengapilloo	Tamida, Sodee	The seed grains are eaten cooked.

A List of plants the various parts of which are used as food, &c.—(continued).

Scientific Names.	Tamil Names.	Telugu Names.	Remarks.
51 Eriodendron anfructuosum.	Elevam ...	Poor	Found in gardens, seeds roasted and eaten.
52 Erythroxylon areolatum.	Davaahdarum keeray.	Devadary kura	The tender leaves are used as greens, grows wild.
53 Euphorbia pilulifera.	Amumpatchay arisee.	Bidarie, Nanabeeam.	Grows wild, leaves and tender shoots eaten as greens.
54 Ficus Bengalensis.	Alamarum ...	Marri ...	Fruits of these and other varieties of the Ficus are eaten ripe.
55 Ficus glomerata	Attee marum.	Maydi ...	Do. do. do.
56 Do. religiosa...	Arasa marum.	Ray, Raghie.	Do. do. do:
57 Glinus trianthenioides.	Sharunnay keeray.	Golijeru ...	Wild, leaves used as greens.
58 Gisekia pharnaceoides.	Numnelli keeray.	Isaka dasari kura.	Grows wild. The leaves used as greens.
59 Guazuma tomentosum.	Rudrasum ...	Rudraksha chettu.	The woody fruits when ripe are eaten.
60 Gynandropsis pentaphylla.	Neivaylla or kadughoo.	Vala kura ...	Grows wild, leaves and young shoots used as greens.
61 Holostemma Rheedi*	Palay keeray.	Pala kura ...	Leaves boiled with salt and chillies and eaten.
62 Hoya veridiflora.	Cooringee keeray.	.....	Grows wild, leaves used as greens.
63 Inga dulcis ...	Coorkapooly...	Sima chinta..	Ripe fruits eaten.
64 Ipomœa reptans.	Vellay keeray.	Tegada ...	Wild, leaves eaten as greens.
65 Iphomœa reniformis.	Perretay do.	Toinnatali ...	Do. do.
66 Do. sepinaria.	Thalee do.	Puriti tige ...	Do. do.
67 Leucas aspera.	Thombay keeray.	Tummi kura ...	Grows wild, leaves and tender shoots eaten as greens.
68 Maba buxifolia.	Erimbellie kai.	Pishanna ...	Grows wild, ripe fruits eaten.
69 Mangifera Indica.*	Mankai.	Mamedi chettu	Fruits and seeds, latter converted into meal.

A List of plants the various parts of which are used as food, &c.—(continued).

Scientific Names.	Tamil Names.	Telugu Names.	Remarks.
70 Melia azadirachta Indica.	Veypa marum.	Vapa chetta.	The ripe fruits are eaten as they contain a small quantity of sweet pulp between stone and skin.
71 Mimusops elengi.	Moghadum ...	Poghada ...	The ripe fruits are eaten.
72 Mirabilis jalapa*	Undi mandarei	Badracha, Nitcha mulligah.	The leaves are used as greens largely at Oossor in the Salem District.
73 Morinda citrifolia.	Munja pavattay.	Molagha, Maddi chettu.	Grows wild, green fruits curried, ripe eaten.
74 Morinda umbellata.	Noona kai ..	Moolooghoodoo	Grows wild, green fruits curried, ripe eaten.
75 Nymphæa edulis.	Shunguneer pushpum.	Koteka, Kalharamu.	Grows wild in tanks, there are two or three varieties according to the coloring of the flowers. The roots and seeds are eaten cooked.
76 Œgle marmelous.	Vilva marum.	Maredoo.	Grows wild, the ripe fruits are eaten.
77 Opuntia vulgaris.	Chuppauthumoolloo.	Nagamala ...	Grows wild, the ripe fruits are eaten, the green fruits and tender shoots may be cooked into curries.
78 Oxalis corniculata.	Pooliaray ...	Pullachinta ...	Grows wild, leaves and tender shoots cooked as greens.
79 Pandanus odorata.	Thalay ...	Mogheli ...	Grows wild, the floral leaves are eaten raw or cooked, and the lower part of the drupes of the ripe fruits are sucked of their pulp.
80 Phaseolus rostratus.	Karalsona ...	Karalsana, Karu alachanda.	Grows wild, the tuberous roots are cooked and eaten.
81 Phœnix sylvestris.	Ethum pannay	Ita chettu ...	Grows wild, leaf-bud or cabbage and ripe fruits eaten.

A List of plants the various parts of which are used as food, &c.—(continued).

Scientific Names.	Tamil Names.	Telugu Names.	Remarks.
82 Phœnix farinifera.	Ethee ...	Chiruta-ita ...	Grows wild, leaf-bud or cabbage and ripe fruits eaten.
83 Portulaca oliracea.	Paroopoo or corie keeray.	Pedda pail kura, Ganga pavilli kura.	Grows wild, leaves and tender shoots are cooked and eaten as greens.
84 Portulaca quadrifida.	Passelie keeray.	Goddu pavelli, Sun pail kura.	Do. do. do.
85 Premna serratifolia.	Mooney do ...	Ghebboon nellie.	Do. do. do.
86 Premna latifolia.	Nella do ...	Pedda-nella-kura.	Do. do. do.
87 Prosopsis spicigera.	Parumbay ...	Chamee, or Jammi chettu.	Do. do. the meals from the pods are eaten.
88 Remna latifolia.*	.....	Nelli kura ...	These herbs are gathered and boiled with some salt and chillies and eaten.
89 Rivia hypocrater formis.*	Boodthee keeray.	Boddi kura .	Do. do. do.
90 Rothia trifolita.	Nurreypitten keeray.	Nucka kura ...	Grows wild, leaves and legumes used as greens.
91 Salicornia bracheata.	Oomarie keeray.	Quoiloo, or Koyaloo ...	Grows wild, leaves and shoots used as greens.
92 SalicorniaIndica	Pavala poondoo	Koyya pippali.	Used as a pot herb.
93 Salsola Indica..	Yella keeray..	Yella kura ...	Wild, leaves used as greens, largely resorted to during famines.
94 Schleichera trijuga.	Poomarum, Conjee marum.	May Roa Tanglia.	Grows wild, ripe fruits are eaten.
95 Schmidelia serrata.	Tanalika ...	Tanalikœ korra chettu.	Grows wild, fruits are eaten.
96 Sesuvium portulacastrum.	Vungaravasee..	.....	The leaves and tender shoots used as a pot herb, grows wild.
97 Sethia Indica...	Tavadrum, Semmanatty.	Adivi gerenta, Davadary.	Grows wild, leaves and tender shoots eaten as greens. This tree has afforded food to many thousands of people during the famine.

A List of plants the various parts of which are used as food, &c.—(continued).

Scientific Names.	Tamil Names.	Telugu Names.	Remarks.
98 Solamun incertum.	Munnuthakalee	Kakamachi	Grows wild, leaves and young shoots used as greens, ripe fruits eaten.
99 Solanum jacquini.	Cundung katrie	Van kuda, or Nella molunga.	Grows wild, fruits are cooked into curries.
100 Solamun torvum.	Soonday kai ...	Choondai kai...	Grows wild, fruits used as vegetable.
101 Spondas mangifera.	Mirrey manga.	Ambra, or amra jouru, Mamedi.	Grows wild, leaves used as greens, fruits cooked into curries and pickled.
102 Sterculia fœtida.	Peenaree marum.	Gurapa Badam chettu.	Grows wild, the roasted seeds are eaten.
103 Strychnos potatorum.	Tettan cottay marum.	Toillaghenjaloo, Induga.	Grows wild, fruits when ripe are eaten.
104 Suæda Indica	Koyey kaseeray keeray.	Kodee kasseery kura.	Used as a pot herb, grows wild.
105 Syzygium jambolanum.	Navel	Neradi	Grows wild, ripe fruits are eaten.
106 Tamarindus Indica.	Poolia marum .	Chinta chettu .	Leaves, young shoots, fruits and seeds are eaten, the latter converted into meal.
107 Toddalia aculiata.	Moolacarnay...	Conda cashnida.	Grows wild, leaves are used as greens.
108 Trapa bispinosa.	Singahara ...	Kubyakam ...	Grows wild, seeds are cooked and eaten.
109 Trianthema obcordata.	Sharunnay ...	Ghelijehroo ...	Do. leaves and tender shoots used as greens.
110 Trianthema obcordate. *Var.*	Shavalay keeray.	Tella ghelijeghroo,	Grows wild, leaves used as greens.
111 Trichianthis cucumera.	Pepoodel. ...	Chayud potta .	Grows wild, fruits curried.
112 Trilobus terristus.	Nerrenjee keeray.	Palleroo ...	Do. leaves used as greens.
113 Urtica tuberosa	.....	Pilli dumpa ...	Grows wild, tuberous roots boiled and eaten.

A List of plants the various parts of which are used as food, &c.—(concluded.)

Scientific Names.	Tamil Names.	Telugu Names	Remarks.
114 Vellarsia cristata.*	Nedel ampel ...	Alligadda, Antara tamara.	This is a species of water lily found in tanks and wells. The substance found in the plant is cooked or merely boiled and eaten.
115 Xanthochymus pictorius.	.....	Jevra memadie.	Grows wild, ripe fruits.
116 Ximenia Americana.	.....	Oora nechra, Konda nakkera.	Do. do.
117 Zizyphus jujuba.	Yellanday kai	Reygoo ...	Ripe fruits.
118 Leptadenia reticulata.†	Palacoody ...	Kalasa ...	The leaves and tender shoots used as a vegetable in the Vinucondah taluq, Kistna, at all times.

† This plant was sent to me by the Collector of Kistna for identification, and "that it was eaten by the villagers of Vinucondah taluq as a vegetable, but which they are now using as food." I have identified it as the Leptadenia reticulata.

NOTE.—Names marked thus * are taken from Mr. H. Yarde's (of the Forest Department) list.

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