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INDIAN COCONUT JOURNAL

VOL. II.

JULY — SEPTEMBER, 1949.

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INDIAN COCONUT JOURNAL

JULY TO SEPTEMBER, 1949.

AS WE SEE IT

OWING to circumstances beyond our control, the publication of this issue of "The Indian Coconut Journal", we regret to say, has been delayed a little. While apologizing to our readers for any inconvenience this may have caused them, we would assure them that we shall spare no pains to see that the publication of the various issues of the Journal is in accordance with the time-table.

♦ ♦ ♦ ♦ ♦
WE are glad, however, that we are presenting in this issue fare of a substantial nature. In "Varieties and Forms of the Coconut" Messrs. G. V. Narayana and C. M. John have for the first time attempted a systematic classification of the varieties and forms of the coconut. The information available on the different varieties grown and studied in the Madras Government Coconut Research Station, Pilicode, as well as that gathered from publications

dealing with the subject from various coconut growing countries are included in the present paper. Although some of the foreign varieties described would appear at first sight to be highly desirable ones, the authors warn private growers against introducing them in their gardens, without first obtaining the advice of research stations which have conducted trials on the varieties concerned and can say with authority whether they have proved economic varieties under local conditions and are free from susceptibility to diseases.

♦ ♦ ♦ ♦ ♦
IN the middle of December 1948 the Indian Central Coconut Committee appointed a special officer to investigate the possibilities of setting up regulated markets for copra in the United State of Travancore and Cochin (then the States of Travancore and Cochin), Madras and Mysore and to draw up schemes for the

purpose. Mr. M. I. Patel, an Assistant Marketing Officer of Bombay who was appointed special officer for the purpose submitted two reports, one relating to Travancore and Cochin and the other to Madras and Mysore. Elsewhere in this issue we have published the first report as far as it concerns Travancore. The remaining portion dealing with Cochin as well as the report regarding Madras and Mysore will be published in the next one or two issues of the Journal. As may be seen from the report now published the case for setting up regulated markets for copra at Alleppey and elsewhere in the Travancore area is unassailable and it would appear that the efforts of co-operators would yield better results if they are linked with regulated markets. It is to be hoped that early steps will be taken by the

Government of the United State of Travancore and Cochin to implement the recommendations contained in the report.

* * * * *

THE shell of the coconut has been recognized as an important industrial raw material although its utilization for industrial purposes is not yet so widespread in this country. In his paper entitled "Coconut Shells as an Industrial Raw Material", the first two parts of which are published in this issue, Dr. Reginald Child, until recently Director of the Coconut Research Scheme, Ceylon, has reviewed the properties of coconut shells and examined the possibilities of pressing them into service as raw material for industrial uses. The third and the fourth parts of this paper will be printed in the next issue of the Journal

VARIETIES AND FORMS OF THE COCONUT

(*COCOS NUCIFERA* LINN.)*

BY

C. M. JOHN AND G. V. NARAYANA

(*Oilseeds Section, Department of Agriculture, Madras*)

THE COUNTRY OF ORIGIN

The coconut belongs to the family of palms *viz.*, *Palmaceae*. It is a very useful tree cultivated by man from very ancient times. De Candolle and others consider the Indian Archipelago to be the original home of the coconut. It is a unique species in respect of the characters of the stem and the nut and is very much unlike any other known species of *Cocos*. The coconut stands in a class by itself. There are some thirty species of *Cocos* and all these are wild in native America, though some of them have been brought under cultivation for ornamental purposes. If all the known species of *Cocos* have an American origin, it is difficult to explain how the coconut alone originated in the Indian Archipelago; and some (Bailey 1937) believe that America is the home of the coconut. By some others, the millions of years old fos-

sil coconut of New-Zealand which is of the size of an arecanut is considered to be the progenitor of the present-day coconut. The consensus of opinion, however, regarding the origin is that the Indian Archipelago should be the original home of the coconut.

VARIATIONS IN CHARACTERS

The generic name *Cocos* is derived from a Portuguese word for a monkey. The eye end of a coconut when the husk is removed, resembles the face of a monkey; and the specific name *nucifera* refers to the kernel-bearing nature of the nut. The palm has been in cultivation for several centuries under varying conditions of soil and climate, up to 20° to 23° of latitude on either side of the equator and from the sea level up to an altitude of about 3000 feet. Therefore, naturally considerable variations in the characters of the species occur. The stem may be thin or robust and its length may vary from just a few feet to 100 feet or more. Even in grown-up palms the length of the leaf and the petiole varies. A fully opened leaf may be 10-17 feet

* This paper was presented at the 32nd College Day and Conference of the Agricultural College, Coimbatore and is published here by kind courtesy of the Editor "The Madras Agricultural Journal" in which it was first printed.



long depending on the nature of the soil and the age of the palm. The flower bunch (inflorescence) may be branched (a spadix) or rarely unbranched. The number of male and female flowers varies considerably, the former from 150 to 14,000 and the latter from 25 to 600 in a single inflorescence. The method of pollination may be cross or self. The time taken from pollination till the nut is ripe is 9 to 12 months. The shape of the nut ranges from linear to spheroid. The weight of copra or dried kernel which is the most important coconut product of commerce ranges from about an ounce to about 12 ounces. The percentage of oil (on moisture-free basis) in the copra varies from 65 to 75 (by chemical extraction). The life of the palm extends from 35 to 100 years. The range of colour variations also is considerable. The leaves and nuts may be green, yellow or rarely red or shades of brown. From the foregoing it is evident that the coconut is a variable species and one would expect a large number of varieties occurring in different coconut countries of the world. But considering the antiquity and the cosmopolitan nature of the species, the number of the so-called varieties of the coconut is rather limited. From a reference to the literature on the subject, it appears that the total number of the varieties in all the coconut countries is estimated not to exceed some

thirty. Even this number may be reduced considerably if all the varieties were studied in the field in one place and the over-lapping ones are eliminated. Abnormalities and freaks sometimes called varieties are not to be included among the varieties proper.

REVIEW OF LITERATURE

A few publications from important coconut countries are reviewed here.

Watt (1889) mentions seven varieties of the coconut. He also states that "a small form is met with in East Africa that does not possess the fibrous pericarp". It is not clear what variety is meant. Perhaps he speaks of a dwarf with very thin husk. If so, such forms are well known in India. Barring this, the remaining six may be grouped into three distinct varieties *viz.*, (1) the dwarf, (2) the ordinary tall and (3) the one bearing small nuts of the size of a turkey's egg. The fourth one "with heart-shaped fruit, pale-yellow colour, with an edible inner rind which turns red when the outer skin is removed" is possibly the one with sweet husk mentioned by various authors. The remaining two which are distinguished by their colour and shape of the nut can only be normal variants of the ordinary variety commonly grown in India. Hooker (1894) mentions of *C. nucifera* Linn. as the most commonly cultivated species and *C. nana* Griff. as a small, low, variety grown in the

Maldive islands and Ceylon. Trimen (1898) speaks of *C. nana* Griff as "a very small-fruited dwarf sort going by the name of Maldive coconut". Here this dwarf variety appears to have been given the status of a species. It will be seen later that this is only a variety. He also speaks of a variety by name "Tembili" with pink endosperm and called the king coconut. The name "Tembili" is mentioned by Watt also but the colour of the endosperm which is unique in Trimen's "Tembili" is not mentioned by Watt. The name 'King coconut' is given to the dwarf variety by other authors.

Ahmed Bin Haji Omar (1919) writes of the races of the coconut palm. He says that in the Singapore island there are twelve races differing in the characters of the nut and two in growth also. He mentions four races *viz.*, Klapa Jatong, K. Bulat, K. Besar and K. Sepang from which copra is made in Singapore. K. Laga has too small a nut to be used in making copra. Two dwarf races *viz.*, K. Puyoh (green) and K. Gading (yellow) are also included. K. Nipah is a promising high yielder but is not common. The shell of K. Sekol is used for making cups. K. Wangi is said to have a 'peculiarly fragrant' endosperm and is medicinal. This unique coconut is also mentioned by Burkill (1935). He (Omar) has not described the races but has given photographs of the different

nuts. The name Klapa or Kelpa meaning coconut is perhaps allied to Kalpa in Kalpa Vriksha (Paradise tree) a Sanskrit name for the coconut palm.

A USEFUL DWARF COCONUT:

Handover (1919) and Jack and Sands (1922) have described a Dwarf Coconut called Nyiur Gading. It is a distinct small variety common in the Malay States, supposed to have been originally introduced from the Dutch Indies. Perhaps this variety first occurred as a mutant in Java. It is a small, hardy palm which begins to bear in about three years after planting. Bearing is profuse and the yield is said to be about 120 nuts per tree, per year. The thickness of kernel is good and the quality of copra is satisfactory. About 8400 nuts yield a ton of copra. The kernel is rich in oil and sweeter than that of the ordinary variety. Trees thirty years old occurring in various parts of Malaya are said to be bearing profusely. Colour variants with yellow, golden, ivory yellow, green, brick red, green bronze and intermediate colours occur in the variety. The chances for self-pollination are more in this variety than in the ordinary one; 70-80 per cent or more of the progenies may breed true to type. This is the only dwarf grown on a plantation scale.

This useful variety may not be confused with other dwarf races or forms which go by different names -

King coconut, Nicobar Dwarf, Laccadive Dwarf, Andaman Dwarf, Malay Dwarf, Chowghat (Malabar) Dwarf and Pathunettam-patta. These will be considered later. In fact, Nyiur Gading comes under the group of palms called semi-talls or medium dwarfs which are more hardy and robust than the true dwarfs, and have copra of good quality. The nut matures in about 11 months after pollination. The time of first bearing occurs in about four years after planting. The Tall x Dwarf or the Hybrid coconut evolved by the Department of Agriculture, Madras, and the Ganga-bondam of the Circars (S. India) belong to this group of coconut palms.

PHILIPPINE FORMS: Copeland (1931) in his book on the coconut has dealt with fourteen varieties occurring in the Philippines and the adjoining islands. Of these, five including Nyiur Gading already mentioned, are more important than the rest which include minor forms and freaks or abnormalities.

1. *The San Ramon:* This is a very high-yielding form with large nuts nearly twice as large as the ordinary, 3270 nuts giving a ton of copra. The yield is, at times, said to be even 200 nuts per year. The distribution of the form ranges from Ceylon across Malaya and Polynesia. This is perhaps the largest nut found on a plantation scale. The large-sized nuts from Ceylon and the Kappadan

of Malabar are allied to this form. From the account given the form is a very promising one for large-scale planting.

2. *The Lagana:* This is the ordinary tall variety, the most common and popular one typical of all the coconut countries of the world. About 6000 nuts are required to produce a ton of copra.

3. *The Coco-nino or the baby coconut:* This is a distinct, dwarf form with short trunk bearing in about four years after planting. It is a prolific bearer with rather thick and hard copra. About 100 nuts are produced by a single tree in a year. Some 7000 or more nuts are required to make a ton of copra. The form is specially valued for tapping and this is a promising one.

4. *The Pugai:* This is a very dwarf form fruiting in three years after planting. The husked nut is about 7 cms. in diameter and the husk is 2 cms. thick. The nut is so small that it does not seem to be economical for large-scale planting.

These four varieties fall into two main groups viz., the Tall and the Dwarf. Besides the varieties described in the foregoing, Copeland mentions others viz., Makapuno, the Thyru Thengai (curd coconut) of Malabar which has the cavity filled with a firm tissue and is considered a delicacy. This is occasionally found in coconut plantations. The nut does

not germinate when planted and produce a seedling. The Makapuno is an abnormality. Certain trees produce both the normal and the abnormal nuts. The normal ones from such trees when planted produce trees giving Makapuno nuts also. Lono nuts with soft kernel and Taban with sweet husk are also mentioned. Taban is known to occur in the Malabar coast also where it is called Kaithathali. There are other types also especially used for decorative purposes, or for their very thick or very thin shell or husk. The one called Lincoranag has a characteristic low habit of growth. Among the colour types the one called Agta is unique in having a dark green colour almost looking black.

VARIETY SPICATA: Jacob (1941) described a very distinct botanical variety called variety *spicata*. This is sometimes known as the spikeless coconut because the inflorescence is unbranched and is without the usual flower-bearing spikes. For the same reason it is called the Panamaram Thengai in Tamil, meaning the Palmyrah coconut. This variety is unique in that it is the only one in which femaleness is most expressed and maleness least expressed, because the number of male flowers is as low as 50, while in the ordinary coconut the number of female flowers is very much less than that of the male flowers viz., 25 and 600 (average) respectively.

The setting percentage i. e., the number of nuts produced per 100 female flowers is very low. The mature nut is smaller than in the ordinary variety; otherwise the characters of the nut are the same. At the Coconut Research Station, Kasaragod (S. India), it was found that 50 per cent of the progenies (natural) of variety *spicata* bred true to the mother. This variety was also found to cross freely with other coconut varieties. The resulting hybrids were vigorous. Variety *spicata* can be made use of in coconut breeding, but is useless for tapping.

THE MALE COCONUT

Var. *spicata* is one extreme of sex expression. It is almost a pure female except for a few male flowers. On the other hand, there is a tree at Kasaragod which is completely a male. It looks very much like any other ordinary coconut tree but is more robust, especially the inflorescence. But it contains all male flowers only, some 5000 per bunch, and is never known to have produced any female flowers or nuts. Similar male coconut trees are said to be found in parts of Malabar. The separation of sexes in different individuals is no doubt a sign of advancement in evolution. But from an economic point of view a male coconut tree is not only unnecessary but undesirable, because it is a loss to the planter. This rare find was described by John and Narayana (1942).

THE HYBRID COCONUT

John and Venkatanarayana (1943) described the hybrid coconut. It is also called the Tall Dwarf cross because it is obtained by crossing the ordinary tall variety with the pollen from the dwarf. The study of the hybrids on a field scale has been in progress during the last fifteen years at the Coconut Research Station, Nileshwar (Malabar Coast). The progenies are vigorous, with a short trunk and low habit. They are early and prolific bearers; they first flower in four years after planting and the nuts mature eleven months later. Their performance has been satisfactory. The yield of nuts is high and the quality and quantity of copra are fairly good. A few seedlings obtained from the hybrids were planted in the field and it remains to be seen how they will do when they begin to yield. Even if the hybrid does not produce palms similar to itself, it is not a serious drawback, because it lives for a sufficiently long period, and seednuts to raise new hybrids have to be produced by artificial crossing. A number of inter-varietal, cyclic crosses between world varieties and forms are in the field. They are still too young to bear and it is too early to judge them. Still it may be said that hybridisation has opened a new line in the improvement of the coconut by producing new strains.

FREAKS AND ABNORMALITIES

A dozen instances of abnormalities are mentioned by Patel (1938) and others in earlier years. These abnormalities are popularly, though incorrectly called varieties. They are, however, dealt with briefly in the following:

POLY-EMBRYONY: This is the phenomenon of a single coconut producing more than one seedling. The number may be two to four. More seedlings are produced on account of more embryos in the nut.

BRANCHING COCONUT: The ordinary coconut palm has only one growing point which gives rise to a single unbranched trunk. Various authors have recorded instances of coconut trees with a number of branches.

FOLIATION OF THE SPADIX: This is an instance in which the flower bunch instead of producing flowers and nuts developed small branches which have subsequently dropped off.

VIVIPARY: Here the young female flowers instead of developing into normal nuts grew into bulbils or small seedlings, which, however, when planted in the ground failed to establish themselves.

SUCKERING COCONUT: This is a rare instance of a coconut tree producing suckers like a plantain. The tree is at Kasaragod (South India).

PLATE 1
VARIETY AND FORMS OF COCONUT

NARAYANA & JOHN

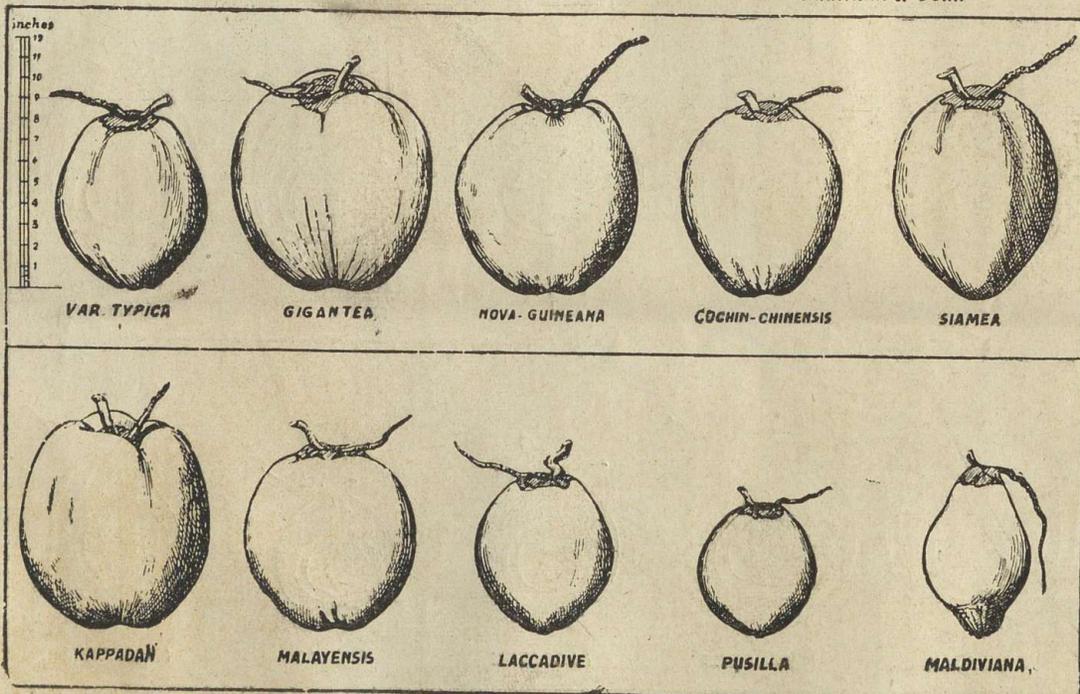
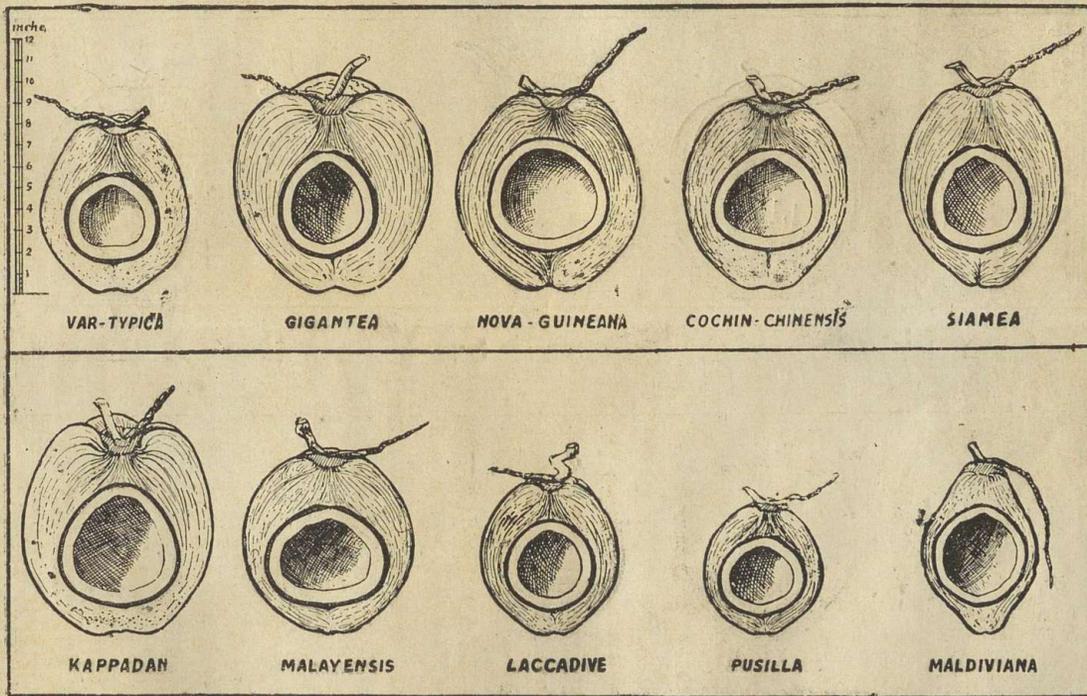


PLATE 2
VARIETY AND FORMS OF COCONUT (CROSS SECTION)

NARAYANA & JOHN



Wambly

A picture of the tree is given by Patel (1938) in his Monograph on the coconut. When separated from the mother and planted in the field the sucker gave raise to quite a normal tree.

HORNED COCONUT: At times one or two flat horns of varying sizes are found developing from the base of the nut. These are modifications of the staminode of the female flower.

Also instances of the pistillode of the male flower developing banana like structures have been recorded. Certain coconuts with semi-solid kernel and others with sweet husk are already mentioned in the previous pages.

The freaks, though interesting by themselves are not of any economic use; and most of them occur in all the important coconut growing countries.

CLASSIFICATION OF VARIETIES

The occurrence of different varieties and races in the various coconut growing countries of the world is well known. Most of them have been dealt with by authors as already mentioned. But a systematic classification of the known varieties does not seem to have been attempted. This is perhaps due to the fact that the material to be handled is very difficult. Though certain varieties appear to be quite distinct, when considered by themselves, it is possible to connect up most of them

except var. *spicata*, by a graded series of intermediate forms. This would naturally lead to considerable difficulty in defining the boundaries of any variety. Still it is necessary to separate the varieties as far as possible into definite groups and place them in their proper position. If not, the knowledge of the subject will tend to be confused. An attempt, therefore, is made in this paper to classify and name the outstanding varieties and forms.

The coconut is an important crop in South India and it has been studied by the Department of Agriculture, Madras, in its various aspects, during the last 33 years. The Department has maintained four Coconut Research Stations in the Malabar Coast, at Kasaragod, Nileshwar and Pilicode. With a view to studying the important world varieties, planting material was obtained in 1921 and 1924 from all the chief coconut growing countries viz., Malay, Philippines, Java, Siam, Cochin-China, Ceylon and Laccadives, and planted at the Coconut Research Station, Pilicode. The various economic characters of the varieties have been studied and the different forms are included in this paper.

The name variety is often used by many in the popular sense to include any variant whether it is a botanical variety, form or type. In the following account variety will be used only

for botanical varieties and races or forms and types will be denoted as such. From a study of the available material and perusal of the literature on the subject all varieties and forms can be broadly divided into two main groups viz., the tall and the dwarf. In each group there are a number of forms. Eco-types of a form, such as heavy yielders and poor bearers are of local importance only and may not have much classificatory value.

The cosmopolitan species *Cocos nucifera* Linn., is divided into five varieties viz., var. *spicata* K.C. Jacob; var. *typica* Nar; var. *nana* (Griff) Nar; var. *javanica* Nar; and var. *androgena* Nar. All these varieties cross with each other freely. Var. *spicata* was already considered. Var. *typica* is the ordinary, tall variety, found in all the coconut countries of the world, and includes most forms some of which are named here as: *ramona*, *Kappadan*, *Malayensis*, *siammea*, *cochin-chinensis*, *nova-guineana*, *gigantea*, *pusilla* and *laccadive*. The large nuts from Ceylon and *Kappadan* from Malabar are allied to forma *ramona*, but the yield of nuts of these forms is less than that of *ramona* in the Philippines. Var. *nana* is the dwarf variety and 'nana' is the earliest known name given to it. This includes all the pure dwarfs, and the forma *nana* (Coco-nino or baby coconut) and forma *maldiviana* (the Pugai of the Philippines). The first form

has larger and economically more useful nuts, while the second has smaller ones. The Laccadive or Maldive Dwarf, the Andaman Dwarf, the Chowghat Dwarf, the Chennangi and the King coconuts etc., come under forma *maldiviana*.

Var. *javanica* is Nyiur Gading said to be originally a mutant from Java. It is intermediate between the tall and the dwarf varieties and is breeding true; economically it is important. As it is considered to be a mutant a separate varietal status is given to it. The Gangabondam and the hybrid cocount of Madras belong to this variety. A tall type of cocount recorded as 'Java' at the Cocount Research Station, Pilicode may not be confused with var. *javanica*.

Var. *androgena* is the male coconut palm. A purely male tree is a unique occurrence and it is here given a different varietal name.

DESCRIPTIONS OF VARIETIES AND FORMS

Var. *typica*: This is otherwise called the ordinary or the common Tall variety and is most extensively grown on a plantation scale in all the coconut tracts of India and elsewhere. Though the coconut is not said to be a native of India by botanists, the ordinary variety has been in cultivation in India from very ancient times and may, therefore, be considered for all practical purposes to be the indigenous variety.

It is a long-lived, hardy palm thriving under different soils, climate and rainfall, and is found in littoral sands as well as in table lands up to an altitude of about 3,000 ft. above sea level. It begins to bear in about eight to ten years after planting. Given sufficient soil moisture and plant food it grows well and lives to an age of about 80-90 years, and is fairly resistant to diseases and pests.

The stem of the palm, or trunk is smooth and erect and of medium girth of about 2 to 2½ ft. under rain-fed conditions becoming stouter and more robust in irrigated and rich soils. The trees attain a height of about 50 to 60 feet or more. Every leaf axil of the bearing tree contains a spathe enclosing a spadix or branched spike. Female flowers which are only few are at the base of the spike and the numerous male flowers studded all over, occupy the rest of the spike. These open first and are shed in a period of nearly three weeks. Then the female flowers open and become receptive. Therefore the common occurrence in South India is that they are ordinarily cross-pollinated in nature, except in the summer months when there are chances of self-pollination due to overlapping of spadices. After pollination, the nut matures in a period of twelve months, when it is fit for planting. Tender nuts are best obtained when they are about 5½ months old after pollination. The nut is medium sized

varying in shape from spheroid to linear with colours varying from green, yellow and orange to shades of brown. The quantity and quality of copra are satisfactory. About 6,000 nuts yield a ton of copra.

There are many eco-types in this variety as heavy bearers, medium bearers, low yielders etc. The heavy bearers yield about 100 nuts per tree per year under rain-fed conditions. Early yielding, medium and heavy bearers are considered good for seed purposes. Alternate and irregular bearers are also met with in the variety; they give bumper crops in some years only, and are not selected for seed purposes.

The main forms of the var. *typica* are described in the following:

1. *Forma ramona*: This form with large nuts and high copra content is described under the Review of Literature.
2. *Forma Kappadan*: The form is called Kappadan with reference to the large quantity of water contained in the tender nut, (Kappadan = 16 bottles by volume). It is a form allied to the var. *typica* proper but is more robust in all characters, particularly in the size of the nut which is one of the largest on record. The shape of the nuts is broadly ellipsoid. The yield is rather low. Quantity of copra is high and copra is thick and hard.

This form is closely related to forma *ramona* and appears to have been naturalised in the West Coast and is met with in parts of South Malabar. The large nuts from Ceylon are similar to this form.

3. Forma *gigantea*: This is a form from the Andaman Islands. As the name indicates, the form consists of palms with tall stature, massive proportions and majestic appearance. The nuts are round, green, and large, perhaps the largest on record. But the yield is poor, with only three or four nuts, in a bunch. Though the copra content is high, the copra is thin and of poor quality. Water in the tender nut is plentiful and insipid in taste. The spathe did not yield to tapping and gave practically no juice.

First flowering occurs in about eight years after planting. It is not an economically important variety. The palms are resistant to diseases. The seed nuts give poor germination. A closely related type of this form, by name Andaman Ordinary is available at the Coconut Research Station, Pilicode. It is a good yielder of toddy. Nuts are big and similar in shape and appearance to those of forma *gigantea*. Stature is smaller than that of *gigantea*.

4. Forma *nova-guineana*: This is one of the forms of large sized palms. The palm is robust with a tall, stout trunk and a massive crown with a large number of long leaves and bunches.

The female flower production is high and setting percentage is rather low. The yield of nuts is fairly good being about 75 nuts per tree, per year. The nuts are medium-large, spheroid or ellipsoid in shape and green or orange brown in colour. The water in the tender nut is plentiful and sweet, Copra is thin and rather poor in quality. Percentage of oil in copra is low, being 66.2.

This palm comes to bearing in about seven years after planting. The form is unique in producing leaves and bunches in very quick succession. Sometimes two inflorescences open even on the same day especially in the summer months, while in var. *typica* proper the interval between the opening of successive bunches or inflorescences is about 25-30 days. This character contributes to high yield and is useful to the breeder. In its native habit at the form is said to produce one of the largest sized nuts.

This form is susceptible to the attack of fungoid diseases, and pests.

5. Forma *cochin-chinensis*: The palm is robust with rather stout, tall trunk and large round crown well filled with large number of leaves and bunches. The bunches are large, full of fairly large-sized, spheroid nuts. The colour varies from green to shades of brown. Female flower production is rather low but setting percentage is high. Tender nut has

fairly large quantity of sweet water. The yield is high but the meat is thin; quality of copra is fair.

The palm comes to bearing in about eight years after planting. It is a useful variety possessing the desirable characters of high yield, medium-large size of nut and high setting percentage. The palms of this form are susceptible to the attack of fungoid diseases, and pests.

6. *Forma malayensis*: The palms of this form have a tall habit and the trunk is rather stout. The yield of nuts is low and the nuts are medium to large in size, green, and quite round or spheroid in shape. The water in the tender nut is sweet and plentiful with a peculiar aroma about it. Copra content of nut is high and the quality is fairly good. The percentage of oil in copra is rather low. Female flower production is low and the setting is fair. The base of the button has a rose-ring seen clearly when the perianth is removed.

It is a late-yielding variety coming to bearing in about ten years after planting. It is highly susceptible to diseases and pests and there is fairly high shedding of buttons and tender nuts, but the form is good for tender nuts.

7. *Forma siamea*: This is an economically important form from Siam allied to *forma ramona*. The trunk is rather short and fairly robust with a good compact crown. The

yield is medium, and the nuts are green, rather large-sized and ellipsoid or spheroid in shape. The water in tender nut is sweet and plentiful. The quality and quantity of copra are fairly good and the copra contains as much as 74 per cent of oil. Female flower production is rather low and the setting percentage is moderately good.

The form is a late bearer beginning to yield in about ten years after planting. It possesses the desirable characters *viz.*, good quality and quantity of copra and high percentage of oil, and is a useful form.

8. *Forma laccadive*: This form very much resembles the ordinary tall variety *viz.*, var. *typica*. Female flower production and setting percentage are high. The nuts are medium sized, the quality and quantity of copra are good. Tender nut water is satisfactory. The yield is high being above 100 nuts per tree, per year. It is a regular and heavy yielder of nuts. It gave the highest yield of toddy, twice as much as var. *typica*.

Economically it is a promising form on account of its high yield and good quality and quantity of copra. It will be worth while multiplying this form on a large scale in India.

9. *Forma pusilla*: This form resembles var. *typica* but is characterised by small-sized nuts and large bunches containing as many as

100 nuts or more in a bunch. The annual yield at times may be as high as 400 nuts per tree. Water or milk in the tender nut is very little and fairly sweet. The quality of copra is good though the quantity per nut is low on account of the small size of the nut. But the number makes up for the size. The form is unique for high female flower production and high setting percentage and yield — three important economic characters. Also the percentage of oil in the copra is very high, being 75 per cent.

The shape of the nut is linear or spheroid according to the type. Spheroid nuts (unhusked) are at times very small being only of the size of a large orange. Then the number of nuts per bunch goes up to even 200. But the only drawback with the form is that it does not seem to be a regular bearer i. e. heavy yields are not regularly obtained every year. Still the average annual yield is high and the total out-put of copra per tree, per year is more than in var. *typica* or the ordinary variety.

It is an important, economic form useful in crossing as well as for large-scale planting, and is particularly prized for making ball-copra. Popularly the form goes by the name of "Divi" which means island possibly referring to the Laccadive and other islands where it is largely grown and from where the copra of this form is

exported. It is occasionally met with in the West Coast gardens.

The size of the nut being small the quantity of kernel utilized for the production of seedling is much less than in any other variety, which means a considerable saving of copra.

The following are the forms of the Dwarf variety viz., var. *nana*:

1. *Forma nana*: The Coco-nino or the baby coconut of the Malay States is described under the Review of Literature.

2. *Forma maldiviana*: This is a popular dwarf form. It has a short trunk and small stature, with small crown and short leaves. The trunk is thin, attaining a height of about 10 to 15 feet with age. Rarely trees are said to live for more than 35 years. Being rather delicate, the variety thrives best in rich soils and under proper conditions of drainage.

On account of its early bearing nature people have a fancy to plant it in back yards of houses and it is now fairly common all over South India, where it is naturalised. The trees come to bearing in about three years after planting and the bunches practically touch the ground in the early stages of bearing and are pretty to look at.

The nuts are small sized and yield a fairly good supply of sweet milk or water in the tendernut. But the copra is thin and of poor quality

being leathery. It, is, therefore not met with on a plantation scale in India. It is also susceptible to the attack of pests and diseases.

Unlike in var. *typica* there are chances for self-pollination due to overlapping of male and female phases of flowering. The nuts mature in about ten months after pollination i. e., two months earlier than those of var. *typica*. Also the leaflets in the seedlings split much earlier than in the seedlings of the var. *typica*.

There are two types in this form. One type has very small narrow nuts with very small quantity of copra. The other has fairly large or medium sized nuts and these should be preferred for planting. Colour forms *viz.*, green, yellow and orange or red and brown are common. These are ornamental. This variety when crossed with var. *typica* (mother) gives rise to progenies with hybrid vigour.

The various forms have been named after the country from which they were originally obtained or where they are largely grown, or after a distinguishing character of the form.

The data relating to the measurable characters of some of the varieties and the forms are furnished in the table appended, which will give a comparative idea of their economic characters. The relative sizes and shapes of the cut and the unhusked nuts are figured in two plates.

A separate key for the identification of the varieties and forms is also included.

USES OF THE VARIETIES AND FORMS

The uses of the coconut are many and varied. Practically every part of the tree and the nut is put to some use or other. Most books on the coconut deal with the many purposes for which it is utilized. The most important commercial product is the copra or dried kernel. For a planter the main consideration is the production of the best quality of copra at a low cost. The output of copra per tree, per year contributes to the yield of plantations. This depends upon the number of nuts each tree bears in a year and the quantity of kernel contained in the nut. The large size of the nut alone does not count, because in the poor soils of South India, the yield of nuts goes down as the size increases. Based on these considerations the best variety for this country is the var. *typica* or the ordinary tall as also forma *laccadive*. The best planting material has to be rigorously selected from among promising eco-types. The *laccadive* form is in fact better than var. *typica*, but planting material is not available on any large scale. There are only a few trees at the Coconut Research Station, Pili-code and attempts have to be made to multiply the form on a large scale for distribution. The form called

pusilla or Laccadive Small as it is called popularly, is quite good from the view point of copra production. But as the size of the nut is small, the husking and breaking charges to produce a unit weight of copra may be comparatively higher. It is a form specially suited to make ball copra which is much in demand in certain North Indian markets. The percentage of oil in this form is the highest on record in the Madras collections.

In this context, the famous San Ramon nut (forma *ramona*) is worth considering. It yields twice as much copra of good quality as the var. *typica* proper of India. The yield of nuts also per tree is quite high. If this form can do as well in India as it has done in the Philippines it should be easily possible to double our output of copra per acre. But unfortunately, it does not seem to have been given any large-scale trial in this country. Also the Pilicode collections are lacking in this important form. The Nyiur Gading or forma *javanica* of the Malay States, which is an early bearing, heavy yielder appears to be promising on a plantation scale, but it has not yet been given a proper trial in India. It will be worth while introducing these two forms and studying their performance carefully in the different coconut tracts of the country, before contemplating large-scale planting.

From the view point of production of sweet toddy for jaggery (gur) making, the forma *laccadive*, the type Andaman Ordinary and the form *pusilla* are the best yielders. Among the dwarfs, forma *nana* is reported to be a high yielder of juice. For the coir fibre forma *laccadive* is good. For ornamental purposes the dwarf types are the best. They have a short stature and well-filled bunches of nuts with different colours as ivory, orange and apricot, almost touching the ground, and make pretty palms in any garden. Among the ordinary tall variety there are certain trees which produce undersized nuts with thicker shell than the normal and these can be used for carving and shell work.

The different varieties, and forms afford a wealth of material for the coconut breeder whose ideal is an early bearing, high yielding palm with large nuts having superior quality of copra and high percentage of oil. And high yield is the resultant of quick production of flower bunches with large number of female flowers with high setting percentage. The palms should also be resistant to pests and diseases. The breeder's ideal cannot be achieved by selection alone, as the different economic characters are distributed among the various varieties and forms and recourse should be had to crossing. Fortunately all the varieties and forms cross freely with one another

and they can be utilized to produce new and useful economic strains.

INTRODUCTION OF VARIETIES

Reading of the many varieties one may be naturally inclined to get outstanding varieties from foreign countries. In this respect particular caution should be exercised especially when large scale planting is contemplated. Because all varieties are not cosmopolitan, which means that they will not do equally well in different countries as the conditions of soil and climate vary considerably from country to country. Also, it should be remembered that in most varieties cross-pollination is the rule, and the progenies may not breed true to the parent (mother). The object of introducing a new variety should be clear — it may be for increased output of copra, or toddy for jaggery making or for ornamental purposes. It is important to ascertain, before importing foreign varieties, whether similar or nearly similar varieties are already available in the country. A variety which has done well in a foreign country need not do equally well in this country. The famous San Blas coconut of Panama which is very productive proved disappointing when it was introduced into the Malay States. Most of the imported varieties grown at the Coconut Research Station, Pilicode (Malabar Coast) did not come upto expectations. Many of them were highly susceptible to the attacks of pests

and diseases, particularly shoot rot. The size of nut went down and the quality of copra was inferior in many instances. Such risks private planters cannot take and it is best to leave the introduction of foreign varieties to the Coconut Research Stations which should be in a position to conduct proper trials and advise the public regarding the best material and variety suitable for planting. Also while introducing new varieties the risk of introducing diseases into a healthy tract should be seriously considered and guarded against.

SUMMARY

The paper deals with the varieties and the forms of the coconut. The information available on the different sorts grown and studied at the Coconut Research Station, Pilicode, and that gathered from publications dealing with the subject from various coconut growing countries is included. A systematic classification of the available material has not been attempted by previous authors, and it is done in this article. The species *Cocos nucifera* Linn, (the coconut) is divided into five varieties, of which only one has been hitherto described. All the varieties fall into two main groups viz., the Tall and the Dwarf. In the Tall groups, three varieties and nine forms and in the Dwarf two varieties and two forms are recognized; these now bear new names which are mostly after the names of the countries from which

they were obtained. The ordinary tall variety which is typical and cosmopolitan in all the coconut growing countries is called var. *typica*. The many types of local importance found in various countries are not emphasized upon. Descriptions of the varieties and forms and a table of their quantitative characters are given, as also a key for their identification. The importance of outstanding forms like the Laccadive nut, and the famous San Ramon from the Philippines is brought out. The Dwarf mutant, here named as var. *javanica* and spoken of as a good performer is recommended for trial. The

rare find of a purely male coconut tree which shows the direction of evolution of the coconut species is christened as var *androgena*. Varieties or forms for special purposes like commercial planting, or for tapping or for ornamental planting etc., are mentioned. The possibility of evolving new and economically useful strains by hybridization is indicated.

It is, however, not claimed by the authors that the work of study and classification of the many varieties and forms of the coconut is either complete or comprehensive. Much remains yet to be done on the subject.

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Key for the identification of coconut varieties and forms.

Varieties.

- A. Inflorescence unbranched or rarely with one or two small spikes. var. *spicata*.
- A.A. Inflorescence normal and always branched.
- B. Tall, late bearing palms.
- C. With both male and female flowers. var. *typica*.
- C.C. With only male flowers. var. *androgena*.
- B.B. Dwarf and early bearing palms.
- D. Vigorous palms bearing in 4 years. var. *javanica*.
- D.D. Delicate palms bearing in 3 years. var. *nana*

Forms of var. *typica*

- A. Nuts very small (about 1000 cc. in volume) and very many in a bunch — even 100 or more. *pusilla* (Laccadive small),
- AA. Nuts not small.
- B. Nuts very large (7000 c. c.) majestic palms, copra content low and quality inferior. *gigantea* (Andaman giant)
- BB. Nuts medium large (about 6000 c.c. or less)
- C. Nuts about 6000 c. c., copra superior and quantity high — about 10-12 oz. per nut.
- D. Yield of nuts per tree, per year, about 100 even. *ramona*.
- D.D. Yield of nuts low about 35 per tree per year. *Kappadan*
- C.C. Nuts 4000 c. c. in volume or less.
- E. Trunk robust — 90-100 cms., in girth.
- F. Percentage of oil in copra high (74) *siamea*.
- F.F. Percentage of oil in copra low (66-69)
- G. Female flower production (annual) very high (744) *nova-guineana*.
- G.G. Female Flower production (annual) low (220) *malayensis*.
- E.E. Trunk of medium girth (73-83 cms.)
- H. Copra thin (0.82 cms.) and per cent of oil in copra low 66. *cochin-chinensis*.
- H.H. Copra thicker (1.2-1.3 cms) and percentage of oil high 72. *laccadive*.

TABLE

The quantitative characters of the coconut varieties and forms—Coconut Research Station, Pilicode.

Serial No.	Variety or Form.	Age of tree.		Age at first flowering.		Girth of trunk at base.		Number of leaves in the crown.		Length of leaves.	Length of petiole	Mean production of female flowers per year.	Highest yield of nuts recorded per tree in a year.	Quantity of water in tender nut.	Weight of unhusked nut.	Weight of husked nut.	Volume of unhusked nut.	Volume of husked nut.	Mean thickness of meat.	Thickness of husk, (middle of husk)	Mean copra content per nut.	Percentage of oil in copra (Ether extraction).	Yield of juice per day, per palm.	Serial No.
		Year	Year	Cms.	Cms.	Cms.	Cms.	CC.	Grams															
1	Var. <i>typica</i>	25	10	73	34	594	129	320	80	300	1134	454	2264	465	1.21	2.45	159	71.6	899	1				
2	Forma <i>laccadive</i>	16	4	76	39	533	137	648	160	290	1219	510	2170	500	1.25	3.04	157	72.2	1758	2				
3	„ <i>pusilla</i>	16	6	91	30	526	144	522	400	261	709	225	1200	250	1.12	1.40	60	75.3	1234	3				
4	„ <i>Kappadam</i>	...	...	...	...	...	...	...	35	894	1929	193	5750	1135	1.48	4.30	332	61.7	...	4
5	„ <i>siamæa</i>	15	10	93	32	487	132	175	59	841	1899	737	3915	855	1.10	3.60	221	74.3	41	5				
6	„ <i>gigantea</i>	16	8	114	38	579	152	199	35	500	1786	878	6900	800	1.29	6.30	180	67.1	nil	6				
7	Type Andaman Ordinary	16	7	91	31	533	144	451	40	377	1701	552	3640	700	1.28	3.70	170	67.1	1339	7				
8	Forma <i>nova-guineana</i>	15	7	91	31	579	152	744	93	348	1105	368	3600	580	1.12	5.20	213	65.6	541	8				
9	„ <i>malayensis</i>	15	10	91	29	465	114	220	44	609	1616	935	3200	996	1.22	2.40	200	69.0	680	9				
10	„ <i>Cochin-chinensis</i>	15	8	83	30	609	137	208	88	464	1162	652	2340	750	0.82	2.30	140	66.2	758	10				
11	„ <i>maldiviana</i>	15	5	71	27	396	106	140	86	348	623	317	1053	450	0.96	1.55	84	66.2	310	11				
12	Var. <i>spicata</i>	8	4	78	30	513	134	978	25	210	510	283	1950	500	1.25	2.10	141	70.6	nil	12				

(Note: 1 oz. — 28.35 grams)

(1 fluid ounce — 28.41 CC.)

REGULATED MARKETS FOR COPRA

It is now a well-established fact that one of the means of enabling the agriculturist to obtain a fair price for his produce and the buyer to get produce of satisfactory quality is to have the buying and selling done in regulated markets where the transactions will be controlled by a properly constituted authority representing the interests involved. There are at present regulated markets for commodities such as cotton, groundnut, tobacco and other agricultural commodities in various parts of the country and they have proved beyond doubt that the cultivators could get better prices for their produce in such markets than in the markets where the buying and selling is not regulated or controlled.

Regulated markets are organized under an Act passed for the purpose by the Government of the Province or State concerned. The Act provides for the setting up of a market committee which exercises control over the regulated market. On the market committee are represented growers, traders, officials, local authorities and other interests concerned. The market committee is authorised to issue licences to brokers and weighmen and to cause

weights and measures to be inspected through duly empowered members and inspectors. The Act also provides for market charges being clearly defined and prescribed and posted at conspicuous places in the market. The use of standard scales and weights and the keeping of returns or accounts are also provided for. The transactions in a regulated market are open and above-board. There is scope for open and healthy competition among buyers and the prices ruling at any time are announced and, therefore, known to the sellers. There is no scope for the practice of duplicity, and the dissemination of market intelligence in regard to prices, supplies, sales, stocks, etc., is rendered easy.

Areas of varying size are declared as notified areas under the Act and in each market centre a market yard under the direct control of a market committee is provided where the main transactions take place. Transactions can take place in any other spot in the notified area provided information regarding the quantity and price of the commodity changing hands is communicated to the market committee, who will send round their Inspectors to arrange to verify the information and

check up the transactions. In no other part of a notified area are sale and purchase permitted. The markets and yards are under the immediate charge of a superintendent while the administration of the market committee is entrusted to a secretary. The committee discharges its functions through sub-committees such as dispute sub-committee, executive sub-committee, control sub-committee, etc.

Regulated markets for agricultural commodities have been in existence in Bombay, Central Provinces, Madras, Hyderabad, etc., for a considerable time now. In the Bombay Presidency regulated markets for cotton have been functioning under the Bombay Cotton Markets Act. In the Central Provinces and Berar there are cotton and grain markets administered under the Berar Cotton and Grain Markets Law, and also the Central Provinces Agricultural Produce Markets Act. In the Madras Presidency, under the Madras Commercial Crops Markets Act, regulated markets have been established in the Coimbatore, South Arcot and Guntur districts for cotton, groundnut and tobacco respectively. There are a number of regulated markets in the Hyderabad State established under the Hyderabad Agricultural Produce Markets Act.

At its meeting held in April 1947, the Indian Central Coconut Committee considered the question of setting

up regulated markets for copra. In the existing markets the seller is obliged to pay so many customary charges and levies and is the victim of exploitation by so many grasping middlemen that he often gets only a part of what he really ought to. In the Alleppey market, for example, the producer gets only 10 or 11 annas in the rupee of the price which the miller and exporter at Alleppey is prepared to pay. Of course, the producer cannot hope to get the whole of the price paid by the consumer as allowances must be made for the cost of transport and for a fair return to the middlemen for their services. But if the abuses of which the producer is almost always a victim and the numerous charges which are levied from him, almost always in kind, under one pretext or other, are removed or properly controlled appreciably higher prices could be secured for the grower.

The Indian Central Coconut Committee's decision at its April 1947 meeting was that a recommendation be made to the Provincial and State Governments concerned to take steps to establish regulated markets for copra within their jurisdictions. At its eighth meeting (October, 1948) the Committee went one step further and decided to appoint a marketing officer for a period of six months to draw up schemes for the organization of regulated markets in Travancore and Cochin, Madras and

REGULATED MARKETS FOR COPRA

Mysore. The services of MR. M. I. PATEL, an Assistant Marketing Officer, Bombay Province, were obtained for the purpose and his report

regarding the possibilities of setting up regulated markets in Travancore and Cochin are given in the following pages:—

A case for the application of Agricultural Produce Markets Act for regulating the sales of Copra in the Travancore State.

AREA UNDER COCONUTS

Travancore State is an important coconut-growing area. It had 5,76,883 acres of coconuts in the year 1946-47 as compared to 64,924 acres in the

Cochin State. The area is concentrated in the coastal region and to a lesser extent in the midland and the hills. Important coconut-growing taluks with the area under coconut are given below:—

Name of Taluk.	Area in Acres.
1. Neyyattinkara	31,960
2. Trivandrum	21,094
3. Chirayinkil	30,101
4. Quilon	49,890
5. Karunagapally	24,391
6. Kottarakara	32,650
7. Ambalapuzha	23,804
8. Mavelikara	19,275
9. Tiruvella	43,205
10. Shertalai	35,110
11. Changanacherry	24,145
12. Kottayam	29,800
13. Vaikom	28,715
14. Meenachil	31,860
15. Parur	22,366
16-30. Other taluks	1,28,517
30.	Total
	5,76,883

COPRA CRUSHING

The estimated production of mature nuts is of the order of 1,200 million nuts, of which a little over 50 per cent is converted into copra (about 92,000 tons). Out of this about 19,76 tons consisting of edible and milling copra were exported in 1947-48. The exports are mainly through Alleppey and Cochin ports. The rest is milled in power factories and country *chuckus* in the State.

About 4,35,55,314 nuts were exported out of the State in 1947-48. Most of them passed to Madras Province mainly through Arruvamozhy and less than 10 per cent (38,73,164 nuts) to Cochin through Arukutty.

There are in the state 35 mills coming under the Factories Act and 94 which do not come under the Act with a total number of 591 rotaries crushing copra (*Vide* Appendix No. 1.). The important crushing centres are given below:

REGULATED MARKETS FOR COPRA

Name of Centre:	Quantity of copra Crushed.
Alleppey	49,886 Tons.
Shertalai	3,520 „
Kottayam	2,179 „
Trivandrum	3,727 „
Quilon	3,564 „
Alwaye	638 „
Mavelikara	1,412 „
North Parur	2,295 „

In the remaining places only small mills are working. The total quantity of copra crushed during last year according to crushing reports received by the Indian Central Coconut Committee were 71,100 tons. Thus it will be seen that Alleppey is the most important centre in the State. Milling copra is exported to Cochin from parts adjoining to it and also to Madras by land route. There are no imports at present.

The total crushing capacity of the mills in the State is estimated at two lakhs tons if they work full time (300 days at 24 hours a day), but the quantity crushed was reported to be 71,100 tons during 1947-48 which means that some mills were closed and many were partially working. This position is mainly due to indiscriminate growth of oil mills both at the main centres and mofussil areas for the following three reasons:—

- 1) Availability of electric power in mofussil areas.
- 2) War-time profits.
- 3) Import of copra from foreign countries.

The position has now changed regarding the last two items; and so the mills at the main centres find it difficult to secure adequate stuff as foreign imports are negligible and there is the curtailment of supplies from local production due to off-take by the mofussil mills. This difficulty of the millers cannot be met with unless there are more imports. Even high prices of copra have not caused any increase in acreage and it is not also likely in the near future so long as there is an acute food shortage. On the contrary, it is reported that the acre yield has deteriorated.

MARKETING OF COCONUTS

Coconut is valued both for its kernel and husk, but the quality of both cannot be secured at the same time. In the South (not extreme South) the husk is valued more; hence pickings are at short intervals. The loss in the value of copra is said to be compensated for by the gain in that of husks. In the North importance is given to copra; hence pickings are fewer. It gives a

large percentage of edible copra and more oil. Shertalai Taluk produces the best copra in the tract. In the interior the husk is more or less neglected because there are no retting facilities and the husk cannot be easily and cheaply transported to coastal areas.

In the monsoon months the quality of copra is inferior to that in the fair season. During the former season areas near Cochin and Madras Province export coconuts, but this has only a limited scope.

Coconut cultivation unlike in Ceylon is in the hands of small holders each having a few trees in his land where he stays. There may be a few landlords, but looking to the general aspect of the matter they may be left out of consideration. These small growers who have a secondary occupation of fishing in the coastal areas sell away coconuts and hardly prepare and sell copra. There may be obvious difficulties in the way of preparing copra. In any case, there is no tendency to go in for copra making. Coconuts are plucked at an interval of 45 to 60 days. It may not, therefore, make a material difference if a grower has to wait for a week more for making and selling copra. But he may be experiencing some difficulty in having a drying yard and a kiln for monsoon drying and going a long distance to dispose of his small lots of copra as, years

back there were very few markets. This obviously means that he should sell copra locally to some other dealers and in that case he would as well prefer to sell coconuts. Thus there was no scope for him to prepare and sell copra.

During recent years the position has somewhat changed by the growth of small factories more or less in every taluk, which afford facilities for sale, but the age-old habits change very gradually.

There are two systems of selling coconuts. In this State the system of annual contract is uncommon and the growers sell their produce at every plucking. In the northern parts it is found that unhusked nuts are sold. The buyers are small copra-makers scattered all over the area having their respective circles within which they are intimately connected with growers and conversant with the quality of the produce. These copra-makers know when the fruits are ready for sale, approach the growers and buy from them. The delivery is generally on the site, but in some cases it may be at the copra makers' place, if convenient.

The copra maker bases the rate of coconuts on that of oil or copra in the market he sells in or is connected with. He would calculate what number of coconuts would yield one candy of copra which is taken to produce 62½ per cent of oil and 35 per cent of cake. He adds the cost

of husk and shell and deducts his expenses in preparing and selling copra. Thus his skill lies in getting as many nuts as possible over the number required to give one candy of copra and in knowing the up-to-date prices of cake, shell, oil, husk, etc. The poor grower may have learnt by long practice something of this, but still he has to sell coconuts to one or other of the copra-makers and generally when mutual relations develop he keeps faith in the copra-maker. Of course, big growers are more watchful and keep in touch with prices. But where a grower is indebted to a copra maker he may have to sell to him at the price offered. This is more prevalent in the South where mills are few.

The price is fixed per 1000 coconuts at Shertalai and neighbouring taluks, but in other places it is for 100 nuts. Only one extra is taken per lot. The practice of rejecting the damaged or unripe nuts does exist but is not followed everywhere. According to the garden and the season 2,500 to 3,000 nuts give one candy of cutter pass copra.

ROLE OF CREDIT SOCIETIES

Where credit societies are recovering their dues in kind they take charge of the coconut crop, arrange for picking, pooling and selling by auction. Here no difference is made regarding quality from garden to garden. This system is known as

the *Kettuthengu* system and is well described by Mr. P. Sivaraman Pillai, Special Officer for Coir and Coir Industry, Travancore, in the article published in the October-December 1948 issue of 'The Indian Coconut Journal'. This system is prevalent in the taluks of Ambalapuzha, Shertalai, Vaikom, Mavelikara, etc. He says that such societies have not found it profitable to prepare and sell copra. There may be reasons for that. But there is no inherent difficulty to undertake this work. Possibly these societies hesitate to undertake the responsibility of further working and incurring more expenses both for equipment and current working. However, no real difficulty can arise if such societies can entrust this work to the copra sale society as at Vaikom which has to hunt out for coconuts. This is an essential link between a producer society and a sale society. So a group of such credit societies can join a sale society which will prepare and sell copra on their behalf. Unless this aspect of the co-operative work is developed the growers are not likely to get all the benefits of a regulated market. They should be in a position to be direct contributors to the market arrivals through such sale societies whose interest is only to help them. Where the credit societies are members of the sale society the financial question would not arise as in the case

of individual members. The development of co-operative work mainly depends upon local initiative and interest which can be created only by public workers and hence they should devote more attention to this work if the interest of the growers is to be properly served.

SALE OF COPRA

All copra-makers are confronted with some handicaps in selling copra directly in the market. Many of them may work on credits. Several prepare lots too small to carry long distances and are obliged to sell them to a copra dealer in their circle. This process is repeated two or three stages further and ultimately the dealers going to the Central Market at Alleppey carry about a boat-load. This change-over from one intermediary to another till final destination involves a margin of profit for each of them and extra costs for every additional handling. Therefore, the more the number of intermediaries the less is the grower's return. One of the objects of the regulated market is to afford scope to small sellers also by providing facilities for sale, and making for simplicity of transactions. But providing such markets near to the grower's home is not practicable in all cases. It needs no mention that places of large consumption and exports where there will be a large number of buyers, are the ideal places for opening regulated markets as prices always

depend upon competition among buyers. So these conditions have to be looked into for establishing regulated markets. However, as stated before, if the centres where markets are established can afford equal opportunities and facilities to small as well as big sellers the barrier of distance may be easily overcome by co-operative transport. It is not possible to help those who cannot help themselves even a little. Growers and small dealers should understand this and make efforts to take advantage of such facilities.

QUALITY OF COPRA

Copra is never fully dried for sale. The reasons for the same are more or less universal for copra-makers and are as below:

1. The prices of coconuts have gone up immensely. So the copra maker, for want of adequate capital or finance, wants to sell off as early as possible so that he can either pay for old or new purchases.
2. Space required for drying will be more if the period is lengthened and in these parts it may not pay to go in for a large drying yard.
3. Copra-makers generally utilise their home labour to a greater extent; so they would like to work to the maximum capacity by resorting to frequent turnovers.
4. The local production falls short of demand and so buyers are not in a position to lay stress on quality.

They simply appraise the losses and pay the prices accordingly.

5. At present there is no competition of better quality from any other source.

6. The production is not surplus for exports; so the quality question does not command that much importance as for foreign exports.

7. Copra-makers work under the false notion that copra gains in weight by incomplete drying, but on the whole buyers are never at a loss in estimating moisture content. It gives them a pretext to offer a low price or get great deductions. It may be that the buyers may lose in a few transactions but they have ample opportunities to make good that loss from other transactions.

8. There is no proper system of artificial drying. The present crude method of kiln drying spoils the quality and reduces the oil content also and in spite of this, copra-makers have to resort to it during monsoons and in other seasons also to get quick drying for early disposal or to give the stuff a deceptive appearance.

9. Growth of small mills in the interior has also contributed to the deterioration of quality. The central market will pay at least some attention to quality but the small mofussil consumers care more to secure stocks which encourage sellers to neglect the quality.

10. Price fluctuations from day to day are always haunting the minds of copra sellers and hence they would not care so much for drying as for the rise and fall in prices. If the prices are falling they cannot continue drying a minute longer and on the contrary might extend it in the rising trend. This situation is more aggravated by speculative markets.

Under the above circumstances it is a problem how to standardise the quality of copra brought for sale to the market. To enforce it under law is only to handicap the producer and to give greater scope for malpractices. However, the existence of a regulated market would create an atmosphere conducive to the gradual raising of the quality level and a stage will be reached when it can be enforced by the market committee. The problem can be made easy if there is a chain of co-operative sale societies. Such societies can control stocks to be delivered in the market in the period of harvest gluts, if they are given licensed warehousing facilities and advances on stocks, but the growth of sale societies is not easy for want of honest and sincere workers both paid and unpaid.

Several merchants and others deplore that the quality of the copra is bad and it should be standardised by law. They, however, little realise how they themselves have contributed to bring down the quality,

and it is well known how far they are prepared strictly to observe the laws. Adulteration is a common vice among traders. The way to improve the quality is to remove those conditions which have created this position and not simply to pass a law which would only complicate matters at this stage.

The causes responsible for producers not preparing quality copra cannot be dealt with all at once. It is to be seen how they can be eliminated one by one not only by the regulation of sales but by organising growers and copra makers on a co-operative basis. Co-operation will give financial relief so as to give producers enough time for drying the copra and to put together small quantities into a bulk of uniform quality which can command the market.

Copra-makers want to shorten the drying period as far as possible to take advantage of the market. This can be done if proper types of kilns are available so that they can be used with little extra cost in any season. I believe this is of very great importance and urgency. Many of the big copra makers have a crude method of drying in country kilns. Devising the construction of kilns to eliminate smoke and to control temperature, as is done in the curing of tobacco, is essential. It should be possible to use such a type of kiln.

The market committee, the Government and the Indian Central Coconut Committee can contribute subsidies to all who want to build such a standard type of kiln and the work should be pushed through vigorously.

Next stage of improvement will be possible during sales. At present even the good quality is not paid its intrinsic value; so there is no incentive to copra-makers to improve the quality. But when all market malpractices are removed it is but natural that the buyers would appreciate the quality and the sellers would be led to come up to the standard and after a certain stage of improvement is reached it can be strictly enforced by the Market Committee.

WAREHOUSE ACT AND ITS RELATION WITH THE MARKET

Now the sellers have no facilities to store their stuff not meant for immediate sale in anticipation of better price, and the stuff prepared by them at present is not fit for storage. But when the stuff is fully dried the market committee which shall be a warehouse licensee under the Travancore Act can easily provide storage facilities in the market yard and the owners will be able to get advances on the stocks from banks or bankers.

The Warehouse Act is still inoperative due to certain difficulties in

the interpretation of a certain clause regarding compulsory licensing of warehouses. The commission agents are shrewd enough to by-pass the Act by clever wording of the receipts passed for depositing goods for sale. The essential aim of a Warehouse Act should be to benefit the growers through their organisations. However, in the case of coir, copra, pepper, etc, growers are only small units and have no organisations; hence the prominence assumed by intermediaries. Due to this reason there can be no uniform standard of quality, and warehousing is not possible without this. Another difficulty is that there may be very few reliable graders or appraisers who can correctly and honestly do the grading according to the standards laid down for warehousing so that the banks can put absolute reliance on the quality on which the price is based.

There is no growth of co-operative sale societies in the State which can work on behalf of grower members, can eliminate intermediaries and can have an effective voice in sales in the market. Such sale societies can easily be warehouse licensees and can store properly the produce they pool not only in the marketing centres but in the producing areas as well, so as to keep equilibrium in market arrivals. They can also give advances for which they should be given exemption from the relevant clause of the Act. This is quite

necessary. In the absence of controlled markets where goods can be sold under the regulated market act, the commission agents have full scope for dealings which will frustrate the operation of the Warehouse Act, but in the regulated markets when goods have to pass through them their sales are properly recorded. This will facilitate the working of the Warehouse Act.

EDIBLE COPRA

As mentioned before only 10 per cent of the copra production is exported as edible copra. This generally passes out through the Alleppey market. Grading of this copra is always done by the exporters when they purchase it from the merchants at Alleppey. The grading is done on the basis of the size and colour of the outer coating of the copra. The question of fixing these grades has been taken up by the Coconut Committee separately. The stage at which the edible copra can be graded may have to be determined when the regulated market act comes into force. It is not possible to grade small lots and to bring small quantities for sale in the market and the millers also will not separate out edible copra. Only big dealers and sale societies who handle big lots can do this. But there is one difficulty here also. The demand for edible copra is not constant. It is keen in certain periods and quite slack in others. So when there is

no demand for edible copra it is not stored but used for milling. This means that grading of edible copra will pay only when there is a demand for it. The State has passed an Act called Agricultural Produce Grading and Marketing Act on the lines of the all-India Act. But so far no schedules of specifications for grades of important products of the State have been prepared. The adoption of these grades is optional. So unless the merchants find it profitable they would not adopt them even if the grades are fixed as is contemplated by the Coconut Committee for copra. However, the market committee can make it compulsory when sales of edible copra are effected. There will be licensed graders who will do this grading which should be acceptable to both buyers and sellers. At present this grading is done by the buyer and hence there is always some heart-burning on the part of the seller. The difficulties arise more in declining markets. It happens that in a rising market sellers find some excuse to avoid delivery or give bad stuff and that when rates are falling the buyers have the upper hand. This could be easily stopped by adopting grading by licensed graders and by sales in regulated markets.

The sales of copra to mills in the mofussil and in the milling centres undergo the same sort of process except that at Shertalai, Alleppey

and Nagercoil they are through brokers and hence they are indirect and secret. This has been a fruitful source of untold tricks which are always disadvantageous to the seller who never knows the actual offer made by the buyer and has to believe what the broker says. It is not that all the brokers play mischief nor that all the buyers acquiesce in such underhand dealings but shady transactions are not uncommon.

It has been found that sales are direct with the buyers at all other places, even at Cochin. The brokers have no financial liability and their responsibility is restricted to settling of prices and attending to weighments. A sincere broker can render real service to his client, but this is not common. He receives brokerage from the seller as well as the buyer who recovers it from the seller. It is a very strange system for a buyer to oblige a broker at the cost of the seller though he also directly pays him. This is in no way justifiable and could be eliminated when the market is regulated.

Some merchants and brokers argue that according to the present system of showing samples and obtaining offers from individual buyers at their places they are able to realise a better price from a needy buyer as he may not know the prices offered by others. This is a very crude way to justify the prevailing system.

A buyer knows the current rate, his requirements and the general trend of the market. He does not buy all the lots at a time, and at any moment during the day he is in a position to know the rates at which others have purchased and even after purchases he is free to use his tricks in weighing and to reduce price by finding fault with quality. One can easily imagine how many sellers will be fortunate to get high prices against such handicaps. So there is nothing like open sales and that too among the multitude of buyers who have ample scope to secure their requirements simply by offering competitive rates. The general opinion of the buyers who were consulted favours open sales and doing away with brokers if the committee-man can carry out auctions.

Some buyers offer higher price to secure their requirements with the full confidence that they can make up that loss while weighing and by raising quality disputes. They would delay weighing till late hours and then will do it to their advantage. They would also try to reduce price under false pretexts as at the fag end of the day the seller would not be able to take back the goods or would not be able to go to some other buyers. In the regulated markets there are prescribed hours of working, weighing and payment and an independent machinery to settle quality disputes

on the spot is provided for. Thus the sellers have no chance to be ill-treated by the buyers.

WEIGHTS AND MEASURES

The Travancore State has in operation a Weights and Measures Act. It has recognised Dutch Rathals and Pounds avoirdupois and the use of only stamped weights. In the copra business generally stone weights of 60 rathals are used. They are cheap and can be easily replaced. It is difficult to stamp them. So stamp plates are sometimes seen attached to ropes used for hanging the weights from the beam. It is doubtful if such stamped weights are used by all or whether there is any effective inspection. The main defect of the Act, as elsewhere, is that it simply prescribes the use of stamped weights and nothing more and hence any extra weight can be taken per unit of weight. This is what actually happens. In the regulated market not only will stamped weights be used but there will be greater and stricter supervision even outside the market place and all extra allowances will be illegal. At present weighmen being servants of buyers naturally safeguard their masters' interest and for every weighing the seller cannot go on raising his protest. Many copra sellers have expressed that 6 lb. are taken as extra per *eda*. It includes all extra allowances in kind and spurious weighing.

The Market Act allows only those weighmen who are licensed and independent of any party. Of course the market committee can have them as its employees. It is necessary that the Government should amend the Weights and Measures Act on the basis of the recent amendment to the Bombay Act. Only cwt. series should be recognised as the trade wants it for the sake of uniformity.

Payment is generally in cash but made very late, as the buyers would be busy in purchases and then with weighing. There may be some truth in this, but when the weighment is done in the market yard itself it will quicken the process and the sellers can be free before evening. Generally buyers give a sale memo to the sellers but it is signed by the broker as the seller and the broker on the counterfoil. The explanation given for this procedure was not satisfactory.

FIXING OF COPRA PRICES

As oil and cake are the ultimate products utilised or exported their ruling prices determine the price of copra. Now that Alleppey is also developing as a speculating market and exports from the ports are increasing due to sales tax at Cochin the relation in prices at Alleppey and Cochin is not constant.* So the price that is to their advantage is taken into account by the buyers.

* Sales Tax is now levied in the United State of Travancore and Cochin.

They take that copra gives 62½ per cent oil and 35 per cent cake and that 2½ per cent is wastage. On this basis they arrive at the price of one candy of copra. From this, milling charges which include cost of gum, transport of oil etc. and other expenses are deducted. This will be the price of cutter pass copra. So if copra is not fully dried or mouldy and contains immature cups and pieces the necessary discounting is done. This is the most knotty problem of the whole business. If there is demand for edible copra its price is taken into consideration for fixing that of the mixed stuff.

Millers and copra merchants are not lagging behind in voicing their handicaps and difficulties. They say that in spite of their getting all unauthorised allowances etc., they are not able to make both ends meet. They offer the maximum price or even more for copra over the oil price in competition to run the business generally relying for the profits on the fluctuations of oil prices. The Alleppey market is dealing in ready, forward and speculative business and hence there is no stability of prices and this upsets the calculations of the merchants. Added to this may be some factors like booking restrictions etc. But of all these, speculation contributes most to these fluctuations as speculators desire to derive undue advantages by creating imaginative disturbances in demand or supply. So if the

millers have to lose it is they and their brother merchants who are to be blamed. There is full scope to control all such sales under the regulated market act once the marketing of copra is properly regulated as the schedule of commodities attached to the Act will include all the agricultural produce and their products.

MARKET CHARGES

In this State there is no sales tax as in Cochin*, but a uniform system of deducting Rs. 2/8/- per candy is prevalent. It includes Re. 1/3/- for the cess of the Coconut Committee, brokerage whether brokers are employed or not and weighing and other expenses. Non-factories though exempt from this cess nevertheless pocket that amount. Except at Shertalai, Alleppey, and Nagercoil, there are no brokers, and still the amount deducted is the same as at all other places. They justify this common deduction on the basis of uniformity and excuses such as paying bonus to cartman or boatman and meeting unloading or drying charges etc.

Where brokers are working they are paid by the seller apart from what they receive from the above sum of Rs. 2/8/-. At Shertalai the sellers pay 8 annas per candy and at Alleppey from 8 annas to one rupee depending upon the seller and the quantity. Allowances in kind, really speaking, go a long way to deprive the seller of a substantial quantity

* Sales tax is now levied in Travancore also.

of the stuff and it is but natural that the copra cups taken by buyers, weighmen, brokers, or coolies are always the biggest and the best. This looks simply shuddering, but the seller being the victim of usage has to bear it without protest. The Market Act disallows all such extra allowances. At some places buyers charge one chuckram per sale for charity and for bill. These market charges have been clearly defined in the accompanying scheme.

COMMUNICATIONS

The State is well provided with roads and the coastal area has an additional advantage of transport by canals and backwaters, which is comparatively cheap. So all the market centres are well linked up with each other and the supply sources and experience no handicaps in this respect. There is a fair weather port at Alleppey and a good water course runs right through the State to the Cochin harbour. In addition there is a road from Cape Comorin to Cochin, and Alwaye Station. The South Indian meter-gauge Railway line is working from Trivandrum to Shencottah *via* Quilon connecting the lines in the Madras Province. There are Out Agencies at Alleppey and Kottayam for booking goods *via* Cochin and Quilon.

LICENCING

The Act for regulating markets will provide for compulsory licensing of dealers, be they sellers or

REGULATED MARKETS FOR COPRA

buyers, commission agents, brokers, weighmen, measurers, graders, market coolies or cartmen. This is easy for the functionaries working in the market yard but in the copra trade there is some complication due to hundreds of copra makers being scattered over the growing areas. These people buy coconuts and sell copra to other dealers locally also. The growers' direct concern is in selling coconuts at their gardens. So it is impracticable and inadvisable to ask them to bring coconuts at suitable market centres for selling to copra makers who will have again to carry them back to their yards. This means unnecessary trouble, transport charges, and waste of time. If the copra makers find that they get a square deal in selling copra in the market they would naturally be inclined to pass on the benefits to the growers also, who will also be in a position to demand a fair price in the absence of any excuses on the part of the copra-makers. This brings us to the question of licensing all coconut buyers within the notified market area. Of course, exceptions can be made for petty buyers fixing the limits for retail sales. Now mere licensing and prescribing methods of transactions in the notified area where village transactions are permitted will not be fully helpful to correct the whole situation. So it will be necessary for

the market committee to provide adequate inspecting staff who can hear complaints from growers and check the buyers. This will be the necessary corollary to the working of the Central Market. It will apply to the sales and purchases of both coconuts and copra. One of the aims of establishing regulated markets is gradually to reduce village sales by inducing growers or primary copra-makers to take advantage of the Central Market where they will find no difficulty in selling the stuff and with this end in view it is advisable to establish as many sub-markets as possible so that sellers have not to cover long distances provided there are sufficient numbers of buyers to offer competitive prices. As stated before there is no necessity of continuing the services of brokers for the sale of copra in the market yard. However, at Alleppey there are several copra merchants who purchase copra. They dry it for resale at favourable times. If there is a demand for edible copra for export they sell edible copra to exporters and the milling copra to the millers. These sales are also effected through brokers, who are licensed by the millers' associations. Under the Act such sales will have to be done in the market yard, but they can be done on the sample basis as the stuff has already passed once through the market yard and the dealings will be between merchants,

only that, weighments will have to be done by licensed weighmen and grading of edible copra by licensed graders. There will be no necessity of brokers in this case also. Quantities offered for sale by local copra merchants will have to be accounted for by them by quoting their purchases, so as to prevent misuse of this privilege.

EXTENT OF NOTIFIED AREA AND CONTROLLED AREA

Owing to the prevalent practice of village sales of coconuts and copra it is evident that the notified area should be of manageable magnitude. If it is very wide it will be difficult to check and regulate the sale transactions which might frustrate the purpose of the Act. However, the importance of the area has also to be judged on the intensity of production and such areas have also to be notified though it may involve additional cost for the inspecting staff. In the notified area village sales and purchases are permitted so that there will be no difficulties for small factories which may be working within such areas.

Market proper or controlled area is a smaller circle within the notified area just round about the market place or yard. In this area village sales are prohibited so as to ensure a flow of supplies to the central market. With this end in view it becomes necessary that the

controlled area should be as large as possible but the present position does not permit it. It may create difficulties for small mills to buy and small copra makers to go long distances for selling in the central market. To obviate this difficulty in the beginning, the controlled area has to be limited in extent.

The above conditions have been taken into consideration in the preparation of the scheme for the Alleppey market, which will represent the intensive area for coconut growing, copra milling and exports. As for the rest of the State it can be handled subsequently on the experience gained at one centre. After working the proposed scheme and getting necessary experience it is permissible under the Act to revise the notified area and the controlled area and also to propose new sub-markets with the respective controlled areas. Thus in the scheme, centres like Trivandrum, Quilon, Alwaye and Parur are omitted at present, but they can be handled once a beginning is made with the important zone after the Act is brought into operation.

MARKET ADMINISTRATION

The Act provides for the appointment of a market committee consisting of 12 to 16 members representing the trade, growers, local authorities and government. The proportion of representation of different interests has to be fixed so that the

buyers may not have a dominating voice and the chairman who is to be elected by the committee should as far as possible be an independent man or one from among growers as he is the executive head of the committee and much will depend upon his impartiality and attention. As there will be no brokers they will not be represented, but exception has to be made for Co-operative Sale Societies. The Vice-Chairman has also to be elected to work in the absence of the Chairman. In the beginning the members of the committee are nominated by Government and the period may be not less than three years after which the representatives of agriculturists and traders may be elected on panel basis or direct election. In the committee there should be at least one member from each of the sub-markets so that he can be given some powers of the chairman to run these sub-market yards and to control and guide the local staff. The market committee can appoint one or more sub-committees for different purposes such as for deciding quality disputes, for finance, for quality control, etc. The Secretary should be an experienced man and should have some power of management independent of the Chairman. The Government should have powers to approve of his appointment or even to appoint one, either an official or a non-official, and to recover his pay from the Committee. This is

quite essential for the proper working of the market.

Ordinarily a regulated market is expected to be self-supporting for its administrative expenses by deriving its income from market cess on commodity arrivals or sales, licence fees from traders, commission agents, weighmen, graders, and such other functionaries. That is why in proposing a centre for a regulated market the first concern is to see if the volume of business is sufficient to give the required income, as the fees that can be levied on market arrivals should be only light so that it would create no prejudice against the market. Markets where the arrivals are very small cannot be artificially developed simply by forcing the sales at these places because the limiting factor will be the number of buyers. For this reason, in the beginning a start has to be made with the markets where the quantities brought for sale are large and are immediately absorbed.

COLLECTION OF MARKET FEES

As stated before, the main source of income of the market committee is the levying of fees on market arrivals. In this connection it may be stated that due to the development of oil mills in the notified area all the copra that may be prepared will not come for sale in the market as the mofussil mills will consume a considerable portion. Thus it will be

necessary that the market fees be collected on such purchases also, for which the purchasing mills must be made responsible. They will be asked to render either daily or weekly accounts to the market committee.

Again, some copra-makers or dealers might export copra from the notified area after making purchases. The question might also arise as to the means of checking this and collecting cess or fees on such purchases. For this purpose arrangements may have to be made with the customs authorities that they should not permit the goods to pass through their customs without a certificate from the market committee that the cess has been paid on the goods. So every exporter will have to obtain such a certificate from the nearest market centre authorities by producing all the bills for his purchases and by paying the cess. This is quite necessary to check the dodgers who might evade payment of market duties.

Growers mostly sell coconuts at their doors; hence this commodity will not be coming to the market for sale. It is, however, known that there is an appreciable export of coconuts from the State. If the cess is to be collected on the sales and purchases of copra it is to be considered whether the cess should not also be levied on sales of coconuts for export only. Anywhere there should be no

loophole in the collection of market fees. The whole question can be fully considered by the committee itself.

THE TRAVANCORE MARKET ACT

This Act is confined to vegetable, fish, fruits, food-stuff, spices, etc., and aims at earmarking sites for their sales in towns and villages for maintaining sanitation etc. This Act is in no way likely to conflict with the proposed regulated markets act. In the whole State there are, about 600 such small markets.

BUYERS' SCOPE TO KEEP DOWN PRICES

One pertinent question that is raised by some is their fear that buyers may join into a clique to offer low prices, particularly when they have to meet at a central place to make purchases. This fear is not quite unnatural. The buyers being a more intelligent class of people and limited in number would try to take advantage of any change in the prevailing practices. Even in the present circumstances they have not spared themselves from making such efforts, but their interests being diverse such an unholy union has not materialised into a working proposition. At Alleppey and Shertalai there are millers and merchants and at other places only a few millers. It has been the general experience that as business has to be run in the interests of

individuals any combination may at the most be a passing phase. But the market committee has to be watchful of any such eventuality. The supply of copra is far short of the demand for milling and every miller wants to buy as much as he can to run his factory for the longest possible period. This is a very favourable factor for establishing regulated market centres.

In the market office the previous day's prices of oil, cake, and copra from all important markets will be put up on the notice board. It will be a sort of impediment for buyers to offer lower prices.

As stated before the demand is greater than the supply, so if buyers at one centre combine, the supplies will naturally be diverted to another centre. Thus it will not be in the interests of buyers to join together to keep down prices. At present there are registered associations of millers and copra merchants at Alleppey, but they have not been able to do anything to keep down prices. Lastly a copra seller is free to sell at any market centre (even outside), in fact wherever he finds it paying.

The suggestion is made that the committee be empowered to fix the basic price of any commodity sold in the market on the basis of the previous day's closing price and also taking into account the trend of the other markets. Bids should start

over this basic price. This is however, feasible only if the commodities are sold according to standard grades. In the absence of that, this is likely to create difficulties. But this may be provided in the Act.

Some people express doubt regarding the feasibility of completing auction sales, weighments, etc., in a market like Alleppey where hundreds of sellers are coming daily. In fact the experience elsewhere shows that no difficulty arises in this respect. As the work starts and finishes within prescribed hours everybody is keen to do his bit of work as expeditiously as possible. Small lots of similar quality can be put to auction together to facilitate the working. It all depends upon how the committee works. The Secretary should be an experienced man.

If desired, open auction sales can be substituted by asking for private bids. Each lot is given a serial number on its arrival and the buyers are given slips bearing these serial numbers. They indicate their offer for the lots they desire to purchase. All these slips are then scrutinised for noting the highest bid for a lot on the name of the merchant offering it. These are finally declared. This will serve the purpose better where the number of buyers is not large.

ELECTORATES

It is expected that a subsequent market committee will consist of fewer nominated and more elected members from the agriculturists' and traders' constituencies. In the agricultural constituency the village credit societies have to be given due recognition. If in a particular village more than half the agriculturists are members of the society, it should be taken to represent all of them. This is with a view to develop the co-operative work. In the traders' constituency all the intermediaries have to be included and their share in representation may also be fixed having regard to their importance. Co-operative sale societies who work as commission agents have to be given representation on the committee and their share should also be fixed. Unfortunately there is no growth of such co-operative sale societies in the State. In fact a regulated market derives its strength from the sale societies and they in turn will find relief from undue competition from merchants only if there is a regulated market.

LICENCE FEES

There cannot be uniform scale of fees for every class of licensees as for example the miller who may have two *chucks* or the one who may have forty *chucks*. In such cases a uniform scale will do injustice to a smaller

man. So some sort of sliding scale may be fixed specially for millers and copra dealers and makers.

JUSTIFICATION FOR REGULATING COPRA SALES

The marketing survey report on coconut and its products carried out by the State Agricultural Department and several other subsequent investigations have pointed out the necessity of regulated markets, and accordingly the State Government is considering to pass an act for the purpose. The present enquiry was undertaken to prepare a concrete scheme against the background of the above facts and circumstances. One concrete proposal for a regulated market is worked out in some detail to give a starting basis when the State has passed the Regulated Markets Act.

I must express my thanks to the Officers of the Agricultural and the Co-operative Departments and the members of the Indian Central Coconut Committee at Alleppey for rendering me necessary help. Mr. Janardhana Pillai, President of the Alleppey Chamber of Commerce, Mr. Naik, President of the Oil Millers' Association, and Mr. Tricomdas of Messrs. Vallabhadas Kanji & Co., Ltd., Alleppey, were available at all times for consultations and discussions.

Appendix No. I

REGULATED MARKETS FOR COPRA

Name of milling centre.	No. of mills		No. of rotaries (in pairs)		Daily crushing capacity per day of 10 hrs.		Quantity crushed		Total
	Fac-tory	Non-Fac-tory	Fac-tory	Non-Fac-tory	Factory Cwts.	Non-Factory Cwts.	Tons.	Tons.	
1. Quilon	4	9	38½	21½	504	181	2379	1185	3564
2. Mavelikara	1	3	5	19	80	65	663	749	1412
3. Alleppey	21	3	287	4	4337	69	48928	958	49886
4. Shertalai	3	1	59	2	542	15	3480	40	3520
5. Other places in Quilon Division	1	24	3	34	11	189	932	1123	2065
Total, Quilon Division	30	40	392½	80½	5474	519	56382	4065	60447
6. Alwaye	2	3	6	4	59	53	459	179	638
7. Parur	1	4	7	9½	60	69	1311	984	2295
8. Kottayam	-	14	-	23½	-	116	-	2179	2179
9. Changanachery	-	8	-	14½	-	149	-	426	426
10. Other places in Kottayam Division	1	14	4	20	45	138	179	659	838
Total, Kottayam Division	4	43	17	71½	164	505	1949	4427	6376
11. Trivandrum	-	6	-	17½	-	145	-	3727	3727
12. Nagercoil & Kottar	-	4	-	9	-	59	-	547	547
13. Attingal.	1	1	-	3	-	10	-	3	3
Total, Trivandrum Division	1	11	-	29½	-	214	-	4277	4277
Total, Travancore State	35	94	409½	181½	5638*	1238*	58331	12769	71100

* If copra is sufficiently available, factories work for 24 hours and a general standard is that a rotary will crush 2 candies of copra in 24 hours. Working number of days for the purpose in a year can be 300.

APPENDIX II

Proposal for the Establishment of a Regulated Market at Alleppey in Ambalapuzha Taluk (Travancore State)

IMPORTANCE OF THE MARKET

This is the most important commercial centre of the State. It is situated on the west coast linked with other coastal villages and towns by both roads and canals which make transport very easy and cheap. There is a road running through Alleppey from Cochin to Trivandrum *via* Quilon which are the other important cities of the State. A canal is also running likewise connecting these centres. Cochin is 40 miles from here, Quilon 60 miles, and Trivandrum is 105 miles. It has also communications with the interior through backwaters and canals. Though it has no rail link the South Indian Railway has opened an Out Agency for booking goods *via* Cochin Harbour Terminus and Quilon Stations. The export figures for 1947-48 were as under:-

Copra	—	34,220 cwts.
Oil	—	2,09,009 „
Pepper	—	14,231 „
Ginger	—	1,860 „

It has a fair weather port and considerable exports take place through it. Steamers both coastal and foreign touch here. The exports during 1947-48 through the port were as under:-

Coconuts	—	3,00,870 Nos.
Copra	—	2,35,930 Cwts.
Oil	—	97,762 „
Pepper	—	68,362 „
Ginger	—	11,989 „
Turmeric	—	2,362 „
Coir mats and mattings	25,204	„
Coir	—	2,88,000 „

In addition to this there are exports of large quantities of goods to Cochin by country craft through backwaters and an idea of them can be had from the figures of the customs house at Arukutty given as under:-

EXPORTS

(Last three years' average)

Coconuts	—	42,29,854 Nos.
Copra	—	52,695 Cwts.
Coconut oil	—	3,93,610 „
Coconut oil cake	—	1,17,692 „

Thus it will be seen that Alleppey is the most important market of the State.

The town has a population of about 32,00 and extends over an area of four square miles with internal communications provided by canals and roads. The town municipality is the local authority.

The figures of exports given above show the importance of this market for various commodities. There are no records to show their actual annual market arrivals, but the trade estimates are as under:-

REGULATED MARKETS FOR COPRA

Copra (Milling quality)	1,55,000	candies.
Copra (Edible)	45,000	„
Pepper	35,000	„
Ginger	10,000	„
Turmeric	5,000	„

SEASON OF MARKETING

Copra arrivals continue throughout the year but are more from December to April. Pepper, ginger and turmeric come to the market in December to March while coir and coir yarn are brought in all months except during the monsoons.

Alleppey is not a consuming market, but is a distributive market, except for milling copra. There are several mills at Alleppey for crushing copra, so milling copra is hardly exported from Alleppey while edible copra is all sent out to Bombay and Northern India either through Alleppey or Cochin port. Pepper, ginger and turmeric are all exported to Bombay and foreign countries.

The above commodities are generally brought here for sale by village merchants, and the local millers, merchants, commission agents and exporters are the buyers through brokers.

There are 6 kinds of merchants' organisations as show below:—

1. The Copra Merchants' Association.
2. The Travancore Oil Millers' Association.

3. The Alleppey Produce Merchants' Association.
4. The Travancore Chamber of Commerce.
5. The Alleppey Chamber of Commerce.
6. The Coir Dealers' Association.

Except the first, all are registered bodies under the State Act. They are generally concerned with forward sales and export business. Speculative business in coconut oil and pepper is also carried out.

In Alleppey there are several copra crushing factories, and in all they are 24 with 291 pairs of rotaries and two expellers, having a total crushing capacity of one lakh tons per year. But the actual quantity crushed for the last year was 49,886 tons as reported by the millers. Three or four factories are making washing soaps also. There are about 36 factories manufacturing coir products like mats, mattings, etc. The number of *Kannitawalas* or copra merchants is 20. They buy copra, dry it and sell milling copra to millers and edible copra to exporters. All the sales are through the brokers numbering 58 individuals and 22 companies who are registered by the Oil Millers' Association.

The present proposal mainly deals with the regulation of copra sales as the Indian Central Coconut Committee is interested in that commodity,

but it is clear that other commodities such as pepper, ginger, nux vomica, etc., are equally important and their sales require to be brought under regulation along with or soon after copra.

THE PRESENT SYSTEM OF MARKETING OF COCONUTS

The growers generally sell coconuts at their gardens to the village copra-makers. Small copra-makers of places away from milling centres sell their small lots to other big dealers and ultimately copra is brought to the milling centres. Thus copra before reaching the market might pass through more than one intermediary.

Sale of coconuts is direct to copra makers who are well acquainted with local growers and the quality of their produce. There are generally seven to eight pickings in a year and the real post-monsoon season starts in January. The rate is fixed on 100 unhusked nuts with the condition of rejecting damaged or immature ones while husking which is generally done on the spot. The rate per 100 nuts is calculated on the basis of the oil and cake prices of the day which the grower may or may not know. First the copra-maker calculates the price of one candy of copra, and then estimates the number of coconuts required to give one candy of copra. To the price he adds the price of husks and sometimes shell and then arrives at the

price of 100 nuts. Generally the number of nuts to make one candy of copra ranges round about 2,500. The seller would be at a disadvantage if he did not know the previous day's market rate of oil or copra and the number of coconuts required to give one candy of copra and the nature of the rejections. There are very small growers who have no holding capacity and they would like to sell their produce as early as possible. In several cases they take advances from copra-makers for which they have to accept lower rates. Thus a copra-maker purchases coconuts from round about his place, prepares copra and either sells it locally or takes it to the market. This means that there are no other primary assembling centres for coconuts and copra. In the Alleppey market payment for copra purchases is in cash, but the copra-makers do not pay to growers likewise. The estimated number of copra sellers coming to the Alleppey market may be about 2,000 including those coming from so far as Trivandrum and Quilon. The maximum quantity and the number of sellers for any day in the season may be 1,000 candies and 250 sellers. During the monsoons it may be only 150 candies and 50 sellers.

About 95 per cent of the stuff is coming in boats to the market. There is a row of *Kannittas*, millers' depots and mills on either side of

the commercial canal and the place where the two canals cross is called Chungom. Thus there is no difficulty of transport at all.

SYSTEM OF COPRA SALES

As a rule copra brought for sale is not fully dried, i. e., not cutter pass or *vettumany* quality. It contains moisture varying from 5 to 15 per cent depending upon the season and the market fluctuations. The incomplete drying causes some difficulties. Either party gains or loses according as he appraises the moisture percentage. Extra labour for further drying and handling is required which can be done at a lower cost at the copra maker's than at the market place, but the copra maker is unable to dry completely mainly for financial reasons and secondly because he does not want to take risks as the price may rise or fall from day to day. This question has been dealt with fully in the main report. As soon as a copra seller arrives in the market he approaches his broker. This broker takes a sample of one *eda* in a basket or a bag on the head of a cooly and moves from *Kannitta* to *Kannitta* to take offers, which are given under cover by the buyers, till he is tired or is satisfied with the bid. It is hardly possible to strike a bargain without going around half a dozen *Kannittas* at least. The seller also moves along with him. He is consulted before accepting the final bid. He, of

course, has to believe what his broker says as the bids are under cover which lends scope for underhand dealings. The stuff is, then, brought to that *Kannitta* and weighed at the convenience of the buyer. The unit of weight is one *eda*, i. e., 60 *rathels* ($42\frac{1}{2}$ tolas = 1 *rathel*) plus one *rathel* and ten *edas* make one candy. One *eda* is a stone weight hung from a beam balance with ropes which perhaps are extra. The basket for weighing is given a counterweight. Weighing is done by the buyer's man though the seller or the broker is present at the time. Rates are quoted per candy and is calculated from the oil price of the previous day at Alleppey. This way the business goes on from 8. A. M. to 4 P. M. Payment is generally made in the evening and may be over by about 8 P. M. or sometimes by next day in the case of late sales.

Some big brokers engage a few assistants to look to the weighing etc. Stuff brought to the market is sold off at any cost at the end of the day, if not sold earlier. Hardly a case of taking back occurs as it would add to the transport cost, loss in a day for drying and some damage in storing undried stuff.

The market charges and allowances are as under:-

1. One *rathel* per *eda*
2. Two or three cups for every weightment, i. e., 20 to 30 cups per candy.

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3. 3 to 4 cups taken by a cooly who carries the sample.
4. Rs. 2/8/- per candy deducted by the buyer as under:
 Re. 1/8/- for the Coconut Committee's cess,
 7 annas for brokerage, and
 9 annas for unloading, weighing etc.

Total Rs. 2/8/-

5. Two chuckrams for charity and the bill.
6. 8 annas to Re. 1/- per candy as brokerage.

So the total expenses borne by the seller both in cash and kind come to Rs. 13-6-2.

The buyer's men invariably take more than the actual weight and the maximum loss of a seller in this respect might come to 6 lb. per *Eda* including all allowances in kind. Payment is made after the weighing is over.

The main malpractices can be summarised as under:-

1. Secret sales under cover.
2. Allowance in kind.
3. Brokerage is received from two sides, though the source is the same.
4. Stone weights are not stamped.
5. Incorrect weighing as weighmen are the servants of the buyers.
6. Deductions for charity and bill.
7. Extra cups taken by a cooly who carries a sample in addition to the payment made by the broker.
8. Delay in weighing and making payments.
9. Disputes about quality during weighing, which generally go against the seller.

Now, if the regulation of the market is introduced the seller will benefit as under:-

	Rs.	As.	Ps.
1. Saving of extra cups - 7 to 11 lb. per candy	-		
average 9 lb. at Rs. 350 per candy	...	4	13 0
2. Saving of commission and brokerage	...	1	7 0
3. Saving in unloading and weighing charges	...	0	3 0
4. Saving of 3 cups taken by the cooly carrying sample	...	0	3 0
5. Saving due to correct weighing - 20 lb. per candy	...	10	4 0
6. Payment for charity and bill	...	0	1 2
		<u>16</u>	<u>15 2</u>

Out of this the seller may have to pay 4 annas per candy as the market fees. Some charges for unloading at the buyer's place may have to be met from this saving. So his net saving will be Rs. 16/4/-. To this can also be added any advantage he might receive on account of correct appraising of moisture content and also the competitive price for his produce. The total saving achieved from the regulated market on the estimated market arrivals of 1,50,000 candies will be about 24 lakhs of rupees.

According to the present system the seller and his broker with a sample on the head of a cooly have to move from one buyer to another to get offers. Thus they have to waste time and labour, and still they cannot have the satisfaction that they have approached all the buyers and got the maximum price. The seller has to depend upon the broker who is his guide and philosopher. If a regulated market is established he will easily get rid of all these disadvantages and disabilities. By open sales the sellers are sure to realise better prices, but it is rather difficult to express this advantage in terms of money. However, it is expected to be substantial because out of several buyers some have commitments to meet for which they have to buy the required quantities of copra by paying sufficiently high. This is bound to raise the general standard

of the price level. In case prices fall the sellers would immediately come to know the market trend and try to withhold the stocks as far as possible.

When better facilities for marketing are available at a central place the small copra-makers who sell copra locally in villages would prefer to come to the market instead of selling at home. Similarly growers will also try to make copra and bring it for sale to the market. To meet the transport difficulties they might have to pool their produce. This is being done even by some dealers. Thus the establishment of a regulated market is expected to induce growers to make copra and to sell in the market. Also small copra makers will increasingly take advantage of the market. The result will be that the advantages of sales at the market will pass on to the growers also.

The question was discussed with growers, copra-makers, copra merchants and millers, who had very warmly appreciated this idea. Only the brokers whose services may not be necessary might try to carry on some anti-propaganda, but it may not be effective.

MARKET AREA

Alleppey is the central market for all commodities like copra, pepper, ginger, turmeric, nux vomica, coir products, etc., and commands practically the largest area of the

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State. It is proposed to have the market area or the notified area comprising the taluks of Ambalapuzha, Shertalai, Vaikom, Kottayam,

Changanacherry, Tiruvella, Kartikapally, and Mavelikara covering 1288 square miles as per statement below:—

Taluk.	No. of Pakuthies.	Square Miles.
Ambalapuzha	13	147
Shertallai	15	124
Vaikom	14	137
Kottayam	16	214
Changanacherry	19	268
Tiruvella	26	212
Karthikapally	18	74
Mavelikara	15	112
	<u>136</u>	<u>1288</u>

The above include the concentrated areas under coconut cultivation, but not those under ginger, pepper, etc., which are mainly grown in the

hilly parts of the State. The farthest limits of the area from Alleppey will be as under:—

North	—	End of Shertalai Taluk	—	26 miles.
		End of Vaikom Taluk	—	35 miles.
East	—	End of Kottayam Taluk	—	25 miles.
		End of Mavelikara Taluk	—	35 miles.
South	—	End of Karthikapally Taluk	—	35 miles.
West	—	Coast line.		

THE MARKET PROPER OR CONTROLLED AREA

Here some difficulties are experienced because several small oil mills are scattered in the mofussil due to the availability of electric current and on account of the war time boom. To meet the needs of such

mills it has been proposed to limit the market proper round the few important milling centres which will have market yards. Having regard to the situation of the milling factories and the importance of centres for copra sales which take place at the mills, the following will be the markets proper:—

1. Alleppey -- Market centre. Controlled area will be Ambalapuzha taluk.
 - Sub-markets: 1. Shertallai, with the controlled area as Shertallai taluk.
 2. Kottayam, with Kottayam taluk as a controlled area.

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Within these controlled areas there are no mills except at the centres, and the extent of the taluks are also very limited. So the copra sellers have to cover only small distances to reach the market centres, and it will not be difficult even for small copra-makers to take advantage of the market as village sales are prohibited within this area.

MARKET YARDS

Alleppey: It is possible to secure a suitable site with buildings on, near Chungam and it will be an ideal site for the market yard. The Government may have to secure this place on long lease and to carry out suitable alterations in the buildings on behalf of the market committee. The extent of the area that may be necessary for the yard should be about 2 acres, so that later on when other commodities are brought under regulation there may not be any difficulty.

Shertalai: Sufficient area about an

acre in extent on the backwater side near the mills may be available.

Kottayam: Here also an area of the same size may have to be acquired near the river head, where mills are situated.

Full details about these sites have not been given as it is too early to go into such matters at this stage and it can be done when proposals are put up before the Government concerned after the passing of the Agricultural Produce Markets Act. There will be only one market committee for the whole market area which will control the chief market yard at Alleppey and sub-yards at Shertalai and Kottayam.

The details regarding other market centres are furnished as appendices.

BUDGET ESTIMATES

At this stage it is not possible to give all the details under different items of expenditure and income, but a general indication can be given as under:-

THE ALLEPPEY MARKET

INCOME	Rs.
I. 1,50,000 candies of copra @ 4 annas per candy for market fees on arrivals.	... 37,500
2. LICENSE FEES	
(a) 21 Millers @ Rs. 20/- or Rs. 2/- per rotary whichever is more per annum.	... 800
(b) 20 Copra Merchants @ Rs. 30/- per annum.	... 600
(c) 2000 Copra sellers from the mofussil coming to the Alleppey market @ Rs. 5/- per annum.	... 10,000
(d) 5000 Village sellers @ Rs. 2/-	... 10,000
(e) Rent for stalls in the market.	... 5,000

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		Rs.
(f)	License fees for 40 weighmen @ Rs. 5/- per annum. ...	200
(g)	License fees for cartmen and boatmen @ 8 annas per annum ...	200
3.	Miscellaneous income ...	200
	Total	64,500

EXPENSES

I Establishment

		Rs.
1.	One Secretary at Rs. 200/- + Rs. 50/- D. A. per month.	3,000
2.	One Assistant Secretary or Appraiser at Rs. 100/- + Rs. 25/- per mensem.	1,500
3.	Two Auctioners at Rs. 75/- + Rs. 25 per mensem.	2,400
4.	Four Inspectors — do — — do —	4,800
5.	Four Clerks at Rs. 50/- + Rs. 20/- per mensem.	3,360
6.	Three Peons at Rs. 30/- + Rs. 15/- per mensem.	1,620
7.	Two watchmen at Rs. 20/- + Rs. 15/- per mensem.	840
8.	One Sweeper — do — — do —	420
9.	One Waterman — do — — do —	420
	Total —	18,360

II Contingencies

1.	Printing, Stationery, etc.	1,000
2.	Contingencies.	1,000
3.	Postage, Telephone, Telegrams, etc.	1,000
4.	Rent, Rates and taxes (This will be a fairly large amount)	—
5.	Travelling allowance.	500
6.	Depreciation, repairs.	2,000
7.	Provident Fund for staff.	1,000
8.	Bonus for staff.	1,000
9.	Publicity.	200
10.	Instalment of loans from Government and interest thereon.	10,000
11.	Miscellaneous.	1,000
	Total --	18,700

There will be non-recurring expenditure as under:

Dead Stock:

Office furniture	—
Weights and balances	—
Badges for Weighmen and coolies	—
Sheds for sellers and buyers	—
Alterations in the existing structures as may be required.	—
One Radio, a clock and a telephone.	—

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For each of the sub-market yards the staff may be as under:	Rs.
One Assistant Secretary at Rs. 100 + 25.	1,500
One Appraiser or Actioner)	
One Inspector) at Rs. 75 + 25.	2,400
Two Clerks at Rs. 50 + 15.	1,560
1 Peon at Rs. 30 + 15.	540
1 Watchman at Rs. 20 + 15.	420
1 Sweeper at Rs. 20 + 15.	420
1 Waterman at Rs. 20 + 15.	420
Total —	7,260

Other expenses will be proportionate to the Alleppey Market.

The main market and the sub-markets will be quite self-supporting and are expected to give some surplus to meet capital expenditure also.

APPENDIX III Other Market Centres

I Shertallai. Shortly there will be a municipality working at this centre. The population is about 10,000.

1. Estimated annual arrivals of copra - 45,000 candies. Maximum per day will be 350 candies. Out of the total arrivals about 40 per cent are sent to Alleppey for sale mostly by the copra merchants. So in the off-season the millers have sometimes to buy copra from Alleppey.
2. Copra buyers - Millers 8 and Merchants 12.
3. Number of brokers - 20.
4. Area served - Shertallai taluk, but some years back there were arrivals from Vaikom taluk also.
5. Number of copra sellers coming

for sale - 300 out of 1000 copra makers.

6. Sale of oil - at Cochin.
 7. Communications - Well connected by road and backwaters with Cochin (25 miles) and Alleppey (15 miles).
 8. System of sales - They are under cover on the basis of sample shown from buyer to buyer through brokers.
 9. Market charges - The buyer deducts Rs. 3 per candy out of which one rupee is paid to the broker. Allowances in kind are almost the same as at Alleppey. There are no factories of other sorts.
- II Kottayam.** It is a municipal town with a population of 30,000.
1. Estimated annual arrivals of copra - 17,000 candies.

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pepper - 1,000 candies, and very little of ginger and turmeric.

2. Number of copra buyers - Millers 16, and Merchants 2.
3. Number of brokers - One man has recently started this work.
4. Area served - Taluks of Kottayam, Kanjirapally and Minachil.
5. Number of copra sellers coming to market for sale - 100 out of 200 copra makers. Most of them are running provision shops in villages. There are a few grower-sellers also.
6. Sale of oil - Mostly to Cochin and partly at Alleppey and 10 per cent locally.
7. Communications - Connected by road and backwater with Cochin (40 miles), Quilon 50 miles, Alleppey 18 miles. There are roads going in the interior parts also.
8. System of sales - Direct sales on sample basis, seller moving from one buyer to another for getting offers. Most of the sales are done on the market day (Monday) and the next day.
9. Market charges - Same as at Alleppey, except that out of Rs. 2/8/- something is paid to the cartman or boatman. There are no brokers.
10. There are three plywood factories and six rubber factories.

There is one un-registered Association of Millers.

III Kayamkulam. This is a small town.

1. Estimated annual arrivals-1,064 tons. The maximum per day may be 75 candies. The mills are not able to get sufficient quantities for crushing.
2. Copra buyers - 3 millers.
3. Number of brokers - Nil.
4. Area served - About 15 miles round about. A greater part of the local production is going to Alleppey and Quilon as the oil price here is lower than at the other two places.
5. Sale of oil - Sold at Alleppey or Quilon to the exporters.
6. Communications - It is situated on the main road from Trivandrum to Alleppey and also connected with interior parts by roads.
7. System of sales - Direct sales to millers.
8. Market charges - Nearly same as at Alleppey.

IV Quilon. It is a municipal town.

1. Estimated annual arrivals 40,000 candies. The maximum arrivals are from January to April, and the maximum per day will be 250 candies.
2. Copra buyers - Millers 19, Merchant 1.
3. Number of brokers - Nil.

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4. Area served.-Copra makers from as far as Trivandrum come here, though those from here might go to Alleppey also. Arrivals are very insufficient having regard to the number of mills.
 5. Number of copra sellers - About a dozen big dealers and two to three hundred small copra makers.
 6. Sale of oil - A part is locally consumed and the rest is exported to Madras Province by the oil exporters numbering 8.
 7. Communications-Linked by rail with Madras Province and Trivandrum, and by road and canals with Trivandrum, Alleppey, etc.
 8. System of sale. - Direct sales to the millers. Millers advance money to the copra makers. Kiln drying is more common here. Quilon oil price is taken as the basis for fixing the price of copra. This is a very important centre for the cashewnut industry. There are about 36 factories engaged in this work.
- V **Nagercoil and Kottar.** This is an important town in the south of the State.
1. Estimated annual arrivals-4,000 candies.
 2. Number of copra buyers - 3 millers.
 3. Number of brokers - 4.
4. Area served - Round about area, but even copra makers from far off places like Neyyattinkara and other hilly parts also come here.
 5. Number of copra sellers - 60. They advance money to the growers.
 6. Sale of oil - All is locally consumed. Only a small quantity may go to Tinnevely.
 7. Communications - Connected by good road with Trivandrum and other parts of the State.
 8. System of sale - Copra dealers bring their stuff to the commission agents who are approached by the millers for purchasing copra. The sellers may or may not be present. The stocks are not kept for a long period.
 9. Market charges - Commission Rs. 2/3/- per candy. It includes cooly charges of about 8 annas. Unit of weight 61 *rathels* per *eda*. One cup is taken as extra per weighment. Charity at 2 annas 3 pies per candy is recovered from outside buyers.
There is no kiln drying here.
 10. Sale of coconuts - Rate of coconuts is fixed per 100 nuts with husk. About 2500 nuts will give one candy of copra on an average. Growers sell at every picking. In all there are 6 pickings per year.

VI Alwaye.

1. Estimated annual arrivals - 10,000 candies.
2. Number of copra buyers-Millers 7
3. Number of brokers - Nil.
4. Area served - Parts of Parur Taluk and Kunnathunad Taluk.
5. Number of copra sellers - 100. Millers have to send out their agents for purchases if there is a demand for oil.
6. Sale of oil - At Cochin. But merchants prefer to sell in up-country markets generally as there is facility of rail transport.
7. Communications - Connected by rail and road with Cochin and other places.
8. System of sale - Few copra dealers come here for sale with the stuff, but the millers first make bargains with them and then the stuff is delivered, as this is not the real producing area. Generally smoked copra is received here.
9. Market charges - Crushing charges at Rs. 12/- per candy. Unloading charges 8 annas per candy. 1 *rathel* extra per unit of weight and 3 *rathels* per candy. Deductions for moisture content etc. as usual. Committee Cess at Re. 1/8/- per candy.

10. Sale of coconuts - Rate is fixed for 1000 plus 25 extra. 2500 to 2800nuts give one candy of copra.

VII Parur. This is a small taluka place.

1. Estimated annual arrival of copra - 2,500 tons.
2. Copra buyers - 6 millers, out of which 3 are from Alwaye.
3. Number of brokers - Nil.
4. Area served - Parur Taluk.
5. Number of copra sellers - 300, though a few might be coming to the market for sale.
6. Sale of oil - It is sold to the Cochin exporters.
7. Communications-Connected with Cochin by backwater, and by road with Alwaye.
8. System of sales - Direct sales on sample basis to the millers.
9. Market charges - Annas 4 per candy for weighing charges. 1 *rathel* per unit of weight; 3 *rathels* for candy. Deductions for moisture etc. as usual. Rs. 15/- as crushing charges for one candy of copra deducted from oil price.

VIII Trivandrum.

This is the capital of the Travancore State. It has not much commercial importance.

1. Estimated annual arrivals of copra - 20,000 candies. If the

REGULATED MARKETS FOR COPRA

- price at Alleppey is higher, copra merchants take copra to Alleppey for sale instead of selling to local millers. Maximum arrivals per day will be 100 candies and number of sellers will be 20.
2. Copra buyers - 12 millers working at Chalai, Attakkulangara and Vallankadavu and about 20 merchants.
 3. Number of brokers - Nil.
 4. Area served - Round about area of 6 miles.
 5. Number of copra sellers coming for sale - 100.
 6. Sale of oil - Oil is locally consumed.
 7. Communications - It is linked by rail with the Madras Province and by road and backwaters with other places within the State and Cochin State.
 8. System of sales - Copra makers sell direct to millers and merchants who would again sell to millers at Trivandrum or Alleppey.
 9. Market Charges - 1. Rs. 2/4/- per candy, though there is no brokerage or Committee's cess.
 2. One *rathel* per *Eda*.
 3. 5 cups as *edamuri* per candy.

(To be continued)

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DEPARTMENT OF AGRICULTURE,
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COCONUT SHELLS AS AN INDUSTRIAL RAW MATERIAL

I. COMPOSITION OF SHELLS

BY DR. REGINALD CHILD

THE object of these articles is not so much to report new observations (though the preliminary results of some unpublished work are included) as to review the properties of coconut shells and to examine their status as a potentially valuable raw material.

COMPOSITION

(i) *Moisture*.—The moisture content of shells varies considerably with conditions and with maturity. Under average conditions air-dried mature shells contain 6 to 9 per cent of moisture^{1,2} and thus retain

less moisture than most woods. This is an important point in connection with dry distillation (see subsequent article). All analytical figures quoted in the following discussion are given as percentages of dry material, unless otherwise stated.

(ii) *Ash*.—Figures ranging from 0.23 to 1.425 per cent have been recorded; recent references give values based on dry weight, but in the older citations it is not usually clear whether or not the results have been so corrected. The following is a selection of analytical figures from the literature:—

Authors	Reference	Date	% Ash	As per cent of ash								
				K ₂ O	Na ₂ O	CaO	MgO	Fe ₂ O ₃ + Al ₂ O ₃	P ₂ O ₅	SO ₃	SO ₂	
Fleck <i>et alii</i>	1	1937	0.23	—	—	—	—	—	—	—	—
Bachofen	...	12	1899	0.29	45.01	15.42	6.26	1.32	1.39	4.64	5.75	4.64
Phillips and Goss	...	4	1940	0.55	—	—	—	—	—	—	—	—
Child and Ramanathan	...	2	1928	0.61	—	—	—	—	—	—	—	—
Georgi	...	5	1941	0.69	52.20	—	—	—	—	—	—	—
Noris (quoted by Sampson)	...	3	1923	1.10	31.6	—	2.97	3.87	—	5.32	—	—
Lepine (quoted by Copeland &c.)	...	13	(1861)	1.41	*	—	*	—	—	*	—	—
Fesca	...	16	1904	1.425	30.0†	—	2.32†	1.12†	—	5.00†	—	—

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* 86.94 per cent of "salts of K"; 2.18 per cent of calcium phosphate; "salts of Ca" 6.53.

† Calculated from the figures given in Preuss (*loc. cit.*) as the percentages on the original shell, assuming an ash content of 1.425 per cent.

Doubtless the percentage and composition of the ash vary with soil and climatic conditions, habitat and variety of palm; thus the nuts examined by Bachofen and by Child were of Ceylon origin; by Norris from Madras Presidency; by Georgi from Malaya; and by Phillips and by Fleck possibly from the Philippine Islands. Maturity of the nut also affects the composition of its component parts, and Copeland (*loc. cit.*, p. 174) remarks that "Bachofen's nut cannot have been thoroughly ripe"; there seems, however, little reason for this statement.

The figures of Bachofen and the still older results of Lepine have been extensively quoted in the literature. Great confidence can hardly be reposed in those of Lepine, which (see Bibliography) appear to date back at least to 1861, but those of Bachofen are useful, pending the collection of further data, in that they give at least some idea of minor constituents.

In the writer's experience in Ceylon, an ash content of 0.6 per cent is usual. Coconut shell charcoal is required by some specifications (see second article) to contain not above 2.0 per cent by weight of the original shells; this implies a maximum of 0.67 per cent ash on the latter and the writer has, in the course of examining many samples of charcoal,

never found this limit exceeded with uncontaminated samples. Potash is clearly the principal constituent of the ash. The salts will largely be present as carbonates, but phosphate, sulphate and silicate also occur, as well as chloride. It is curious that chloride estimations have not been recorded; the writer's (unpublished) analyses of charcoal samples indicate the presence of 1 to 2 per cent of Cl¹ in the ash.

About 90 per cent of the ash is water-soluble, and the present writer² has also shown that most of the potash is extracted from the powdered shells by hot water.

The ash content is comparable with that of most woods; the large proportion of soluble ash is an advantage in preparation of activated charcoal, since it is easily removed.

Georgi and Gunn Ley Teik¹⁵ report the following average figures for eight lots of shells averaging 20.2 per cent moisture (*i. e.*, not air-dried but as collected): K₂O 0.364, CaO 0.009, MgO 0.014, P₂O₅ 0.035. They do not, however, state the actual ash contents, so that their figures cannot be collated with the above table; from inspection of the figures it looks as though the ash content would have been considerably higher than 0.6 per cent.

(iii) *Organic Constituents.*— An early analysis is that of W. L. Winton⁶ in 1901, who employed the

ordinary methods of Food and Drug examination for the detection of powdered coconut shell in species which adulteration he stated to be a common practice in the United States. His figures are not now of particular interest; a value of 56.19 per cent was recorded for "crude fibre", but this is now known to have little definite relation to the structural constituents of the original material. Curious figures of Brandes, quoted by Hunger¹⁴ are of little value.

More adequate proximate analyses have been published by Fleck¹ (1937) by the present writer² (1938), and by Phillips⁴ (1940). The original papers should be consulted for details; the chemistry of cell-wall substances is in an active state of development and methods of analysis are still somewhat empirical. However, the three sets of observations quoted are in fair agreement over the main features of the composition of coconut shells.

(a) *Solvent Extractives*.— Only small quantities of material are extractable by non-hydroxylic solvents, 0.19 per cent by ether,¹ and 0.27 per cent by benzene². Alcohol has been found to extract 2.51 per cent² and a 1:2 alcohol-benzene mixture 4.56 per cent⁴. The manner in which coconut shells burn has given rise to the supposition that they contain considerable quantities of oily or resinous

matter; this is seen not to be the case. The nature of the solvent extracts has not been examined, but the alcohol extract presumably contains some tannin matter.

Cold water has been reported to extract 1.43 per cent¹ and 0.20 per cent,² and hot water 2.67,¹ 3.57² and 2.76.³ 1 per cent caustic soda removes 20.53 per cent of material¹ or 18.80 per cent;² and 1 per cent hydrochloric acid, 29.69 per cent. These figures are of limited theoretical value, since the alkali- or acid-soluble fractions are not clearly defined; the former, for example, includes part of the lignin and of the polyuronide and cellulosan fractions

(b) *Nitrogen*.— Georgi and Gunn Ley Teik¹⁵ give the analysis of eight samples as 0.073 to 0.090 per cent (average 0.081 per cent.) for shells having a moisture content of 20.2 per cent (not air-dried but fresh collected). This corresponds to an average per cent nitrogen on dry weight of 0.10 per cent and agrees well with the 0.11 per cent reported by Phillips.⁴

A somewhat higher figure, 0.156 per cent is given by Fesca.¹⁶ The nitrogen seems to be largely associated with the lignin fraction (see below).

(c) *Lignin*.— The percentages of lignin reported are 33.30,¹ 36.51² and 27.26 per cent.³ Methods of determination were all different and there

may, of course, have been some natural variation between the samples examined. In the writer's opinion a figure of 32.0 per cent is, probably, fairly near the true value.

Phillips gives a figure of 0.29 for the percentage of nitrogen in the lignin; this accounts for over 70 per cent of the total nitrogen (see above).

Methoxyl.—The methoxyl content of shells has been reported as 5.39¹ and 5.84 per cent.³ According to Phillips,³ the lignin fraction contains 16.17 per cent methoxyl or 16.46 per cent, calculated on the nitrogen and ash-free lignin. This accounts for 4.41 per cent of the original. It does not, however, follow that the balance of about 1 per cent methoxyl is associated with the non-lignin constituents of the shells, since it is by no means certain that there is no loss of methoxyl during the isolation of the lignin by strong acid treatment.

The lignin content of the shells is higher than that of most woods. Further reference is made particularly to the methoxyl content in the discussion of the distillation product of shells in a subsequent article.

(d) *Total Pentosans.*—Both Fleck¹ and the present writer² estimated pentosans by the method of Schorger, and obtained similar figures, viz., 30.28 and 29.27 per cent respectively. These figures were not corrected for the presence of polyuronides. Phillips³ determined uronic

acid anhydrides as 3.82 per cent and used an empirical formula to give a correction for the amount of furfuraldehyde derived from the uronic acids; this correction came to 1.42 per cent calculated as pentosans, and his so corrected "total pentosans" figure to 30.14 per cent.

The estimates of "total pentosans" by the three sets of workers are thus reasonably concordant. The percentage is considerably higher than in most woods and is the highest recorded for all nut-shells so far examined,^{7,8,4}

No further quantitative details are available regarding the nature of the pentosans, but as long ago as 1895 Tromp de Haas and Tollens¹¹ obtained a "satisfactorily yield" of crystalline xylose by hydrolysis of coconut shells with 4 per cent sulphuric and stated that this appeared to be the only product of the hydrolysis. The residue gave dextrose on further hydrolysis with stronger acid.

(e) *Cellulose.*—Published estimates of "cellulose" differ considerably and it is obvious that this is largely due to the methods of estimation and that the various workers were not dealing with similar "cellulose" fractions. Phillips³ use of the method of Kurschner and Hanak⁹ seems to imply his opinion that the Cross and Bevan method or modification thereof as used by Fleck¹ and by the

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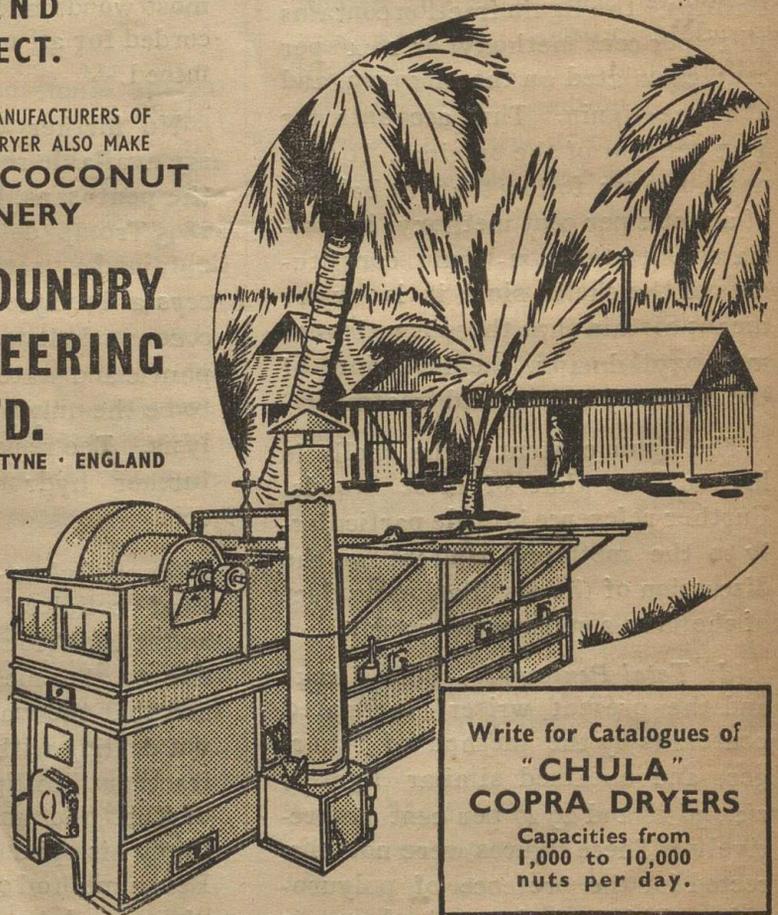
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present writer² is less reliable for resistant materials like coconut shells. The wide discrepancies between the recorded percentages of "crude cellulose" become less serious when adjustment is made for

the pentosan content. All the three workers determined the furfuraldehyde yield of their "crude cellulose" and calculated the pentosan content in the usual way based on Krober's work:

	Fleck (1)	Child (2)	Phillips (3)
% Crude Cellulose ...	44.98	53.06	33.52
„ Pentosan in Cellulose ...	17.67	20.54	5.26
„ Cellulose ...	27.31	32.52	28.26

It would appear, therefore, that the "crude cellulose" of each worker differed materially only in that the respective methods of treatment had removed more or less of the pentosan fraction.

No further examination of the nature of the "cellulose" has been carried out, except that Fleck determined the arbitrary "Hydrolysis No.", *i. e.*, the percentage loss in weight after hydrolysis with 15 per cent sulphuric acid, which he found to be 35.35. It may be noted that this is not markedly different from his figure for the pentosan content of the cellulose. Fleck also determined the "holocellulose" fraction by the method of Van Beckum and Ritter;¹⁰ this fraction, 61.0 per cent., purports to represent the entire non-lignin constituents of the cell-wall, and indeed does accord reasonably well with an estimate of 32.0 per cent for lignin, allowing also for ash and extractives.

Further examination of "cellulose" fractions obtained in various ways seem to be desirable and a critical examination of methods of preparation. It seems safe to say, however, that the cellulose content of coconut shells is lower than that of most woods.

Boswell⁸ noted that the cellulose separated from Brazil nut-shells was obtained as a hard mass whatever method of drying was used, and the writer has made a similar observation on cellulose derived from coconut shells, which was always obtained as a hard horny mass.

(iv) *Discussion.*—Qualitatively, coconut shells resemble, in composition, the hard woods, but they have higher contents of lignin, total pentosans and pentosan in cellulose, and lower contents of cellulose. The methoxyl content does not differ greatly from those of many woods. The nature of the products obtained by dry distillation (described in a

subsequent article) show considerable quantitative differences from those of woods, and it is likely that these differences point to features in the composition of the raw material not indicated by existing analytical methods. It is believed that further investigation of the various

fractions — lignin, "cellulose", pectosan, etc.,—would yield results of interest in the chemistry of cell-wall substances. This is probably also true of other nut-shells, few of which have been studied (see Refs. 7, 8, 4), but which present several novel points of interest.

II. MISCELLANEOUS USES: FUEL

THE first article¹⁷ of this series reviewed in some detail the present state of knowledge of the chemical composition of coconut shells. This, the second article aims at describing uses which have been made of shells in the past and are being made at the present time.

UTILIZATION OF SHELLS AS SUCH

The uses which will be dealt with under this head can scarcely be described as industrial, but rather as domestic and ornamental.

Coconut shells have always been used in the domestic economy of coconut-growing countries in a variety of ways. To go no further back than the seventeenth century, Robert Knox¹⁸ relates how that ".....when they (*i. e.*, the Sinhalese) mean to make a bottle of the nut they make but a little hole in one end and keep it till all the meat in the inside is rotted out and then it is like a bottle without a neck, in which they keep

Racke* or oyle or any other liquor: some will hold a quart. The cups or dishes is only to split the nut in the middle as it will do easier than any other way and then there is 2 cups made of one nutt."

Old Knox overlooked the fact that the half carrying the eyes is apt to "spring a leak" when the soft eye decays and that after all only one practicable cup is obtained from one "nut". However, half-shells continue to be used in Ceylon as drinking cups in toddy taverns, as receptacles for collecting rubber latex, fitted with handles as scoops and ladles, and as begging bowls.

Bennett (1843)¹⁹ gives a similar account and mentions containers for oil lamps and "sportmen's liquor flasks"! He also refers to the employment in Ceylon of a coconut shell as a resonant backing for a musical instrument. "The Singhalese *Vinah* is formed of a neatly carved or polished coconut shell (of which

* *i. e.*, arrack.

about a third part is cut off) and covered with guana skin (*Lacerta iguana* L.); to this is fixed a solid handle of about an inch in diameter, which is generally lackered with various colours, and, on the opposite side of the shell, a sort of peg is fixed, to which two strings, one of horse-hair, and the other of fine bow-string hemp (*Sensiviera zeylanica*), are attached; these strings are passed over a wooden bridge, upon the centre of the covering, one horizontally, and the other upon an inclined plane, the slope commencing from within three inches of the extremity of the handle, where it is perforated large enough to receive a strong peg of nearly half its circumference, and of about a fourth part of its length, having at the point a notch for the reception of the strings, which, by turning the peg, are kept in a state of tension, like the strings of a violin. — This instrument is played upon with a bow.....”

Watt (1889),³⁰ says that “by Hindus, the dried shell is almost universally used as the water-bowl of their smoking-pipes or *hukah*. In Madras these shells are made into elegantly carved ornamental vases, lamps, spoons, sugar-pots, tea-pots, etc.” He also gives a list of 83 different articles prepared from the coconut palm exhibited at the Colonial and Indian Exhibition in the 1880's, which includes several shell articles.

Burkill (1935),²⁰ has some interesting particulars of coconut shell vessels used in Malaysia. “The measure of capacity known as a ‘chalok’ is what a coconut scoop will hold. A ‘chupak’ is the amount which half a coconut shell will hold.” Similarly Grisard and Vanden-Berghe (1889),²¹ note that in Siam “.....les noix de coco coupees en deux sont graduees et employees comme mesures de capacite dans le trafic des graines et des liquides.” Burkill adds some curious information on Malaysian folk-lore: “..... in Java, the coconut shell is held to be the appropriate vessel for medicines. In Sarawak, medicinal preparations in connection with births must be given in a coconut shell. Among the Malays a coconut shell vessel is used in a rice-ceremony because evil spirits must be confronted with objects which they recognize (Skeat, *J. Roy. Asiatic Soc., Straits Branch*, 1898, 31, 13). In the Nicobar Islands a baby until two months old must only be washed in water from the shell of a young coconut (Whitehead, *In the Nicobar Islands*, 1924, p. 121).

The manufacture of such articles as have been mentioned has of course been often more than merely utilitarian, as the reference above to Watt's *Dictionary* indicates. Coconut shell is hard, takes a high polish, can be carved, if with some difficulty, decorated with lacquer, inlaid with silver or other metals, and

generally used with ornamental effect. Local craftsmanship has, therefore, produced articles of frequently very attractive appearance, and characteristic of the native art of the various countries of origin.

Several early writers, including Regnaud (1856)²² and Grisard and Vanden-Berghe²¹ have noted that by washing with an alkaline solution and/or rubbing up with oil, coconut shell takes on a fine dark-brown to black shade, which enhances the attractiveness of articles made therefrom. "Grateé et polie", says Regnaud, "puis frottée d'huile ou lavée dans une solution alcaline, la noix de coco devient d'un beau noir, et se transforme, entre les mains d'un ouvrier industriel, en toutes sortes d'ustensiles de ménage ou de simple fantaisie."

Of decorative work illustrations have been published of very ornate Indian work (lamps, goblets, flower-vases, etc.) by J. Shortt (1888),²³ of combs, ladles, bowls and stands, and water-dippers from East Africa by Hamel Smith and Pape (1914),²⁴ and of more modern Ceylon ware by Pieris (1936).²⁵ Three good illustrations in Pieris' little volume show bangles, buttons, cuff-links, ash-trays, trinket-dishes and paper-weights; and a complete tea-set, including pot, six cups and sugar-bowl. Some of these are perhaps to be described as articles "de simple fantaisie"; the tea-set for example,

is probably more ornamental than useful. Buttons and similar things such as studs are, however, practicable; Little (1908)²⁶ had many years before noted the occasional manufacture of buttons in Malaya, and even said, "it is proposed to send the shell to Europe for button manufacture".

It would doubtless be possible by curious literary research to extend considerably the foregoing account of domestic and ornamental uses of coconut shells; but the main features have been covered and one further reference must suffice. O. F. Cook (1910),²⁷ in the course of his attempt to show by botanical and historical evidence that the coconut palm had its origin in South America (a conclusion not now usually accepted), has a good plate of a small carved coconut found in a grave in the Chiriqui district of Panama. This specimen is carved in a simple design and is very attractive.

USE OF COCONUT SHELLS AS FUEL

Of the enormous quantities of shells produced annually in coconut-producing countries (estimates of which are given in a later section), the uses discussed in the previous section account of course for a negligible fraction. Undoubtedly the bulk of shells produced have been and are in most countries used as fuel; they do provide for many purposes an excellent fuel, although

Regnaud's comment: "Il n'y a pass au monde un combustible superieur a la coque du coco" may be taken as rhetorical rather than factual.

Especially in countries where a well-developed plantation industry exists, shells are largely used for firing copra-drying kilns. Burkill (*loc. cit.*), for example, says that "it is the destiny of 70 per cent of the coconut shells in Malaya to be burned for drying copra".

In Ceylon on most estates copra is dried by direct heat from burning shells in kilns of simple but effective design. Good descriptions of the procedure are given by Cooke (1932),²⁸ and by Pieris (1940).²⁹ Cooke notes that in Ceylon nuts are usually allowed to wither in storage for about a month before curing. In consequence a cleaner separation of the husks results and the shells are obtained free from adhering pith and fibre. The shells are also frequently dried before use. In this way clean-burning almost smoke-free fires are given by these shells.

The percentage of total shells used in copra drying naturally varies with conditions and with the efficiency of the kiln and its operators. Cooke (*loc. cit.*, p. 49) states that under unfavourable conditions, as with a draughty kiln or in wet weather, shell consumption may be between 75 and 100 per cent., whilst under good conditions only 25-50 per cent

may be used. In the writer's experience, Ceylon kilns do not attain the latter order of efficiency and about 60 per cent consumption is probably normal. Lower consumption than this is only obtained in very dry districts where the copra is partly sun-dried (*cf.* Pieris, *loc. cit.*).

On small-holdings, as in S. India and to a large extent in Ceylon, shells are for the most part used as domestic fuel. On estates, any surplus left over from copra curing may also be so used, but in Ceylon, for example, there is a not inconsiderable sale to laundries, bakeries,* lime kilns, brick-yards and others requiring fuel. Cooke notices such uses and states that at the time of his enquiries (1931) the price obtainable was between Re. 0.90 and Re. 1.50 per 1,000 shells, though as much as Rs. 4.00 was paid for larger well-shaped shells for rubber tapping (see previous section).

In subsequent years Ceylon developed a considerable export business in coconut shell charcoal and the price of shells became largely dependent on the export price of charcoal, frequently being as high as Rs. 5.00 per 1,000. (Shell charcoal forms the subject of the next article in this series.) At the time of writing the price of shells at estates is round Rs. 2.00 per 1,000 whole shells.

* At the time of writing (Nov. 1943), for example, one large bakery in Colombo uses some 15,000 shells (about 2 tons) a week.

Working with average Ceylon coconuts roughly 6,000 to 7,000 whole shells go to a ton. (Actual data are given in the next article.) Thus at the 1931 prices quoted by Cooke the fuel cost per ton was between Rs. 5.40 and Rs. 10.50, and compared favourably with other fuel when long transport was not involved. Scientific data do not appear to have been recorded on the calorific value of shells; it is likely to be over 7,500 British Thermal Units per lb.

Shells are not favoured as a boiler fuel; there seems to be a rapid corrosive effect of the vapours on fire-bars, etc., due partly to the high temperature reached and to the acid nature of the combustion products when air-intake is insufficient. (See Article IV on Products of Dry Distillation.) There is also in Ceylon a slight prejudice against their use in the cooking of food, especially meat, which the "creosotic vapours" are alleged to render tough and indigestible.

SHELL ASH

The chemical composition of shell ash has been dealt with in the previous article.¹⁷ It seems, however, desirable to conclude the present section on the use of shells as fuel, with a few supplementary remarks on the ash. Burkill is clearly wrong in stating (*loc. cit.*, p. 160) that the ash has but little manurial value, in view of its high potash content. The

point is that something like a million shells are required to give a ton of ash. Furthermore, there is some loss of potash by volatilization if the temperature of combustion is very high. Georgi (1941)⁵ discusses the manurial value of shell ash.

Burkill quotes some uses of shell ash in Malayan native medicine, with which this article may be closed: "The ashes of a coconut shell with pepper, garlic and vinegar, make a medicament drunk after confinement (Skeat, *Mal. Magic*, 1900, p. 346). The ashes, with vinegar only, may be rubbed on the body (Ridley, in *Journ. Straits Med. Assoc.*, 1897, 5, p. 138). In the *Medical Book of Malayan Medicine (Gardens Bull., S.S., 1930, 6)*, the ash of coconut shell is prescribed in applications for swellings, pain in the stomach, and rheumatism; it enters also into a gargle. In no case is its presence anything but empirical, and in the treatment of swellings, the use of the eye-end of the shell suggests magic."

It is indeed difficult to see what effect the acetates formed by dissolving the ash in vinegar can have other than as a mild diuretic due to salt action.

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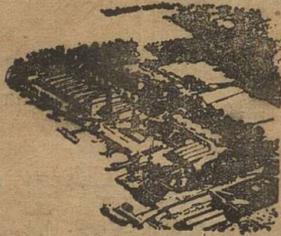


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