On certain aspects of the morphology of arecanuts

(*Areca catechu* Linn.)

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INTRODUCTION.

Arecanut *(areca catechu* linn. Palmae) used extensively as a masticatory in the oriental nations is cultivated in the hot damp regions of Asia and the Malayan Islands. In India, arecanut cultivation is confined to Assam, Bengal, Bombay, Madras, Mysore and the South West Coast. In Assam, the palm grows chiefly in the Districts of Kamrup, Cachar, Nowgong, Sibsagar and the Khasi and Jaintia Hills, the total area under cultivation being 25,000 acres with an annual yield of 2.61 lakhs of maunds of arecanuts. There are three other species of *Areca*, namely *A. Concinna* Thw., *A. nagensis* Griff., and *A. triandra* Roxb. which are distributed in the Indian Subcontinent (Hooker, 1894) In Assam, two species occur, namely, the economically importaut *A. catechu* and *A. nagensis*, latter being confined to the Naga Hills of Assam. The edible arecanuts belong exclusively to *A. catechu* Linn. There are, however, differences in the size and shape of fruits and other characters on which types* may be distinguished.

So far there has been, however, no detailed investigation of the morphology of the different types of Indian arecanuts; still much less is known about the variations in the characters exhibited by the different types. In no case the characters of the plants have been assessed in relation to the type of fruit or to the climatic and biotic conditions of the particular locality. The present investigation, therefore, is undertaken to determine the botanical characters of the different types of arecanuts in Assam and to evolve a system for their identification.

MORPHOLOGY OF ARECA CATECHU LINN

The characters of the plants were assessed by observing random samples from different plantations. The characters of the various types occurring in different Districts of the State were also studied to observe the variations in the characters of a particular type. In sampling out the plants, the important characters observed include the .size and shape of fruits such as round, oblong, long etc. and the characters of the infloresence.

The botanical characters of the different types of *Areca catechu* are described below :—

TRUNK. The palms are tall, erect with typically unbranched stems, the height of the palm varying from region to region but not generally exceeding 70 feet. No relation between the height of the tree and the size

* 'Type' is used here in a restricted sense and does not necessarily indicate distinct types based on botanical characters.

and shape of the fruit it bears has been observed, since in the same areas different types of fruits borne on palms of almost the same height are met with. The height of the palms appears to be influenced by the environmental and biotic factors prevailing in the area and on the density of plantation, the taller are the trees, (c. f. Nambiar, 1949; Raghavan and Baruah, 1956 b).

The stem is cylindrical, the circumferance of the trunk about five feet from the base varying from 11—18 inches. The trunk is greyish brown in colour, sometimes with outgrowths of lichens and is ornamented with scars of fallen leaves in a regular annulated form. The girth of the tree and the type of fruit it bears are unrelated.

LEAVES. The leaves are formed at the tip of the unbranched, annulated, erect stem forming a compact crown having 8—10 pinnate leaves. The leaves are pinnatisect, basal region forming a broad sheath which partly encircles the stem and forms a protective covering for the developing inflorescence until a few days prior to its opening. The sheath measures more than 2 feet in length; the petiole bearing the leaflets ranges from 3.5—5.8 feet in length in the different types.

The leaflets partly fused and partly free are arranged alternately on either side of the petiole, number of leaflets varying from 30-50 on each side. At the distal end of the petiole 2–3 pairs of leaves of each side fuse to form a bifid tip. The leaflets generally vary in length from 22–23 inches; in some cases leaflets as long as 3 feet or more have been observed.

INFLORESCENCE. The palms are monoecious, male and female flowers being formed on the same inflorescence. Rarely bisexual flowers have also been found (Raghavan and Murthy, 1954). The flowers are formed in panicled spadices, whole inflorescence being covered by a glabrous boat-shaped spathe, 19—23·5 inches long and 5-6 inches broad. The secondary and tertiary and spadices are formed alternately on the transversely compressed main branches. In almost all the cases examined the number of groups of secondary rachises on the main branches was from 21-22. The female and male flowers are indefinite in number, the former being confined to the base and axils of the secondary and tertiary branches or terminally on special off-shoots from the rachises and the latter forming serial alternate rows distally on either side of the compressed rachis forming filiform tips. Usually the female flowers are confined to the base of the rachis, solitary or in groups of two, or sometimes adjoining a female flower, a male flower may be found. The female flowers rarely extend to the middle or distal portion of the rachis. They are subtended by a broad scaly bract and two small hyaline bracteoles. The male flowers are smaller in size and much larger in number than the female flowers.

Each female flower has two whorls of perianth, the outer boat-shaped green whorl of 'sepals' and an inner whorl of ovate 'petals'. Each sepal has a triangular thickening on its outside. They vary in length from 1-2 cms. and present an imbricate aestivation. The petals are closely adpressed to the ovary and imbricately arranged.

The ovary is ovoid-globose with a dome shaped top formed by the three stiff stylar projections. The whorl outside the ovary is formed of six staminodes which wither very early during development of the flower.

The male flowers are minute cream coloured triangular structures. They are characterised by two whorls of perianth, outer whorl being conspicuously small (0·1 cm in length) with an acute apex and imbricately arranged. The inner whorl is 0·35–0·4 cm. long, subsimilar, with acute valvate tips. The whorl interior to the petal is occupied by a ring of stamens with basifixed anthers. The anthers are closely adpressed to a rudimentary ovary in the centre which may be termed 'pistillode' or 'rudimentary pistil' (c. f. Petlot, Frontou and Carton, 1926). The pistillode divides in the middle into three lobes.

FRUITS. Fruits maybe of various sizes and shapes such as round, long, oblong etc. Usually, about 100–250 fruits are formed in each bunch. In the younger stages they are green and as maturity approaches the colour gradually changes from orange yellow to yellow or scarlet red. The husk is thick and fibrous, enveloping a single seed which is generally known as the nut. The endosperm of the seed is reddish brown with dark wavy lines giving it a marbled appearance. There is a single embryo situated at the base of the seed.

TYPES.

The different types of arecanuts are normally seedling races, which propagate true to seed except for some simple fluctuating variations. Beccari (1919) describes a few new varieties of arecanuts which occur in the Philippines and Sands (1926) and Nambiar (1954) have described the variations in Malayan arecanuts and designated them by local names. Different varieties have also been reported to occur in South India and Ceylon (Sands, 1926). According to Kannangara (1941) in Mysore there are apparently no distinct varieties of arecanuts though there are some trees with yellow fruits and others with green fruits. Rau (1915) has described a new variety of arecanut from Mysore (*A. catechu* var. *deliciosa*) based on the sweet kernels of the fruits when mature. Except for these, no precise data are, however, available regarding the delimitation of the Indian types.

It has become evident that the different types are strikingly similar in their morphological and floristic characters, showing no indication of a varietal distinction. Sands (1926) writes "As observations on the flowering of the betelnut palm have shown that the flowers are normally cross-pollinated and that in all plantations and gardens there are numerous types, it will be realised that in the absence of breeding experiments, it is an almost hopeless task endeavouring to decide which of the large number of forms are distinct varieties or races and which are merely unstable hybrids".

Varietal characters are mainly attributed to the fruits which exhibit marked differences in size and shape and the following types have been collected from different localities. This distinction is arbitrary and borderline types are also not uncommonly met with. Investigations on the pollen morphology (Raghavan and Baruah, 1956, a.) and anatomy of the flowering axis which show no variation in the different types indicate the causes for limited range of morphological and floral structures in the types.

Locality.	*Types collected.*
Cherrapunji.	Big oblong. Small oblong. Small apex pointed.
Dawki.	Big oblong. Big round. Small oblong.
Gauhati.	Big oblong. Big round. Small oblong. Small round.
Jorhat.	Big oblong. Small oblong. Apex round. Long.
Nowgong.	Large oblong. Big round. Big oblong. Small ellipsoid.
Palasbari.	Big oblong. Big round. Small oblong.
Sibsagar.	Big oblong.

The same types have been collected from different sources to determine the range of size of the fruits.

DESCRIPTION OF THE TYPES.

The ranges of variations generally observed in the types collected are given below. The list of variable characters of the types of arecanuts is prepared from observations of the different types from different regions and of the same types from various sources for two consecutive seasons. It is possible that variable characters noted may serve as a basis for further studies on taxonomic classification of *areca*.

1. General appearance and size of the fruits.
2. Colour of the fruits at maturity.
3. Presence of persistent calyx in the mature fruit.
4. Dimensions of the fruit.
5. Weight of the fruits (average of 100 fruits).
6. Volume of the fruits (average of 100 fruits).
7. Weight of the husks separately (average of 100 husks).
8. Thickness of the husk.
9. Arragement of the vascular bundles in the husk.

10. Volume of the husk separately (average of 100 husks).
11. General size of the nut.
12. Dimensions of the nut.
13. Weight of the nuts (average of 100 nuts).
14. Volume of the nuts (average of 100 nuts).
15. Nature of the lamella of the ruminate endosperm.
16. Pattern of the net work on the surface of the nut.
17. Size and dimensions of the embryo.

The average weight, volume and dimensions of the entire fruits, husks and endosperms of the different types are those taken from ripe fresh fruits.

The types have been divided into main groups.

1. *Big fruit type* where the fruits range from 1·5–2·3 in length and 1·2–1·75 inches in breadth.

2. *Small fruit type* where the fruits are of lesser dimensions. It may, however, be noted that though fruits as long as 1·75 inches have been included in this group, the breadth of the fruits of this group does not exceed 1·15 inches.

Further, a classification on the basis of the weight and volume of the fruits is as follows:—

1. *Big fruit type* where the weight of the fruits ranges from 24·8–46 gms. (28–49 cc. volume).

2. *Small fruit type* where the weight of the fruits ranges from 14–23·4 gms. (14·6–26·8 cc. volume).

However, in this grouping, 'Long type' included in the first group by virtue of its length should be included in the latter group since the fruits weigh only 23·6 gms (23·6 cc. volume).

Both groups include many geometrical variations in sizes based on which the following types have been demarkated. Big oblong, Big round, Large oblong, Apex round, Long, Small oblong, Small ellipsoid, Small round and Small pointed apex. An examination of the collections from various places will show that Big oblong, Big round and Small oblong are the dominant types, others being poorly represented.

BIG OBLONG TYPES.

1. *Big oblong* (Cherrapunji). Fruit big, ovoid or obovoid, reddish when ripe; about 1·8" long and 1·3" in diameter at its widest part; apex* slightly conical with a small protuberance representing the remnants of the dried-up stigma; base** more roundish than conical; covered by the persistent perianth lobes; average weight of fruits 26·2 gms; average volume of fruits 28·0 cc. Pericarp hard, smooth, 0·5 cm. thick enclosing the vascular bundles; vascular bundles of the husk girdling the nut and arching at its top enclosing a dome of wooly fibres; vascular fibres strong, anastomosing, intermingled with a mass of lignified non-vascular fibres; bundles not abundant; average weight of husk 15·3 gms; proportion of the husk to the entire fruit 73·3%. Nut more or less oval, flattened at the base and slightly hemispherical at the apex; 0·8" x 0·8", or rather longer than broad; average weight of the nuts 10·9 gms; proportion of the nut to the entire fruit 26·7%; endosperm ruminate, lamella confined to the sides, 25–28 in number, narrow and slender; central core wider in area than the ruminations white; lamella 0·9 cm in length; network on the surface of the nut in the form of polygonal areas. Embryo small, cylindrical, centrally placed; 0·4 cm. in length.

2. *Big oblong* (Dawki). Fruit big, ovoid, or obovoid; yellowish when ripe; 1·8" long and 1·4" in diameter; apex imperceptably tapering into a rudimentary protuberance; base tapering, slightly roundish, covered by the peristent perianth lobes; average weight of fruits 25·8 gms; average volume of fruits 28·2 cc. Pericarp hard, 0·5-0·6 cm. thick, enclosing vaseular bundles; vascular bundles arranged as in 1; average weight of husk 15·7 gms; proportion of the husk to the entire fruit 77%. Nut as in 1, 0·9" x 0·9" or generally longer than broad; average weight of nuts 10·1 gms; proportion of the nut to the entire fruit 23%; rumination on the endosperm confined to the sides; 20-22 lamella, band like, more or less extending to the central core; central core small; net work on the surface of the nut as in 1, but slightly larger. Embryo small, cylindrical, 0·4 cm. in length.

3. *Big oblong (Gauhati).* Fruit big, ovoid, reddish when ripe; 1·9" long and 1·35" in diameter; apex narrowing into a projection; base slightly conical

* Apex–free end of the fruit.
** Base–the end with which the fruit is attached to the bunch.

capped by the thick and coriaceous fruiting perianth; average weight of fruits 26·0 gms; average volume of fruits 28·6 cc. Husk 0·4 cm. thick; vascular fibres confined to 0·15 cm. in thickness; arrangement of the vascular and non-vascular fibres as in 1; average weight of husk 14·8 gms; proportion of the husk to the entire fruit 76%. Nut ovoid, as broad as long or longer than broad; average weight of nuts 11·2 gms; proportion of the entire fruit 24%; lamella of the reminations narrow and band like, 18-20 in number; central core smaller than ruminate area; net work on the surface of the nut in the form of rectangular areas. Embryo cylindrical, 0·4 cm. long, centrally placed.

4. *Big oblong (Jorhat).* Fruit big, ovoid, reddish when ripe; 1·9" in lenght and 1·4" in breadth; average weight of the fruits 27·0 gms; average volume of fruits 32 cc. Pericarp 0·5 cm. thick; average weight of the husk 15·2 gms; proportion of the nuts to the entire fruit 25%. Rest of the description as in the previous type.

5. *Big oblong (Nowgong).* Fruit big, ovoid, orange red when ripe; 1·8" long and 1·2" broad; apex more or less hemispherical with a central depression and a prominent cylindrical projection representing the dried-up stigma; base conical, capped by the fruiting perianth lobes; average weight of fruits 33·95 gms; average volume of fruits 38 cc. Husk 0·4 cm. thick, vascular fibres arranged as in 1; average weight of husk 23·55 gms; proportion of the husk to the entire fruit 75%. Nut ovoid, 0·8" × 0·8"; average weigit of nuts 10·4 gms; proportion of the nut to the entire fruit 25%; lamella of the rumination in the form of narrow bands, extending to the central core, 20-22 lamella; net-work on the surface of the nut in the form of rectangular curved areas. Embryo oval, situated centrally, 0·35 cm. long.

6. *Big oblong (Palasbari).* Description corresponds to the previous type.

7. *Big oblong (Sibsagar).* Fruit big, ovoid reddish when ripe; 2" long and 1·4" in diameter; apex imperceptably tapering into a cylindrical protuberance; base conical, capped by the coriaceous lobes of the fruiting perianth; average weight of fruits 35·3 gms; average volume of fruits 39·8 cc. Husk hard, 0·5 cm. thick, vascular and non-vascular fibres arranged as in the first type; average weight of husks 24 gms; proportion of the husk to the entire fruit 77·9%. Nut ovoid, as long as broad, 1" × 1"; aevrage weight of nuts 11·3 gms; proportion of the nut to the entire fruit 23·1%; lamella of the ru minate endosperm narrow and long, 20-22 in number; net-work on the surface of the nut as in 1. Embryo conical, obliquely placed to one side of the fruit, 0·5 cm. long.

BIG ROUND TYPES.

8. *Big round (Dawki).* Fruit big, globose round, bright red when mature; 1·5" long and 1·5" broad or sometimes as long as broad; apex round or hemispherical with a slightly sunken protrusion; base more or less conical, enveloped incompletely by the fruiting perianth; average weight of fruits 24·8 gms; average volume of fruits 28·7 cc. Husk bright red, 0·45 cm. thick, vasculer fibres arranged as in 1, but lesser in number; bundles occupying 0·2 cm. in area; average weight of husk 15·0 gms; proportion of the husk to the entire fruit 74·6%. Nut ovoid-globose, broader than long, 0·75" × 1·0", flattened at the apex and hemispherical at the base; average weight of nuts 9·8 gms; proportion of the nut to the entire fruit 25·4%; lamella of the ruminate endosperm slender, 22-24 in number, central core large and white; net-work on the surface of the nut as in 1. Embryo slightly conical, centrally situated, 0·4 cm. long.

9. *Big Round (Gauhati).* Fruit big, reddish when ripe; 1·5" long and 1·3" brodd; appex round, remnants of the stigma poorly or not represented; base hemispherical slightly sunken and capped by the fruiting perianth; average weight of fruits 36·8 gms; average volume of fruits 40·4 cc. Husk 0·4 cm. thick, vascular fibres arranged as in 1, confined to 0·25 cm. in area; average weight of husk 24·9 gms; proportion of the husk to the entire fruit 79%. Nut round-globoid, broader than long, 0·7"×1·0"; apex hemispherical; base flat; average weight of nuts 11·9 gms; proportion of the nut to the entire fruit 21%; lamella of the rumination in the form of linear bands converging to the centre leaving a white area towards the region of the embryo; 16-18 lamella; net-work on the surface of the endosperm in the form of rectangular bands with small polygonal areas; Embryo conical, placed obliquely to one side of the fruit, 0·4 cm. long.

10. *Big round (Nowgong).* Fruit deep reddish when ripe; 1·55" long and 1·5" broad; base hemispherical. Other characters correspond to the previous type.

11. *Big round (Palasbari).* General description of the fruits as in Big round (Gauhati).

SMALL OBLONG TYPES.

12. *Small oblong (Dawki).* Fruit small, oblong-ovoid, creamy yellow when mature; longer than broad, 1·5"×1·1"; apex conical with a slight protrusion; base conical, covered partly by the fruiting perianth; average weight of fruits 14·8 gms; average volume of fruits 15·9 cc. Husk 0·3 cm. thick; vascular fibres less in number, confined to 0·2 cm. in area, arranged as in 1; average weight of husk 9·8 gms. proportion of the husk to the entire fruit 66·7%. Nut as long as broad., round or slightly ovoid, 0·8"×0·8"; average weight of nut 5·0 gms; proportion of the nut to the entire fruit 33·3%; lamella of the rumination in the form of broad bands, 20–22 in number, central area large, white; net-work on the surface of the nut in the form of small polygonal or irregular areas. Embryo small, globoid-round, situated centrally, 0·3 cm. long

13. *Small oblong* (Gauhati) Fruit small, oblong-ovoid, reddish when ripe; 1·6" long and 1" broad; apex conical with a prominent protrusion; base conical, covered by the fruiting perianth; average weight of fruits 14·4 gms; average volume of fruits 14·8 cc. Husk 0·3 cm. thick; vascular fibres less in number, confined to 0·1 cm. in area, arranged as in 1; average weight of husk 10·7 gms; proportion of the husk to the entire fruit 78·4%. Nut ovoid, longer than broad 0·8"×0·75"; average weight of nuts 3·7 gms; proportion of the nut to the entire fruit 21·6%; lamella of the rumination small and band like, 18–20 in number; net-work on the surface of the nut in the form of small polygonal or irregular areas. Embryo small, globoid-round, situated centrally, 0·3 cm. long

14. *Small oblong (Jorhat).* Fruit as in the previous type, slightly smaller, 1·45" long and 0·9" broad; base round; average weight of fruits 14·0 gms; average volume of fruits 14·6 cc. Husk 0·2 cm. thick; vascular fibres lesser in number and arranged as in 1; average weight of husk 10·6 gms; proportion of the husk to the entire fruit 77·2%. Nut ovoid, as long as broad, 0·675"×0·675" or slightly longer than broad; average weight of nut 3·4 gms; proportion of the nut to the entire fruit 22·8%; lamella of the rumination broad or linear; central core small; net-work on the surface of the nut in the form of small or big polygonal areas. Embryo small, linear, placed obliquely to one side of the fruit, 0·5 cm. long.

15. *Small oblong (Palasbari).* General description corresponds to that of Small oblong (Jorhat).

16. *Small oblong (Cherrapunji).* General description corresponds to that of Small oblong (Jorhat).

LARGE TYPE.

17. *Large oblong (Nowgong).* Fruit large, roughly about the size of a hen's egg, deeply reddish when ripe, the pericarp splitting at the apex of the fruit at maturity; 2·3" long and 1·75" broad; apex slightly tapering into a small protuberance; base more hemispherical than conical, partly covered by the fruiting perianth; average weight of fruits 46 gms; average volume of fruits 49·4 cc. Husk 0·6 cm. thick; vascular fibres abundant and frequently anastomosing, arranged as in 1; non-vascular fibres intermingled with vascular fibres; vascular fibres confined to 2/3rds of the thickness of the husk; outer surface of the pericarp become fleshy at maturity of the fruit and peeling off easily; average weight of husk 31 gms; proportion of the husk to the entire fruit 24·2%; lamella of the rumination linear, wavy band like, extending into the central core of the fruits; lamella as long as 1·5 cm., 20-22 in number; net-work on the surface of the endosperm in the form of longitudinal bands. Embryo small, globoid, 0·3 cm. long.

SMALL ROUND TYPE.

18. *Small round (Gauhati).* Fruit small, round-ovoid, orange yellow when ripe; 1·5" long and 1·15". broad; apex slightly conical, remnants of the dried-up stigma notched; base conical covered by the fruiting perinth; average weight of fruits 20·0 gms; average volume of fruits 24·2 cc. Husk orange red when ripe, 0·3 cm. thick; vascular fibres less in number, arranged as in 1; average weight of husk 14·0 gms; average volume of husk 72%. Nut broader than long, 0·8" x 0·95"; average weight of nut 6·0 gms; proportion of the nut to the entire fruit 28%; lamella of the rumination thick and extending to the centre, 20-22 in number; net-work on the surface of the endosperm in the form of wavy rectangular bands with small polygonal areas. Embryo globoid with slightly conical apex, 0·4 cm. long, situated centrally.

LONG TYPE.

19. *Long (Jorhat).* Fruit long, yellowish green when ripe; length nearly double the breadth or more; 2·1" x 1·25"; ellipsoid with a slightly even depression towards the base; apex conical with a small projection, base more or less hemispherical, covered by the persistent perianth; average weight of fruits 20·6 gms; average volume of fruits 23·6 cc. Husk 0·45 cm. thick, increasing considerably in thickness towards the apex, vascular fibres strongly anastomosing, confined to

0·2 cm. area in thickness; arrangement of the fibres as in 1; average weight of husk 14·2 gms; proportion of the husk to the entire fruit 71·2%. Nut long, oval, length nearly double the breadth; 1·125" x 0·75"; average weight of nuts 6·4 gms; proportion of the nut to the entire fruit 28·8%; lamella of rumination short and broad and arranged symmetrically; central area white; large; net-work on the surface of the nut in the form of rectangular areas. Embryo round-globose, 0·4 cm. long.

Beccari (1919) describes a closely resembling type from the Philippines under the name *areca catechu* var. *longicarpa*. Similarly Sands (1926) describes closely allied types from Malaya and South India under the names 'Pinang Selung' and 'Long' respectively. However, in the local type the fruits were smaller in dimensions than the Philippine, Malayan or South Indian types.

APEX ROUND TYPE.

20. *Apex round (Jorhat)*. Fruit large, globose-ovoid, yellow when ripe; 1·7" long and 1·45" broad; apex wider than base and folded inwards in the form of a depression enclosing the projecting stylar remnants; base more or less tapering, capped by the fruiting perianth lobes; average weight of fruits 27·0 gms; average volume of fruits 31·9 cc. Husk 0·45 cm. thick, increasing to 0·75 cm. towards the apex of the fruit; vascular fibres arranged as in 1; confined to 0·25—0·35 cm. in thickness; average weight of husk 16·0 gms; proportion of the husk to the entire fruit 78·1%. Nut globose-ovoid, broader than long, 0·85" x 1·0"; average weight of nuts 11·0 gms. proportion of the nut to the entire fruit 21·9%; lamella of the rumination broad, 16–20 in number; central area large and white; net-work on the surface of the nut in the form of small rectangular areas. Embryo cylindrical with conical apex, 0·5 cm. long.

SMALL ELLIPSOID TYPE.

21. *Small ellipsoid (Nowgong)*. Trunk 50–60' high, 10–15" in diameter; leaves 2-2·5' long with about 30 pairs of leaflets. Spadix diffuse with slender floriferous branches. Male, female and bisexual flowers present (Raghavan and Murthy, 1954).

Fruit small, ovoid, ellipsoid, reddish yellow when ripe; 1.4" long and 0·9" broad; apex conical with a prominent projection; base conical; average weight of fruits 15·2 gms; average volume of fruits 18·2 cc. Husk 0·45 cm. thick; vascular fibres confined to 0·15 cm. in area, arranged as in 1; average weight of husk 11·1 gms. proportion of the husk to the entire fruit 68·2% Nut small, as broad as long, 0·7" x 0·7"; apex conical base flattened; average weight of nuts 4·1 gms; proportion of the nut to the entire fruit 31·8%; lamella of the rumination broad and closely arranged, 20–22 in number; net-work on the surface of the nut in the form of small areas. Embryo long, obliquely conical, 0·6 cm. long. Some of the fruits in the bunch have immature and undeveloped endosperm.

SMALL APEX POINTED TYPE.

22. *Small apex pointed (Cherrapunji)*. Fruit small or medium, yellow when ripe; convex shaped; 1·75" long and 1·15" broad; apex narrowing into a cylindrical projection, base of the projection marked by a ring-like thickening; average weight of fruits 23·4 gms; average volume of fruits 26·8 cc. Husk 0·2 cm. thick; vascular fibres less in number, closely adpressed to the nut inside the shell like endocarp forming a girdle round it, but arching from about its middle; average weight of husk 16·3 gms; proportion of the husk to the entire fruit 71·0%. Nut convex shaped, both ends more or less conical, 1·0" long and 0·95" broad; average weight of nuts 7·1 gms; proportion of the nut to the entire fruit 29%; lamella more or less converging to the centre; white softer endosperm more in area; net-work on the surface of the nut in the form of irregular areas. Embryo placed obliquely, 0·65 cm. long.

This fruit corresponds to that described by Sands (1926) from South India under the name 'Convex shaped'.

It appears that the same type collected from different regions exhibits minor variations in characters, some overlapping one another being border-line types. It is possible that the slight variations exhibited by the same type from different regions may be due to physiological peculiarities of nutrition or due to climatic and edaphic factors. The schedule is thus based mainly on the fruit's size and shape which are important characters applicable to differentiate the types. However, apart from fruit size and shape, the colour of the fruits at maturity, nature of the lamella in the ruminate endosperm, pattern of the net-work on the surface of the endosperm and nature of the husk have also been emphasised. The relative proportions of the husk to the volume of the nut in a fruit are also measured to determine the vairations in the proportions of husk in fruits.

SUMMARY.

The range of floral variations usually met with in the cultivated types of arecanuts in Assam has been studied.

A schedule based on the size, shape and certain other characters of the fruits showing the range of variations in the types is given.

Ovoid oblong.		Big fruits (longer than broad)			Small fruits longer than broad)			
		Round or spherical	Ovoid globular	Ellipsoid elongated		Ovoid oblong		Round or spherical
Big oblong	Large oblong.	Big round.	Apex round.	Long.	Small ellipsoid.	Small oblong.	Small apex pointed	Small round.
Fruits 1·8–2·0″ long and 1·2-1·4″ broad. Nuts longer than broad. Fruits reddish or rarely when ripe.	Fruits 2·3″ long and 1.75″ broad. Nuts broader than long. Fruits deep reddish when ripe; outer skin peeling off easily.	Apex round; 1·5″ long and 1·3-1·4″ broad or rarely as long as broad. Nuts broader than long. Fruits orange yellow or rarely reddish when ripe.	Apex round and broader than base, folded inwards in the form of a depression; base distinctly tapering. Fruits 1·7″ long and 1·4″ broad. Nuts broader than long. Fruits yellow when ripe.	Length of fruits nearly double the breadth or more; ellipsoid with an even depression towards base; 2·1″ × 1·25″. Nuts 1·125″ × 0·75″. Fruits yellowish green when ripe.	Fruits 1·4″ long and 0·9″ broad; both apex and base conical. Nuts 0·7″ × 0·7″ or sometimes longer than broad Palms usually bearing male, female and bisexual flowers.	Fruits 1·45″—1·6″ long and 1·9″ 1·1″ broad. Nuts slightly bigger than in small ellipsoid but longer than broad. Spadices with male and female flowers only.	Fruits as in Small oblong, convex shaped, apex narrowing into a projection.	Fruits as in Small oblong; apex round. Nuts broader than long 0·8″ × 9·95″.

ACKNOWLEDGEMENT.

The authors wish to thank the Gauhati University and the Indian Central Arecanut Committee, Kozhikode, for financing a scheme on the "Better Utilisation of the Bye-products of Arecanuts".

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