VARIETIES AND FORMS OF THE COCONUT PALM GROWN IN CEYLON

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The varieties and forms of the cosmopolitan coconut palm (*Cocos nucifera L.*) have been described by different workers from time to time. Recently, Narayana and John (1949), Gangolly, et al (1957), Menon and Pandalai (1958) have given a comprehensive list of coconut varieties. Although, a number of forms have been described by the use of local names, it is very unlikely that the total number would be so large, if a critical analysis of world varieties and forms is undertaken and the terminology is standardised.

Hunger (1920) has described seven varieties of coconut palms based on size of palm, characteristics of the nut, mainly colour and size, as follows: (1) *viridis* Hassk.—nuts green, (2) *rubescens* Hassk.—nuts grey brown, (3) *macrocarpa* Hassk.—nuts very large, (4) *rutila* Miq.—husk very thick, of little value for copra, (5) *eburnea* Hassk.—an albino variety of no commercial value, but useful as an ornamental palm, (6) *pumilla* Hassk.—early maturing dwarf type bearing green nuts and (7) *regia* Miq.—early maturing dwarf bearing golden-yellow or orange-yellow nuts. Perhaps types (1) to (5) may be more appropriately described as forms of a single variety and (6) and (7) forms of another variety.

Narayana and John (1949) have divided the species into five varieties, *viz.* (1) *spicata* Jacob —a purely female coconut palm, (2) *androgena* Nar.—a male coconut palm, (3) *javanica* Nar.—a mutant true breeding type from Java, (4) *typica* Nar.—the ordinary tall type found in all the coconut growing areas of the world and (5) *nana* (Griff.) Nar.—the common dwarf variety. A number of forms in each variety have been listed. Probably, *typica* and *nana* describe appropriately two distinct varieties, but other classifications purely on sex expression are rather doubtful since the genetical behaviour of that character has not been studied. I was unable to locate in Java, the variety described as *javanica*.

The existence of varieties of coconut in Ceylon has been recognised from very early times. Seeman (1856) has recorded five indigenous varieties of the coconut palm, 'Thembili, Navasi, Dwarf, another Thembili form with large nuts and the common tall type'. Trimen (1898) records that several varieties of coconut are recognised by growers but mentions only two types, King Coconut and a 'very small fruited dwarf sort (*Cocos nana* Griff.)'.

A number of forms of coconut which are distinct from one another could be identified. Considering the fact that most of the types are out-breeding and a number of variants are bound to occur, a distinct classification would be rather difficult. Nevertheless, an attempt has been made in this paper to divide the indigenous types of coconut palms into groups of strains that distinctly differ from one another and suggest a tentative classification.

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Varieties

On a critical examination of data pertaining to morphological characters and the breeding system of the different types of coconut palms grown in Ceylon, three varieties could be distinguished. Using the terminology of other workers, two varieties could be described as **typica** Nar. *i.e.* the popular tall variety grown on a plantation scale, and **nana** (Griff.) Nar. *i.e.* the dwarf variety. The third variety is the group to which *King Coconut* belongs, which type probably is endemic to this country. Since the bright orange colour of nut is a prominent characteristic of this variety, it is described as **aurantiaca** Liy.

The salient characters of these three varieties are indicated below. Girth measurements of stem have been taken 5 feet above ground and the leaf lengths are of 10-year old palms.

Variety **typica** Nar. Stem, broad, mean girth 33 inches (approx.), attains a height of about 60 feet; leaves, long, mean length 18.2 feet (approx.); flowering late, 8 years (approx.) after planting, flower production continuous; predominantly out-breeding due to protandry; nuts, medium to large in size, 4,000 to 5,200 nuts per ton of copra; copra, hard and of good quality. Hardy palms tolerating a wide variation of soil type and climate. Under a favourable environment economic production possible up to 60 years.

Variety **nana** (Griff.) Nar. Stem, narrow, mean girth 22 inches (approx.), attains a height of about 35 feet ; leaves, short, mean length 13.3 feet (approx); flowering, early, 3 years (approx.) after planting, flower production seasonal; predominantly in-breeding as male and female reproductive phases of inflorescence overlap; nuts, small, 9,000 to 12,000 nuts per ton of copra; copra, leathery and of poor quality. Palms very susceptible to pests and diseases and thrive well on fertile soils with a well distributed rainfall; suffer adversely from drought. Economic production period not more than 40 years.

Variety **aurantiaca** Liy.* Stem, semi-broad, mean girth 28 inches (approx.), attains a height of about 40 feet; leaves, short, mean length 14.0 feet (approx.); flowering, late, 6 to 8 years (approx.) after planting, flower production seasonal; predominantly in-breeding as male and female reproductive phases of inflorescence overlap; nuts, medium size, 8,000 nuts to a ton of copra; epicarp of nut orange in colour, endosperm thin and of little value for copra production. Palms very susceptible to pests and diseases and thrive well on fertile soils with a high water table and a well distributed rainfall. Palms suffer adversely from drought. Economic production period not more than 40 years.

Forms of Varieties

Within each variety, a number of forms could be recognised and their salient distinguishing characters are indicated below. Variations between forms in quantitative characters of nut components are illustrated in Tables 1 and 2, and the variations in size and shape of nut in

*Arbor, 12 m. alta, 7.1 dm. in circumferentia; fructu aurantiaca. typus: Liyanage in Herb. Peradeniya.

Figures 1 and 2. The names used for the forms are local terms and wherever possible the local terms used in other countries to describe similar types are listed. The somatic chromosome number of some forms are given.

Forms of the variety **typica** Nar.

(i) *Typica:* Nuts, generally oblong; epicarp of nut, different shades of green to reddish brown; mesocarp, a good source of fibre; endosperm, thick, giving about 7 ozs. of copra per nut. Chromosome number 2 n = 32. This type is commonly grown on a plantation scale.

(ii) *Navasi:* Epicarp of nut, green; mesocarp of immature nut, sweet and edible; husk, soft; nut-water insipid; of no commercial importance. Chromosome number 2 n = 32.

Same form described as *tamisan, taban, cayamis* in Philippines: *kalapa tebu* in Indonesia; *kaithathali* in India; *cay dua sap* in Viet-Nam.

(iii) *Gon-thembili:* Epicarp of nut, and rachis of leaf, ivory yellow; water of tender nut usually insipid; nuts, fairly large, out-turn low; oil content high (69.2 per cent). Chromosome number 2 n = 32.

Same form described as *garing* in Philippines and *kalpa kuning* in Malaya.

(iv) *Ran-thembili:* Immature nut 2-3 months old, mesocarp, endocarp, and the portion of epicarp covered by perianth lobes, pink in colour; nut 4-6 months old, epicarp green, chalazal region of mesocarp (basal portion) pink in colour; husk soft; oil, said to be of medicinal value.

(v) *Pora-pol:* Husked-nut, small and elongated; endocarp, exceptionally hard and very thick—about 6 mm. These nuts are used for a type of sport practised in the Southern parts of Ceylon. Chromosome number 2 n = 32.

Same form described as *tutupaen* in Philippines.

(vi) *Bodiri:* Prolific bearing palms; nuts, very small requiring about 20,000 to a ton of copra; each bunch carries 50 to 100 nuts; oil content, high (69.6 per cent).

Same form described as *coconino, mangipod* in Philippines and *mapraw-puong* in Thailand.

(vii) *Kamandala:* Nuts, large, approximately 1½ times the size of the nut of the form *typica*, similar to San Ramon nuts of the Philippine Islands but not so globose; few nuts per bunch; distribution restricted to the Southern Province of Ceylon.

Same form described as *lupisan* in Philippines, *Kappadam* in India and *Markan* (?) in New Guinea.

(viii) *Dikiri-pol:* Commonly described as *Macapuno*. Endosperm, 2 to 3 cms. thick, very soft, certain portions of a buttery consistency and gelatinous; two to three nuts in each bunch are *Macapuno*, while the other nuts are normal. Soft meat considered to be a delicacy.

Same form referred to as *macapuno* in Philippines and *thairu thengai* in India.

Forms of the variety **nana** (Griff.) Nar.

(i) *Pumilla:* Inflorescence, yellowish green; epicarp of nut, green.

(ii) *Eburnea:* Inflorescence, ivory yellow; epicarp of nut, yellow.

(iii) *Regia:* Inflorescence orange; epicarp of nut, apricot red.

Hunger (1920) classified the green forms as *pumilla* Hassk. and the red form as *regia* Miq. Dwarf palms are referred to as *Pugai, Lincoranay* in Philippines, *N'uleka* in Fiji Islands, *Cay due xiem* in Vietnam. *Kalapa Puyah* or *Quails* coconut of Malaya refers to the green dwarf form.

Forms of the variety **aurantiaca** Liy.

(i) *Thembili* (or *King Coconut*)*:* Upper surface of leaf rachis, inflorescence and epicarp of nut, orange; sucrose content of tender nut-water, relatively high (5 to 6 per cent), furnishing a delicious and refreshing drink. Oil said to be of medicinal value and has the peculiar characteristic of having a higher melting point than ordinary coconut oil. Breeds true to type (about 80 per cent). Chromosome number 2n = 32. This form is also popularly known as *King Coconut.*

(ii) *Navasi-thembili:* Upper surface of leaf rachis, inflorescence, and epicarp of nut, orange; mesocarp of tender nut, sweet and edible.

TABLE I

Quantitative characters of nut components of forms of coconuts found in Ceylon

	Un-husked nut			*Husked-nut*		*Endocarp*		*Thickness of endosperm (m.m.)*
	Length (ins.)	*Width (ins.)*	*Volume c.c.*	*Volume c.c.*	*Weight (oz.)*	*Thickness (m.m.)*	*Weight (oz.)*	
Variety **typica**								
1. Form *typica* ..	8.6	7.0	3200	870	25	3	5.6	15
2. Form *navasi* ..	8.9	7.6	3175	877	22	3	6.0	13
3. Form *gon-thembili* ..	8.9	6.5	2535	787	24	3	7.0	13
4. Form *ran-thembili* ..	8.6	7.6	3728	857	29	3	7.0	14
5. Form *pora-pol* ..	9.0	6.5	1870	683	19	6	8.0	13
6. Form *bodiri* ..	4.5	3.8	606	218	7	2	1.8	10
7. Form *kamandala* ..	10.6	8.9	5922	1760	56	3	11.4	14
8. Form *dikiri-pol* ..	—	—	—	—	—	—	—	—
Variety **nana**								
9. Form *pumilla* ..	7.8	5.4	1457	367	10	2	2.5	11
10. Form *eburnea* ..	7.5	5.8	1591	474	15	2	3.1	12
11. Form *regia* ..	7.7	4.9	1140	334	10	2	2.0	11
Variety **aurantiaca**								
12. Form *King Coconut* ..	8.2	5.3	1394	559	14	2	6.0	12
13. Form *navasi-thembili* ..	7.6	5.7	1573	525	16	2	3.5	12

TABLE II

Some economic characters of the forms of coconut found in Ceylon

	No. of nuts examined	Weight per husked-nut (lb.)	Weight of copra per nut (oz.)	Nuts per ton of copra	Oil content (dry basis), per cent
Variety typica					
1. Form *typica* ..	100	1.53	7.52	4750	68.95
2. Form *navasi* ..	19	1.34	6.32	5675	69.54
3. Form *gon-thembili* ..	55	1.53	8.15	4400	69.20
4. Form *ran-thembili* ..	19	1.83	7.79	4600	68.46
5. Form *pora-pol* ..	20	1.18	5.00	7150	69.73
6. Form *bodiri* ..	20	0.43	1.80	19900	69.58
7. Form *kamandala* ..	45	3.54	13.33	2700	67.65
8. Form *dikiri-pol* ..	—	—	—	—	—
Variety nana					
9. Form *pumilla* ..	52	0.63	4.00	8950	69.65
10. Form *eburnea* ..	100	0.95	3.96	9050	65.49
11. Form *regia* ..	90	0.61	3.07	11675	65.23
Variety aurantiaca					
12. Form *King Coconut* ..	100	0.88	5.00	7150	65.62
13. Form *navasi-thembili* ..	21	1.02	4.95	7250	68.10

Discussion

It is apparent that there is considerable variation between different coconut palms with respect to habit of the palm, vegetative characters, breeding system, size, weight and colour of nut and its components (Tables 1 and 2, Figure 1). Strains that distinctly differ in structural or functional characters from one another, and some of which breed true to type could be distinguished. On this basis, separation of the indigenous coconut palms into three varieties is feasible; variety **typica** is tall in habit and predominantly out-breeding, variety **nana** is short in habit and in-breeding and variety **aurantiaca** is semi-tall, in-breeding and nuts are orange in colour. Within each of these groups, there are types that differ distinctly, in relation to size and colour of nut, or its components, and they may be conveniently described as 'forms'. Size of nut is influenced largely by environment, yet in some palms, it is an inherent character and consequently they could be called forms (e.g. *bodiri*).

The main commercial products of coconuts are copra, oil and desiccated coconut. In an evaluation of the different forms, the main emphasis should be on yield of copra or oil per unit area, which ultimately depends on nut weight, and yield per palm. Statistics pertaining to these characters are not available except for the forms *typica*, *King Coconut* and the three **nana** forms; the other forms are relatively few in number, and that too widely scattered amongst plantations. The yield of copra of the three forms of **nana** and *King Coconut* is low, and further copra is of poor quality, that they are unsuitable for commercial planting for copra production.

Variations between forms relative to out-turns are very large, but that relative to oil content of copra is only appreciable (Table 2). The *regia* form of the variety **nana** has given the lowest oil

value (65.2 per cent) and the *pora-pol* form of **typica** the highest value (69.7 per cent). The out-turns have varied from 2,700 to 20,000 nuts per ton of copra; both these extreme forms belong to the variety **typica.**

Coconut palms grown in all the countries for copra production on a commercial scale belong to the variety **typica,** but between countries, there are differences in palms particularly with regard to shape and size of nut; the Thailand form is larger than the Ceylon form and the latter is larger than the Laguna form of the Philippine Islands.

The *typica* plantation form grown in Ceylon varies considerably with respect to colour of epicarp of nut from various shades of green to reddish brown—these differences are to be expected due to natural cross-fertilisation. There is a popular but erroneous belief that palms with reddish brown nuts are more productive than those with green nuts. On an examination of 50 palms taken at random from the two colour types, it was found that there were no significant differences in the yield of nuts between the two types. On the contrary, the reddish brown nuts had a distinctly thinner endosperm requiring about 700 nuts more than the green nuts for a ton of copra. This form is likely to be a hybrid having germ plasm from the form *King Coconut,* for in controlled crosses between forms with green nuts and orange nuts, the F_1 palms bear reddish brown nuts. An important characteristic of the Ceylon *typica* palms is that they are very hardy and resistant to pests and diseases to a fair degree.

The *kamandala* form is characterised by having large nuts, a husked-nut weighing over 3.5 lb. giving nearly 1 lb. of copra; 2,700 nuts per ton of copra is very remarkable. Each palm is said to yield 30-40 nuts a year. The distribution of this form is restricted to a portion of the Southern Province of Ceylon. Direct introduction of this form to other parts of the country may be profitable, provided the palms do not react adversely to a changed environment.

Bodiri is quite a remarkable form; nut size is no more than an orange, oil content is high (69.6 per cent). *Mapraw-puong* is a form of coconut growing in Thailand very similar to *bodiri,* but in the former more than 90 per cent of the nuts in a bunch are barren. Perhaps, *mapraw-puong* and *bodiri* are geographically isolated races and they may produce progenies exhibiting considerable heterosis when crossed with other forms.

At one time it was considered that the **nana** palms would be useful for production of toddy. From a tapping trial carried out on 24 of these palms, it has been pointed out that they are of not much value for that purpose as toddy production is low; 49 and 61 litres (approx.) of toddy per acre per day for *pumilla* and *typica* palms respectively (Nathanael, 1951). Two characters of importance for breeding work in the **nana** palms are the short habit and early flowering—3 years. Field observations have indicated that the **nana** palms are adversely affected by drought—drooping of leaves and bunches unusually heavy and nut size considerably reduced—and that they are generally less hardy than the **typica** palms and are highly susceptible to pests and diseases.

King Coconut is probably endemic to Ceylon. It is characterised by the bright orange colour of the nut and the sweetness of the tender nut water which is due to a higher sucrose content. Because of the latter character, the nut water is a popular beverage, and this form is grown specially for this purpose.

Forms that are useful for breeding are: *kamandala* (high nut weight), *bodiri* (prolificity in bearing, high oil content), *gon-thembili* (low out-turn, high oil content), and *pumilla* (early bearing, short habit). The early bearing character of the **nana** forms is partially dominant and the

short habit is recessive. The F_1 palms of *typica* × *pumilla* show considerable heterosis; they combine the physiological vigour of the *typica* and the early flowering habit of *pumilla* to give high yields as early as the sixth-year after planting.

Summary

The indigenous coconut palms in Ceylon have been classified into three varieties: **typica** Nar. tall in habit, late flowering and predominantly out-breeding; **nana** (Griff.) Nar. short in habit, early flowering and in-breeding; **aurantiaca** Liy. semi-tall in habit, late flowering, in-breeding and nuts of orange colour. Altogether 13 forms distributed amongst these three varieties have been described.

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Key for the identification of varieties and forms of coconut found in Ceylon

	Nut size	*Epicarp*	*Mesocarp*	*Endocarp*	*Endosperm*
A. Variety **typica**: tall in habit, late flowering (6-8 years), and predominantly out-breeding.					
1. Form *typica* ..	large	green to red-dish brown	creamy white	thin	thick, hard
2. Form *kamandala* ..	very large	do	do	do	do
3. Form *bodiri* ..	very small	do	do	very thin	do
4. Form *navasi* ..	large	green	do, soft, edible	thin	do
5. Form *ran-thembili* ..	do	do	pink	do	do
6. Form *gon-thembili* ..	do	ivory yellow	creamy white	thin	do
7. Form *pora-pol* ..	do	green	creamy white	very thick	do
8. Form *dikiri-pol* ..	do	do	do	thin	very thick, soft, jelly-like
B. Variety **nana**: short in habit, early flowering, (3-4 years), in-breeding.					
1. Form *pumilla* ..	small	green	creamy white	very thin	thin, hard
2. Form *eburnea* ..	do	ivory yellow	do	do	do
3. Form *regia* ..	do	apricot red	do	do	do
C. Variety **aurantiaca**: semi-tall in habit, late flowering (6-8 years), in-breeding, nuts orange in colour.					
1. Form *King Coconut or thembili* ..	large	orange	creamy white	very thin	thin, hard
2. Form *navasi-thembili*	do	do	soft and edible	do	do

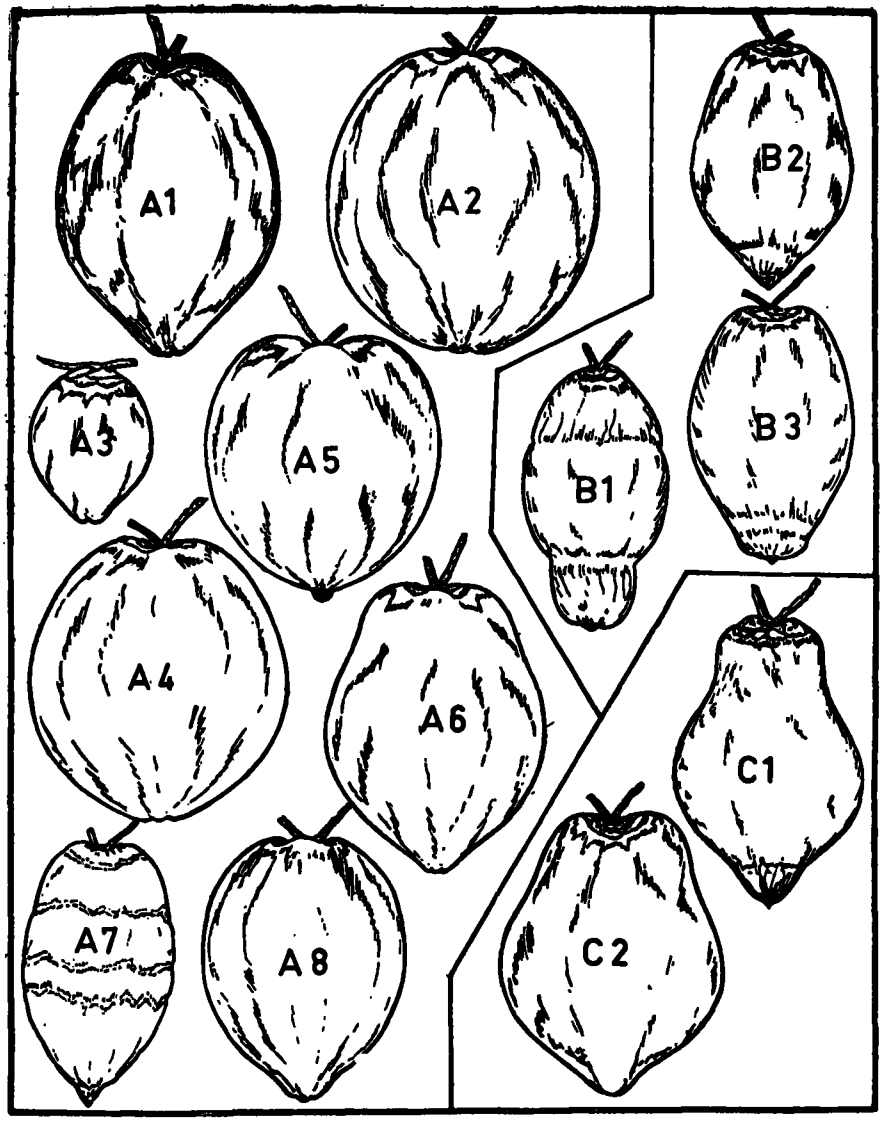

Fig. 1. Shape and size (approximate) of forms of coconut found in Ceylon. Forms of variety **typica:** A1—*typica*, A2—*kamandala*, A3—*bodiri*, A4—*navasi*, A5—*ran-thembili*, A6—*gon-thembili*, A7—*pora-pol*, A8—*dikiri-pol*. Forms of variety **nana:** B1—*pumilla*, B2—*eburnea*, B3—*regia*. Forms of variety **aurantiaca:** C1—*thembili* (*King Coconut*), C2—*navasi thembili*.

Each illustration 1/6 natural size.

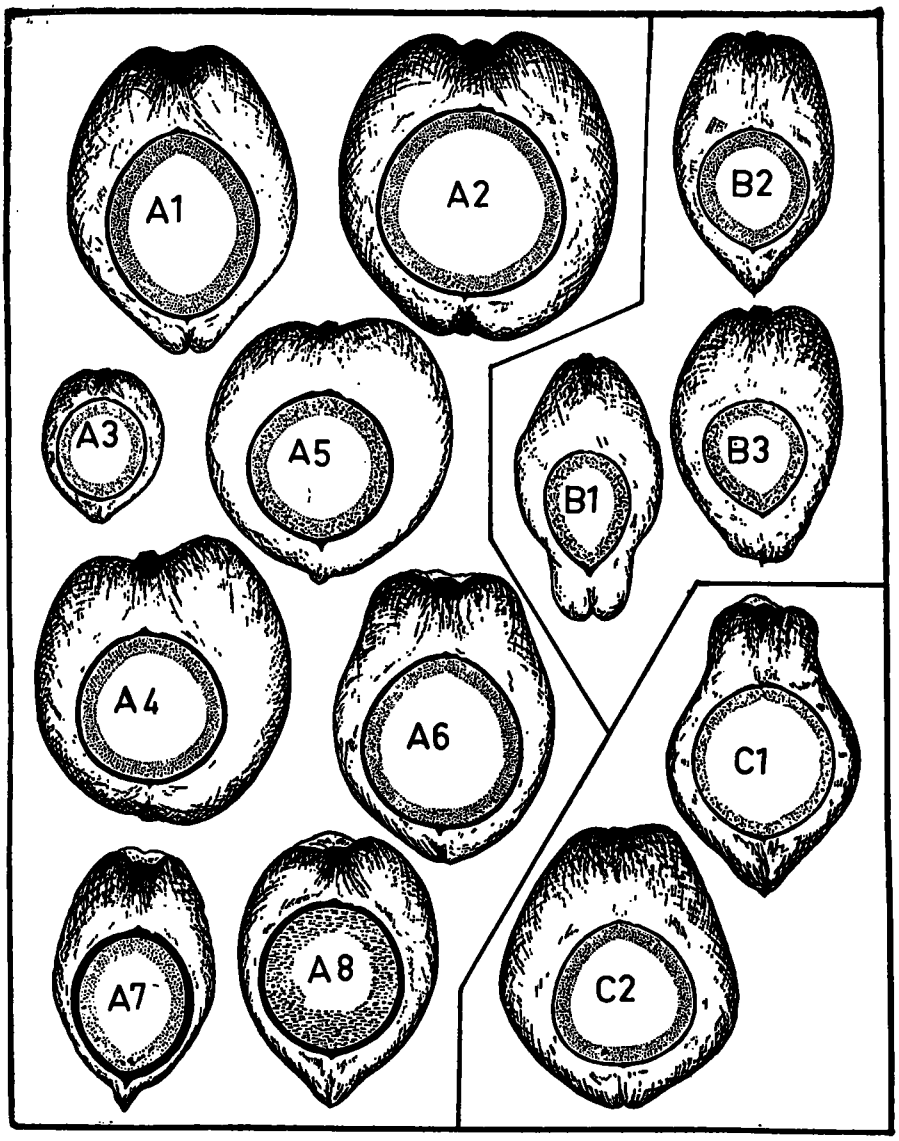

Fig. 2. Longitudinal section of nut of forms of coconut illustrated in Fig. 1. Legend same as for Fig. 1. Each illustration 1/6 natural size.

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