An Examination of the Type-Forms of Fruit Present in the Progeny of a Single Forastero Cacao.

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A block of cacao, bearing plot numbers 63 to 67 on the Experiment Station, Peradeniya, has the distinction of being planted out "from seed exclusively derived from a single tree of a good Forastero strain." (1).

This was planted out in December, 1908, by the late DR. R. H. LOCK. The intention was to establish an "even" plot of cacao for the purpose of testing "the influence of differential artificial manures upon the growth and yield of cacao." (1).

The area originally consisted of ten half-acre plots. At present, a little more than half, or nearly three acres, are under cacao. The rest of the block is in a gully where the soil is poor. Here cacao can be established only with difficulty. In the block of cacao studied, vacancies were periodically supplied from seed of the same parent tree; the trees are regularly pruned, the shade is now regulated and the ground weeded and mulched. At present the plantation is under a scheme of manurial experiments.

It was found when the trees commenced to bear fruit that there was considerable variation in the form, colour, texture, etc. of the pods. This is not so remarkable if the seed parent is a hybrid. What really forms the remarkable feature of this progeny is the surprising and unexpected forms of fruit met with. It is no exaggeration to state that from this plantation alone fruits can be selected showing characters comparable with that of any well-known "variety" found in the cacao-growing countries in the world.

This great tendency to variation and to what would appear to be reversion to ancestral forms, suggests that we are dealing here with the progeny of a derivative hybrid cacao.

It was decided that the various forms of fruit present in the plantation should be examined with a view finally to describe, define and classify the type-forms and to compare them with other well-known "varieties" of cacao.

Method of Procedure.

It was necessary at the commencement of the examination to gain an acquaintance with the types of fruit present. Certain pairs of contrasted characters suggested the framing of suitable

keys for the identification of the various type-forms. In this the writer was largely influenced on the one hand by the contributions made to our knowledge of cacao varieties by LOCK (2) and VAN HALL (3), and on the other hand by the fact that he appeared to be dealing all the time with the progeny of a hybrid cacao.

The pairs of constrasted characters that appeared to deserve consideration in classifying and defining these type-forms of cacao were:—

(a) **The difference in the form of the fruit.**—e.g., whether the fruit was broader or narrower than half the length and treating the "bottle-necked" character as an intermediate between these two forms.

(b) **The surface of the fruit-wall.**—i.e., whether warty or smooth.

(c) **The colour of the cotyledons.**—i.e., whether white or coloured.

The ideal long, warty fruit with white seeds (Criollo) contrasted with the ideal round, smooth fruit with purple seeds (Calabacillo) and the hypothetical cross of these two phenotypes as resulting in a "bottle-necked" fruit with mixed purple and white seeds (Forastero-Cundeamor) furnished the writer with his working hypothesis.

Keys for the Identification of the type-forms.

The most convenient plan in identifying the various types of cacao found on this plantation was first to make three large group-forms or classes.

In the examination each tree was designated by a letter with a number below. There are three letters, L, C, and A. These stand for the names *Liso* (or Angoleta), *Cundeamor* and *Ameloado*.

The figure below a letter signifies the number of the type-form included in the group. Thus there are four type-forms of Angoleta or Liso (distinguished as L_1, L_2, L_3, L_4); similarly five of Cundeamor (C_1, C_2, C_3, C_4, C_5) and four of Amelonado (A_1, A_2, A_3, A_4) are described.

The position of each tree was determined by a notation which recognised 21 rows and at the most 46 trees in a row. Thus 7/21 denotes the 21st tree in the 7th row. A blank denotes a vacancy and 8 a tree not in bearing. A plan of the field was accordingly drawn up.

The Angoletas, Cundeamors and Amelonados are distinguished by the following key:—

Fruits with largest diameter less than half the length.

Fruit-base not constricted.

1. LISO OR ANGOLETA.

Fruit-base constricted.

2. CUNDEAMOR.

Fruits with largest diameter more than half the length or half the length.

3. AMELONADO.

The sub-divisions into the type-forms were made according to the following keys:—

1. ANGOLETAS.

Fruits warty. Broadly and symmetrically attached at base. Apex obtuse to acute.

L_1 = THE CRIOLLO ANGOLETA.

Tapering towards the base; attachment oblique ("high shouldered"). Apex acute to acuminate. Seeds generally large.

L_2 = THE NICARAGUA CRIOLLO ANGOLETA.

Fruits smooth. All seeds purple.

L_3 = THE ASSINAN ANGOLETA.

Some seeds white or pale-coloured. *

L_4 = THE PORCELAINE ANGOLETA.

2. CUNDEAMORS.

Fruits warty. Fruits red or reddish. Longer than 7 inches.

C_1 = THE PARENT CUNDEAMOR.

Seven inches or less in length.

C_2 = THE SMALL CUNDEAMOR.

Fruits green (vivid yellow when ripe).

C_3 = THE GREEN CUNDEAMOR.

Fruits smooth. All seeds purple.

C_5 = THE SMOOTH CUNDEAMOR.

Fruits moderately warty or nearly smooth. Fruit-wall soft, thin (never thicker than $\frac{1}{2}$ inch). Some seeds white or pale-coloured.

C_4 = THE TRINIDAD CRIOLLO CUNDEAMOR.

3. AMELONADOS.

All seeds purple. Fruits never longer than 6 inches.

A_1 = THE CALABACILLO AMELONADO.

Fruits longer than 6 inches. Smooth; furrows indistinct.

A_2 = THE TRINIDAD AMELONADO.

Rather rough or even warty; furrows well defined.

A_4 = THE CACAO NACIONAL AMELONADO.

Majority of the seeds white or pale-coloured. Surface smooth and polished.

* "Pale-coloured" refers to seeds "intermediate" or "very faint purple" as described by Lock (2).

A_3 = THE PORCELAINE AMELONADO.

Surface somewhat rough or warty.

A_4 = THE CACAO NACIONAL AMELONADO.

With the aid of these keys it was possible in the final analysis to place the plants into groups, each group containing plants with fruits which were similar in appearance.

The keys, it must be borne in mind, were manifestly artificial and had nothing else to commend them but their practical usefulness. They also helped in forming a basis for discussing later all the well-known cultivated forms of cacao. The plants of a group, therefore, did not possess fruits similar in appearance so much as that they bore pods which happened to fit into a particular place in the keys.

In the analysis of the Forastero cacaos the outstanding fact was the individuality of each tree. The question as to what constituted a type-form and what only an individual form of that type became more complex according as an endeavour was made to define the limits of a type. This was because the limits of one type did not impinge on the other but overlapped bringing out certain individuals as intermediate forms of doubtful classification. The classification of these must rest upon judgment and experience. Such judgment was greatly influenced by the amount of material examined and for this reason alone it is stated that the final analysis herein presented is the outcome of six revisions made at intervals of sometimes six months apart, each revision being an independent check on the one previous to it.

The Seed Parent.

Before proceeding to describe in detail the type-forms found on the plantation it will be well to describe the form of fruit exhibited by the parent of the progeny examined.

The tree from which seeds were selected for planting was a form of Forastero Cundeamor. It was known to yield heavily and there was noted a yield of 172 ripe pods in one season (4). On examination the tree was found to have been trained on what is now known as the Ecuadorian system of encouraging the water shoots at the base of the stem to grow. In this way four stems of nearly equal girth had arisen and developed four foliage systems. These were now old and sparsely branched. The tree was identical with "No. 4219, Experiment Station, Forastero type A" of Dr. Lock, who thus describes it in his bulletin on varieties of cacao (2). "One of the best of the Forostero varieties growing upon the Experiment Station attracted my attention owing to the presence of white as well as purple seeds in the majority of pods. This variety is remarkably prolific, 553 pods being obtained from six trees in only part of a season." (p. 396).

It will be observed from Dr. Lock's Table III. (cf. p. 397) that No. 4219 gave the largest yield out of the six trees, i.e., 172 pods, and that it is the form of fruit selected for illustration (cf. No. 9 in the plate showing specimens of pods). Dr. Lock has attempted to trace the origin of this type from a group of Forastero varieties sent in 1880 by Mr. Prestoe of Trinidad when Dr. Trimen was Director of Botanic Gardens in Ceylon.

What follows now is an attempt only to describe and define the type-forms examined.

L_1. THE CRIOLLO ANGOLETA.

1. Description. Medium sized fruits (typically 7·5 inches by 3·25 inches), always broad at the stalk-end, not constricted. Except in the oblong sub-type, broadest towards the middle, then tapering towards the apex in a blunt point; often moderately mamillate or ending (rarely) in a slightly curved point. Surface red, orange-red or brownish-red (chocolate red), very warty and somewhat polished. Ten prominent ridges separated by furrows of which five are deeper and narrower than the other five alternating with them. Fruit wall moderately thick but soft and easy to cut. Seeds 32 to 48, generally plump and rounded in section. A varying percentage show white or pale-coloured cotyledons.

2. Distinguishing characters. (1) The medium size (fruits longer than 8 inches may safely be suspected to be Cundeamors). (2) Fruit-base broad, ending abruptly, not bottle-necked, not high-shouldered. (3) Surface very warty and somewhat polished; orange-red in colour. (4) Pale-coloured seeds. (All seeds rarely found to be purple; these may be suspected to be Cundeamor).

3. Measurements.

	Typical	Limits
Length	7·5 inches	6·8—8·8 inches
Breadth	3·25 ,,	2·6—4·0 ,,
No. of seeds	37—40	29—48

Percentage light-coloured 30% to 50%. All purple or all white.
Size of seeds 23mm by 12mm by 10mm.

The fruits referred to in this type-form may be regarded as the closest approach there is in Ceylon to the Criollo type. When the seeds are white, the form must be regarded as a Criollo cacao and a varying percentage of coloured seeds will include in it the group of Angoletas. Of the 609 trees in bearing examined in the plot there were 32 trees within the limits of this type-form.

L_2. THE NICARAGUA CRIOLLO ANGOLETA.

1. Description. Fruits variable in size (typical 7·0 inches x 2·5 inches), generally slender and elongated; rounded somewhat

Plate 1

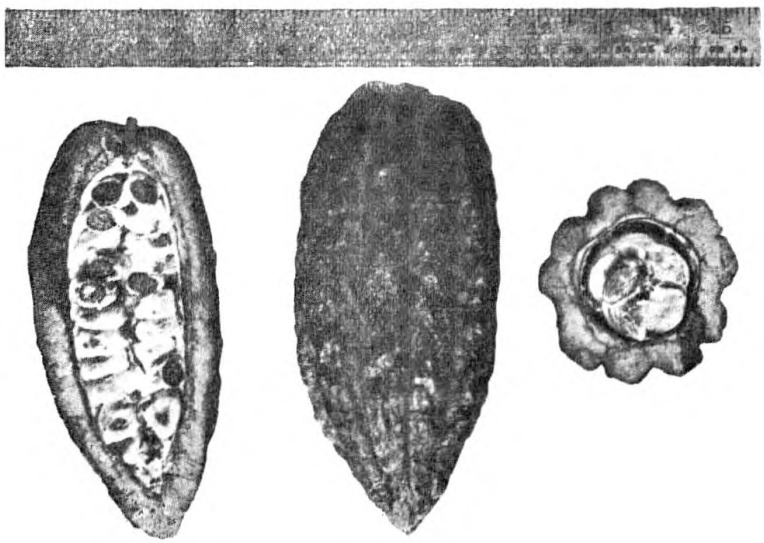

Fig. 1

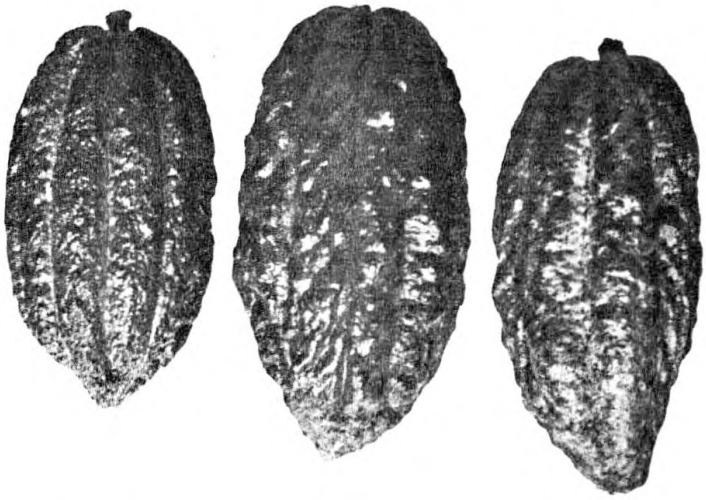

Fig. 2 Fig. 3 Fig. 4

Fig. 5 Fig. 6 Fig. 7

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The Criollo Angoleta.

Legend:—Fig. 1. Type-form resembling Zehntner's Criollo type of the Djati-Roenggo hybrid.
Fig. 2. Type-form of the Old Red of Ceylon.
Fig. 3. Type-form of the Java Criollo.
Fig. 4. Type-form showing divergence towards Forastero.
Fig. 6. Type-form showing divergence towards Forastero.
Figs. 5 & 7. Type-form resembling Hart's Trinidad Forastero Veraguso.

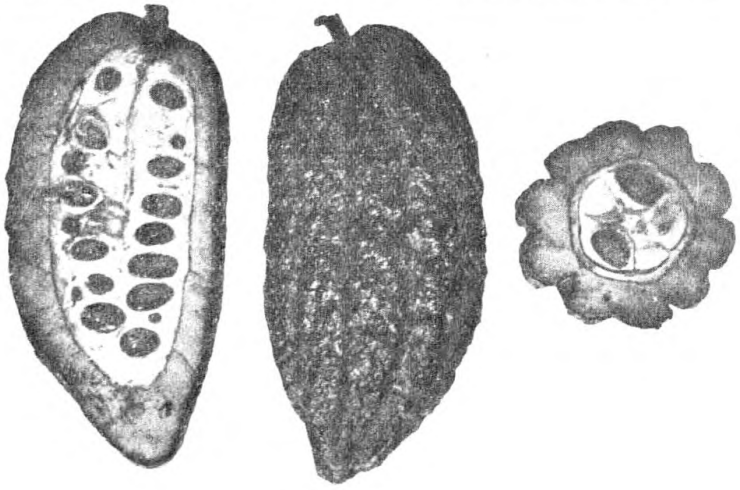

Fig. 8

Fig. 9 Fig. 10 Fig. 11

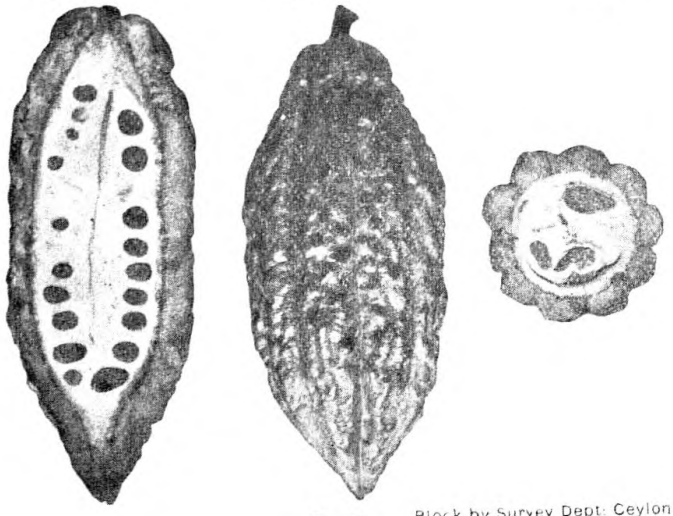

Fig. 12

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The Nicaragua Criollo Angoleta.

Legend:—Fig. 8. Type-form resembling Zehntner's Nicaragua Criollo.
Fig. 9. A sub-type which should be compared with Plate I, Fig 2.
Fig. 10. Type-form to be compared with Lock's figure 1 of Nicaragua Criollo.
Fig. 11. A sub-type with Cundeamor affinities, might be compared with Wright's figure 3 of Nicaragua Criollo.
Fig. 12. A sub-type showing diveregence towards Forastero.

towards the fruit-stalk which is often fixed to the end obliquely causing the development of a high shoulder. The apex tapers into a long acuminate point generally slanting. Surface typically dull brownish-red; warty, especially towards the apex, with ten prominent ridges. Fruit wall moderately thick and hard.

Seeds generally 37 to 40. Seeds are moderately large and may measure 3·2 cms by 1·4 cms by 1 cm (generally about 2·6 cms by 1·3 cms by 1 cm). A varying percentage always white or pale-coloured in cross section.

2. Distinguishing characters. (1) Rounded base somewhat tapering (if not obliquely high-shouldered). (2) Long tapering, somewhat acuminate apex (often turned to one side). (3) White, moderately large seeds in fair proportion. The absence of "bottle neck" is characteristic.

3. Measurements.

	Typical	Limits
Length	7·0 inches	6·5—10 inches
Breadth	2·5 inches	2·5—3·6 inches
No. of seeds	37—40	33—48

Light-coloured seeds 30%—50%. All purple or all white
Size of seeds 19mm. by 11mm. by 10mm.

Nicaragua Criollo is regarded as a type with a slanting curved apical point, a high shoulder and large white seeds. The seeds should be at least 3·5 cms. to 4·5 cms. long. Nicaragua Criollo Angoleta is a form with characteristics as above except that the seeds are smaller and show a varying percentage of coloured cotyledons. Of the 609 trees in bearing in the plot there were 25 trees within the limits of the type form.

L_3. THE SMOOTH ANGOLETA.

1. Description. Fruits generally medium size (typical 7·75 inches by 3·25 inches). In shape elliptical to ovate or oblong. Apex slightly acuminate, generally obtuse or acute blunted. Surface pearly smooth, light ashy pink with ashy-green patches. Turns yellow to brownish-yellow with orange-red when ripening. Furrows five, broad and shallow. Fruit wall (0·3 inches in furrows and 0·45 inches in ridges) thick, with a moderately hard woody core. Seeds 38 to 46, generally small, plump and all purple.

There are trees listed as belonging to this type-form. The seeds are not of desirable quality but the trees are generally good yielders.

2. Distinguishing characters. This form is distinguished from L_4 by having all its seeds purple and from an Amelonado by the measurements, the breadth never exceeding half the length.

3. Measurements.

	Typical	Limits
Length	7·75 inches	6·0—9·0 inches
Breadth	3·25 inches	3·0—3·8 inches
No. of seeds	38—46	28— 50

Of the 609 trees in bearing in the plot there were **101** within the limits of this type form.

L_4. THE PORCELAINE ANGOLETA.

1. Description. Fruits generally small to medium-sized (typical 6·5 inches x 3·0 inches) in shape similar to L_3, as also in character of surface. Colour typically carmine ripening to deep orange-red rather than yellow. Seeds 30—38, all being nearly white or only a small percentage purple. Seeds 23mm. by 13mm. by 19mm.

2. Distinguishing characters. The large percentage of white seeds, connected by intermediates with A_3 (q. v.).

3. Measurements.

	Typical	Limits
Length.	6·5 inches	6·25—9·0 inches
Breadth	3·0 inches	6·9—3·9 inches
No. of seeds	30—38	26—48
Percentage of light-coloured seeds	100%	3%—100%

The forms of Plate III. represent an intermediate class which has previously been referred to under Nicaraguan Criollo but the purple seeds link it up with the Amelonado class of cacao. Of 609 trees in bearing in the plot there were 36 trees within the limits of this type-form.

C_1. THE PARENT CUNDEAMOR.

1. Description. Fruits medium to large, generally elongated oblong-oval tapering abruptly to a blunt point. Surface not very warty; ten furrows distinct; alternate ones deeper and narrower. Colour generally greyish green with dull red shade, ripening to yellow with a reddish vivid hue or only a coppery-yellow suffusion. Fruit-wall moderately thick; soft or with a hard rind. Seeds 28 to 48; oval in cross-section and generally dark to light purple in colour. A few seeds often white or nearly so.

2. Distinguishing characters. (1) The bottle-neck. (2) Elongated form. (3) Dull hue.

3. Measurements.

		Typical	Limits
Length	(a)	8·5— 9·0 inches	
	(b)	7·75—8·0 inches	7·25—10·00 inches
Breadth		3·2 —3·6 inches	2·2——4·0 inches
No. of seeds		38 — 42	28——48

Fig. 13 Fig. 14 Fig. 15

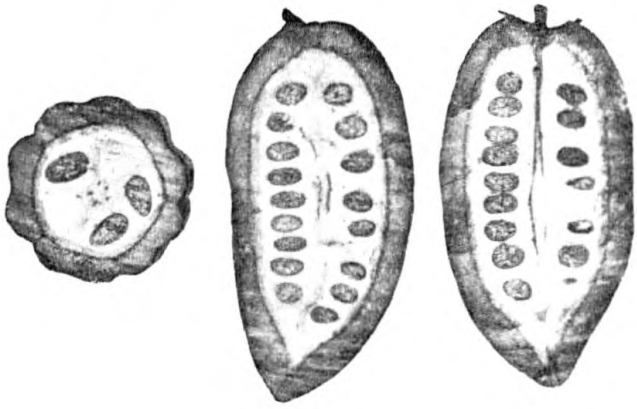

Fig. 16

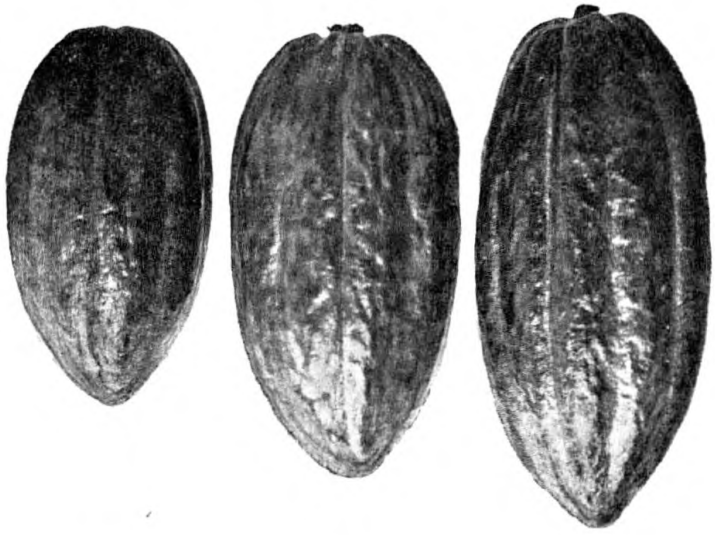

Fig. 17 Fig. 18 Fig. 19

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The Smooth Angoleta.

Figs. 13, 14, 15, 16, 17, 18, and 19. Forms separated from the Amelonado group on measurements.

Thickness of pericarp 2/3 inch in furrows and nearly 1 inch on ridges.

Of 609 trees in bearing in the plot there were 144 trees within the limits of this type-form.

C_2. THE SMALL CUNDEAMOR.

1. Description. Fruits small (7 inches or less) well-furrowed, warty, with furrows equally marked, bottle-necked, elliptical-oval. Obtuse apex, light red with greenish-white, ripening brilliant orange-red. Fruit-wall thin (0·2 inch in furrows and 0·5 inch in ridges) and easy to cut. Seeds generally 33 to 37 with a varying percentage pale-coloured. Size 21mm. by 13mm. by 9mm.

2. Distinguishing characters. (1) Small size (never more than 7 inches). (2) Vivid hues on ripening.

3. Measurements.

	Typical	Limits
Length	6·5—7·0 inches	5·5—7·0 inches
Breadth	3·25 inches	2·5—3·50 inches
No. of seeds	33—37	18—42
Size of seeds	21mm. by 13mm. by 9mm.	

Of 609 trees in bearing in the plot there were 15 within the limits of this type-form.

C_3. THE GREEN CUNDEAMOR.

1. Description. Fruits generally long, very warty; the tubercles on ridges swell out making the furrows extremely narrow and deep. Typically ashy-green, turning a lemon-yellow when ripe. Apex generally obtuse and tubercled. Fruit-wall thick with a woody inner shell. Seeds 36 to 48 all purple and small.

2. Distinguishing characters. The green warty surface suggesting a Kaffir-lemon. In some forms where the constriction is faint very much like a green Nicaragua Criollo form.

3. Measurements.

	Typical	Limits
Length	8·5—8·75 inches	7·25—10·00 inches
Breadth	3·25	2·9—3·75 inches
No. of seeds	39—42	36—48
Size of seeds	23mm. by 13mm. by 10mm.	

Of 609 trees in bearing in the plot there were 34 within the limits of this type form.

C_4. THE TRINIDAD CRIOLLO CUNDEAMOR.

1. Description. Medium-sized fruits, slender and pointed towards the apex, bottle-necked strongly. Surface smooth to irregular, ashy pink ripening a bronze-yellow to orange-yellow.

Furrows distinct in most cases and deep. Fruit wall thin and very soft to cut. Seeds 37 to 48, a fairly large percentage white or pale-coloured.

2. Distinguishing characters. (1) Slender shape, (2) Surface not quite smooth, (3) Colour bronze-yellow, (4) Thin fruit wall, (5) Pale-coloured seeds.

3. Measurements.

	Typical	Limits
Length	7·0—7·5 inches	6·5—9·0 inches
Breadth	5·0 inches	2·2—3·4 inches
No. of seeds	37—42	37—48
Percentage of pale-coloured seeds.		25% to 33%

Of the 609 trees in bearing in the plot there were 12 within the limits of this type-form.

C_5. THE SMOOTH CUNDEAMOR.

1. Description. Forms comparable with L_3, except that they are bottle-necked. Some are large-sized, others slender, generally smooth, polished surface with shallow furrows. Shape generally elliptical, tapering often to a straight point. Colour ashy-green with a red suffusion ripening into a yellow with a light red shade. Others with an apex that is mamillate ripen a chrome yellow, the colour of a mango. Seeds 40 to 43, all purple.

2. Distinguishing characters. Smooth polished surface with a bottle-neck and purple seeds.

3. Measurements.

	Typical	Limits
Length	6·0—7·5 inches	4·75—9·5 inches
Breadth	3·0—3·25 inches	2·75—3·5 inches
No. of seeds	40—43	30—49

Thickness of pericarp 0·5 inch and 0·6 inch.

Of the 609 trees in bearing in the plot there were 152 within the limits of this type form.

A_1. THE CALABACILLO AMELONADO.

1. Description. Small fruits never longer than 6 inches, ovate in form, blunt at the apex, furrows indistinct to smooth. Colour pale-whitish green, turning yellow or red. Fruit-wall somewhat woody. Seeds generally 41 to 43, small, dark-purple.

2. Distinguishing characters. Small fruit with a woody pericarp and purple seeds.

3. Measurements.

	Typical	Limits
Length	5·25 inches	5·0—6·0 inches
Breadth	2·75 inches	2·75—3·0 inches
No. of seeds	41 to 43	21 to 46

Of the 609 trees in bearing in the plot there were 20 within the limits of this type-form.

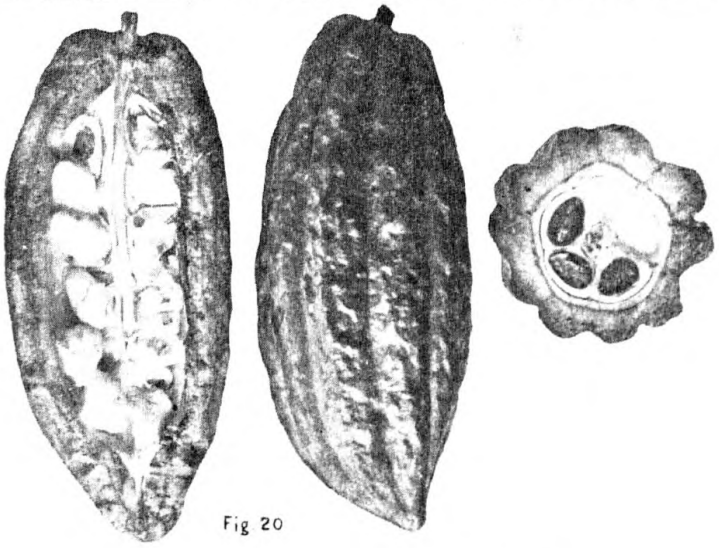

Fig 20

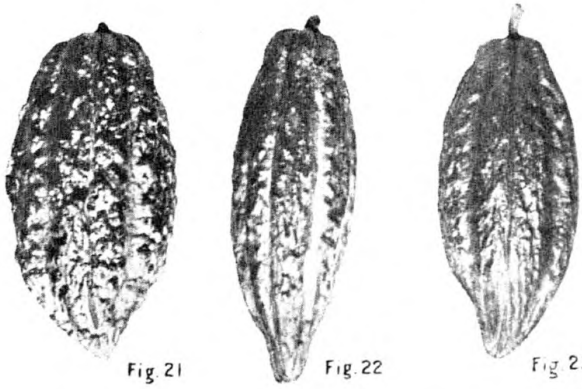

Fig 21 Fig 22 Fig 23

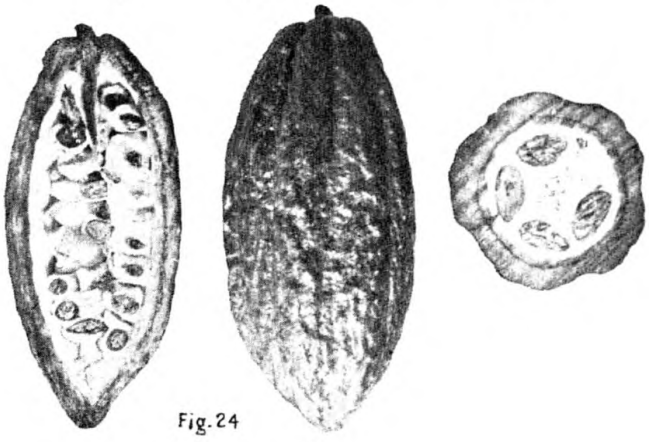

Fig. 24

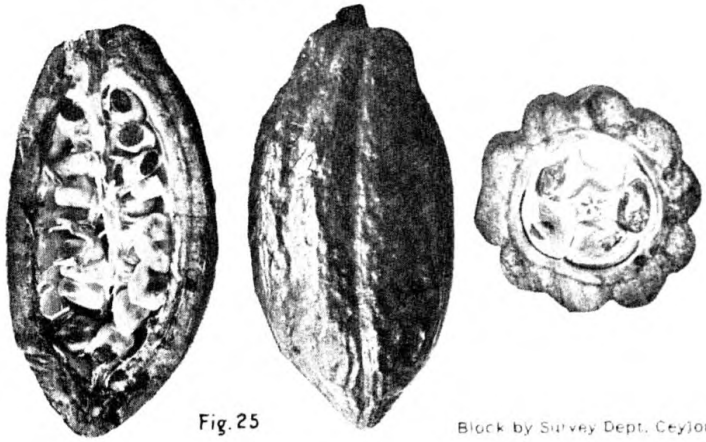

Fig. 25

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The Cundeamor Type Forms.

Legend :—Fig. 20. The Parent Cundeamor.
Figs. 21, 22 and 23. Examples of the Small Cundeamor comparable with Zehntner's type of Brussels cacao.
Fig. 24. The Trinidad Criollo Cundeamor.
Fig. 25. The Smooth Cundeamor.

A_2. THE TRINIDAD AMELONADO.

1. Description. Large fruits (larger than 6 inches) similar in shape to A_4 or elliptical and faintly bottle-necked. Surface smooth and indistinctly furrowed in some cases only. Seeds 41 to 43, small, dark-purple.

2. Distinguishing characters. Fine, large, somewhat polished, smooth, green fruits, yellow when ripe.

3. Measurements.

	Typical	Limits
Length	6·25 inches	6·0—7·8 inches
Breadth	3·75 inches	3·2—4·5 inches
No. of seeds	41—43	34—49

Pericarp 0·5 inch and 0·6 inch (latter on ridge).

Of the 609 trees in bearing in the plot there were 18 within the limits of this type-form.

A_3. THE PORCELAINE AMELONADO.

1. Description. Small fruits (generally not larger than 6 inches) with furrows indistinct to smooth. Ovate with apex obtuse or acute. Colour and surface otherwise as in L_4. Fruit-wall thin and soft. Seeds 25 to 35, a varying percentage white or pale-coloured in cross-section.

2. Distinguishing characters. Small ovate fruits with dark reddish polished surface, thin fruit-wall and white seeds.

3. Measurements.

	Typical	Limits
Length	4·5 inches	4·0—7·05 inches
Breadth	2·75 inches	2·4—3·7 inches
No. of seeds	25—35	25—46

Percentage of pale-coloured seeds 40%

Of the 609 trees in bearing in the plot there were 14 within the limits of this type-form.

A_4. THE CACAO NACIONAL AMELONADO.

1. Description. Large fruits like A_2, except that furrows are well-marked, constricted in some cases. Seeds 33 to 42, all deep purple.

2. Distinguishing characters. The large green fruits well-furrowed, bottle-necked in some cases.

3. Measurements.

	Typical	Limits
Length	6·75 inches	6·0—7·7 inches
Breadth	3·5 inches	3·0—4·2 inches
No. of seeds	33 to 42	33 to 42

Of the 609 trees in bearing in the plot there were 6 within the limits of this type-form.

The results of the examination are shown in the following table:

Tabulated Statement of Trees Examined.

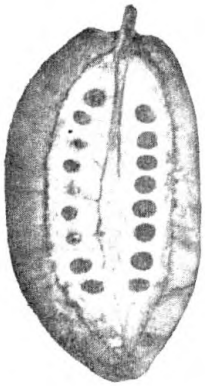
No. of the row.	Angoletas				Cundeamors					Amelonados				Total in bearing	Trees not in bearing
	L_1	L_2	L_3	L_4	C_1	C_2	C_3	C_4	C_5	A_1	A_2	A_3	A_4		
1	...	...	3	...	1	...	...	...	2	...	...	...	...	6	1
2	8	4	10	2	6	...	3	2	3	...	...	...	...	38	5
3	...	...	5	4	9	...	2	...	10	1	...	1	...	32	10
4	2	...	3	4	7	2	3	...	15	1	1	...	...	38	5
5	3	...	3	...	9	...	1	1	10	2	...	2	...	31	10
6	1	...	8	2	7	3	2	1	7	1	...	...	2	34	8
7	3	1	5	2	9	...	3	1	7	3	1	3	...	38	5
8	...	4	5	2	6	1	4	...	9	...	2	..	1	34	9
9	...	1	2	3	4	1	3	2	6	2	2	2	1	29	12
10	...	1	6	3	7	1	2	...	14	2	.	1	...	37	7
11	1	2	5	2	7	...	2	1	9	..	2	...	...	31	9
12	1	...	6	1	11	1	1	2	7	...	1	2	...	33	9
13	1	3	4	2	10	1	2	1	5	3	3	1	...	36	6
14	3	2	7	4	9	...	1	...	8	1	...	2	...	37	6
15	2	1	6	...	11	...	...	...	7	1	1	...	1	30	10
16	2	1	7	2	5	..	1	1	10	1	1	...	1	32	8
17	1	...	3	1	10	3	1	...	8	...	1	...	...	28	10
18	1	1	4	1	7	2	2	...	11	...	2	...	...	31	5
19	1	2	5	1	6	...	...	...	3	2	1	..	...	21	6
20	2	1	4	...	3	...	...	...	...	...	.	...	...	10	4
21	...	1	...	...	...	...	1	...	1	...	...	...	...	3	2
Total	32	25	101	36	144	15	34	12	152	20	18	14	6	609	147

Of the 609 trees from a single parent in bearing at the time of examination the classification was as follows:—

Fig. 26

Fig. 27

Fig. 28



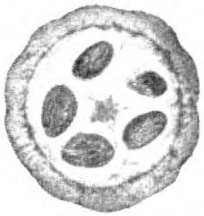


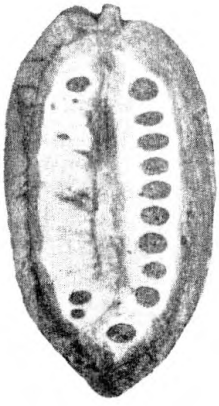
Fig. 29

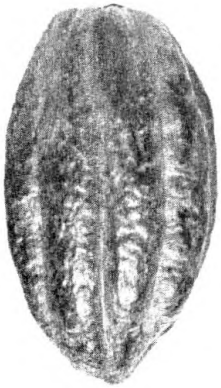
Fig. 30

Fig. 31

Fig. 32

Fig. 33





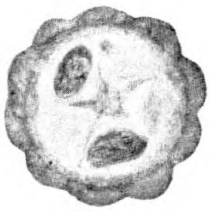


Fig. 34

Block by Survey Dept. Ceylon

Legend:—Figs. 26, 27 and 28. The Calabacillo Amelonado type-form.
Fig. 29—The Trinidad Amelonado type-form.
Figs. 30, 31, 32 and 33. The Porcelain Amelonado type-form.
Fig. 34—A form which resembles some form of Cacao Nacional.

Angoletas	Criollo	32	
	Nicaragua Criollo	25	
	Smooth Angoleta	101	
	Porcelaine Angoleta	36	194
Cundeamors	Parent type	144	
	Small	15	
	Green	34	
	Trinidad Criollo	12	
	Smooth	152	357
Amelonados	Calabacillo	20	
	Trinidad	18	
	Porcelaine	14	
	Cacao Nacional	6	58
	Total		609

The Forms on Plots 63-67.

From a careful census made of the trees on this block of young cacao it was found that there were 756 trees (exclusive of vacancies). Of these over 25% (i.e., 147 trees) were young plants and were in bearing at the time of examination. The 609 trees in bearing carried pods of shapes which indicated the hybrid character of the parent. The forms when referred to the three Forastero types existed in the following proportions:—

Cundeamor	357 trees	or 58·6%
Angoleta	194 trees	or 31·9%
Amelonado	58 trees	or 9·5%
Total	609 trees	or 100%

It is possible that in a few years more the characters shown by the pods may have necessitated a slightly different division. It is improbable, however, that the proportions given will ever be greatly different and the proportions are likely to remain permanently somewhere in the ratio of 60 : 33 : 7 for Cundeamor, Angoleta and Amelonado forms. These proportions bring out the fact that the progeny of a hybrid form is being dealt with. The proportions are of value in showing what one may expect after careful selection of seed from a good strain of Forastero. If the 60% of Cundeamors all showed characters similar to the parent form, then it would indeed be a matter for congratulation. Unfortunately, the case is far from being so simple. Under Cundeamor, a large number had of necessity to be grouped into a class which would be considered undesirable when compared with the desirable parent form. Similarly, the Angoletas comprise a group of good and bad forms. There are also good Amelonados and, though they are very few, bad Amelonados.

It is remarkable what a large amount of variation is shown in the forms of pods of each and every tree. Nearly every tree can be described as a "form," the pods of which approximate in characters to one "form" that may be classed as typical of the tree. Another tree may show in its type only a trifling variation from the first tree, e.g., a long tapering point or a moderately warty coat, but this is shown over and over again in the pods of this tree which can in turn be said to differ very minutely from the "type" of another tree. The external character of the fruit cannot be correlated with seed characters. It would seem as if the set of factors operating in changing the size, shape and colour of seed operate sometimes with less, sometimes with greater, force in changing the size, shape, colour and other external features of the fruit-wall. Small smooth-skinned fruits do not give deeply-coloured seeds always nor do large warty fruits always give plump and light-coloured seeds. Yet these characters may, generally speaking, be said to be correlative.

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Note added by F. A. Stockdale, October, 1928.

A count of the seeds with dark purple, light purple and white cotyledons was made on a number of trees selected in the different groups for future breeding work but the investigation

was incomplete when the death of the investigator occurred. Such a count is of importance if further selection work is to be done, as also is the record of yields which has been begun on a number of trees in this plot. The records so far available have been tabulated by Holland, the Manager of the Experiment Station, Peradeniya, as follows:—

Individual tree yields of 133 trees in the "B" Cacao, Experiment Station, Peradeniya, for the years 1925-26 and 1926-27.

April 1925 to March 1926 Persentage of number of trees giving			April 1926 to March 1927 Percentage of number of trees giving			Averages for the two years 1926-1927	
Pods no.	Good pods %	Good and diseased pods %	Pods no.	Good pods %	Good and diseased pods %	Good pods %	Good and diseased pods %
0 to 12	31·57	12·70	0 to 12	33·08	15·78	32·32	14·24
13 to 25	22·55	13·53	13 to 25	16·54	20·30	19·54	16·91
26 to 50	24·81	33·08	26 to 50	27·81	28·57	26·31	30·82
51 to 75	14·28	21·05	51 to 75	13·53	18·04	13·90	19·54
76 to 100	4·51	9·72	76 to 100	6·75	8·27	5·63	8·99
Over 100	2·25	9·72	Over 100	2·25	9·02	2·25	9·37
Total...	99·97	99·80		99·97	99·98	99·95	99·87

It has, however, been pointed out by Holland in the *Tropical Agriculturist* for January, 1928, page 62, that four years' records of individual yields of pods from 133 trees in the "B" cacao revealed the fact that, with one exception, the trees bearing the largest number of pods all bore small pods.

A test was then made to ascertain the relative amounts of dry cacao obtained from equal numbers of large pods and of small pods. Four lots of 150 large pods and 4 lots of 150 small pods were taken. The results were as follows:—

Large Pods.

	Weight of 150 pods lbs.	Weight of dry cacao obtained lbs.
Lot 1	235	16
,, 2	220	$14\frac{1}{2}$
,, 3	188	$13\frac{3}{4}$
,, 4	225	15
Average	217	$14\frac{3}{4}$

Small Pods.

	Weight of 150 pods lbs.	Weight of dry cacao obtained lbs.
Lot 5	136	12
,, 6	124	10½
,, 7	126	11
,, 8	138	11¼
Average	131	11¼

This indicates that although the larger pods had a greater proportion of shell, an equal number still gave 21% more dry cacao than was obtained from a similar number of small pods. The method of recording yields in experiments by numbers of pods cannot therefore be considered satisfactory. Data are being secured on the Experiment Station, Peradeniya, as to the weight of wet cacao per 100 pods for the 133 trees under investigation, but the records have not yet been kept for a sufficiently long period for the results to be published.

F. A. STOCKDALE.

Peradeniya, October, 1928.