

the dried chips to suit the taste and palate of the people, have to be evolved. The best way of drying also has to be worked out. Would raw tubers give the most acceptable type of chips or should the tubers be blanched or cooked partially or fully, before drying, are points that require to be settled. It is suggested that the chips could be easily milled into flour and used as a partial or entire substitute for making *dosais*, *iddalies*, oil-fried cakes and various other preparations. When the use of flour as acceptable types of food is popularised in the ordinary household, the cultivation of sweet potato will increase, and successfully combat the shortage of food supply in the country.

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“Classification of the Bananas”—A Resumé*

By

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Although there seems little reason to doubt that the banana was one of the first foods of man and that it was one of the first plants cultivated, its specific and varietal relations have never been well defined. For want of a proper approach to the problem of classification and nomenclature, the various attempts to study these plants have only resulted in chaos. Based on the extensive collection of the species of *Musa* at the Imperial College of Tropical Agriculture, Trinidad, Cheesman (1947, 1948, 1949) has recently discussed the subject in a series of articles under the caption “Classification of the bananas”. His publications really deal with the genus *Musa* as a whole and not on the edible bananas as such. It is, therefore, necessary to point out that the word ‘banana’ has been used by him in these papers in a very wide sense and it covers both the fertile (wild and seeded) and the parthenocarpic (edible) forms.

* I have freely drawn from Prof. E. E. Cheesman's publications. He has been of guidance to me in some of my work and I wish to take this opportunity to express my indebtedness to him.

Many of the original publications on this genus are not easily accessible to every worker and Cheesman's revision of the genus *Musa* with extensive transcriptions of important material from the older works is, therefore, a mine of useful information. These papers place at one's hands the essence of the classification of a genus, which presents some peculiar difficulties to the student. Although of great economic importance, it remains very imperfectly known and classified. Its geographical distribution is rather wide, including Ceylon, India, Burma, Siam, S. China, Indo-China, the Malay Peninsula the whole of East Indian Archipelago, Queensland and many of the islands of the Pacific Ocean. Within this vast territory the ecological distribution of the fertile species is mainly in forest areas. Many species occur in inaccessible places where opportunities for collection are few. The plants do not lend themselves to the preparation of useful herbarium specimens; even after careful and laborious drying they only present a sadly distorted caricature of the living plant. The inflorescences are large, not generally available in numbers to enable a complete description and the size of the various parts is such that collection of more than a few fragments is not possible. Thus, the living specimen seems to be the only satisfactory material for study.

The determination of species and varieties appears to have depended largely on verbal descriptions and drawings of varying quality and unfortunately a bulky and confusing literature has resulted. The seedlessness of the cultivated bananas has proved a source of error to many and some have regarded the seedless forms as ranking with the fertile species. Advances in genetics have now modified our views about the origins and taxonomic status of crop plants. A modern view of the genetic system of the bananas has been presented by Dodds (1943) and cytogenetical studies have greatly aided the proper grouping of the various species of *Musa*.

The Genus *Musa* L. : The last good revision of this genus was made by Baker (1893) and it has remained the standard treatment for more than five decades. According to him the genus could be divided into three sub-genera, (i) *Physocaulis* (stem bottle-shaped; flowers many to a bract; petal usually tricuspidate; fruit inedible), (ii) *Eumusa* (cylindrical stem; many flowers to a bract; bract green, brown or dull violet; petal ovate-acuminate; fruit usually edible), and (iii) *Rhodochlamys* (stem cylindrical; few flowers to a bract; bract bright coloured, often red; petal linear; fruit usually not edible). Since Baker's last treatment of the subject, a number of new species has been added.

Undue emphasis on the cultivated forms is a weakness in Baker's treatment. Edibility in the bananas primarily depends on the occurrence of parthenocarpy, with which is always coupled a degree of female sterility and comparative seedlessness. There is no evidence that parthenocarpy

has ever occurred in more than a few *Musa* species and although of great economic importance, the numerous parthenocarpic forms are, therefore, of no taxonomic value. The classification of the edible varieties is a separate problem from the general taxonomy of the genus and needs almost a different technique for its solution, viz., a detailed description of the vegetative and fruit characters and carefully chosen sketches and photographs for readily distinguishing the well-known varieties (Venkataramani, 1946). Cytogenetical studies prosecuted during the last two decades and over, have provided an entirely different approach to the classification of the genus, especially with regard to the relationship of the cultivated forms to the wild. Cheesman has now revived Horaninow's neglected genus *Ensete*, to which he has also proposed the transfer of a group of *Musa* species, including the whole of Baker's sub-genus *Physocaulis*. To conform with the findings of cytogenetical studies of the material in the Trinidad collection of *Musa*, a regrouping of the remaining species has been suggested.

The revised grouping of the species: The different groups have been termed 'sections' rather than sub-genera in an attempt to avoid the implication that they are of equal rank. One division in this new classification has a cytological basis and falls between species having 11 pairs of chromosomes and those having 10 pairs. The difference involves fundamental differences in genetical behaviour and chromosome number in *Musa* appears to be not only a safe criterion of relationship but also the best. Each of these 'chromosome-groups' is again divided into sections.

The suggested division into sections:

A. Chromosome number $X=11$. Bracts usually more or less sulcate, often more or less glaucous, rarely or never polished, convolute or more or less imbricate in the bud, usually strongly revolute on fading. Seeds occasionally subglobose, more often dorsiventrally compressed, sometimes lenticular, smooth, tuberculate, or irregularly angulate, with a marked or obsolete umbo opposite to the hilum.

1. Inflorescence pendent or semi-pendent from the first, the fruits reflexing in development towards the base of the rachis. Flowers many to a bract, in two series. Bracts commonly dull-coloured, green, brownish or dull purple. Pseudostems commonly exceeding 3 metres high

Section *EUMUSA*

2. Inflorescence erect, at least at base, so that the fruits do not reflex in development but point towards the apex of the rachis. Flowers few to a bract, usually in single series. Bracts brightly coloured, often red. Pseudostems commonly less than three metres high

Section *RHODOCHLAMYS*

- B. Chromosome number $X=10$. Bracts plane, firm in texture, polished on the outside, rarely or never glaucous, strongly imbricate in the bud, not or only slightly revolute on fading.
3. Seeds sub-globose or more or less dorsiventrally compressed, smooth, striate, tuberculate, or irregularly angulate, with a marked or obsolete umbo opposite to the hilum corresponding to a small perisperm chamber within.....
- Section *AUSTRALIMUSA*
4. Seeds cylindrical, barrel-shaped, or top-shaped, marked externally by a transverse line or groove, above which they are warted, tuberculate or variously patterned, below usually smooth; internally with a well-developed perisperm chamber above the same line, this chamber empty in the ripe seed.
- Section *CALLIMUSA* "

Cheesman's "Classification of the bananas", as already mentioned is really a revision of the entire genus *Musa*. We shall, however, presently deal with the 'section' *Eumusa* to which can be ascribed all our edible, horticultural varieties and even in this section with only those which are or are supposed to be, the parent species of the numerous cultivated forms.

Section *Eumusa*: A revision of Baker's sub-genus *Eumusa* leaves the following fertile species in this section: *Musa acuminata* Colla, *M. banksii* F. M., *M. basjoo* Siebold and *M. balbisiana* Colla (included by Baker in *M. sapientum* L.). To this, of course, is added *M. nagensium* Prain, a species included since 1893. This section may be called the group of "true" bananas. It contains the two commonly occurring wild species, *M. acuminata* and *M. balbisiana*, and with them all the cultivated bananas that are believed to have been derived from them. The occurrence of parthenocarpy in *M. fehi* Bert. ex Vieill. (Section *Australimusa*) has to some extent obscured the position, as all edible bananas were considered in the past as fairly closely related. The 'fehii' are evidently distinct from the "true" bananas common in cultivation throughout the tropics and they are seldom cultivated, though edible.

***Musa balbisiana* Colla:** This is the commonest and most widely distributed of all *Musa* species. Its identity has been badly muddled and it has been chiefly known as a variety of *Musa sapientum* L., "the most confounded and confusing combination in the whole literature of *Musa*." Colla was the first to recognize this as one distinct from any previously described species and his nomenclature, therefore, seems to be the valid one. A brief description of the species is as follows:

Plant suckering freely; pseudostems robust, green or pale green; leaf blades oblong, truncate at apex and rounded or slightly cordate at base; petioles long, their edges almost meeting over the adaxial channel, margins developed in the lower regions and closely appressed to the

pseudostem. Inflorescence is pendulous, 'heart' or male bud ovoid or ellipsoidal, bracts imbricate at the blunt apex; bracts rounded at apex, often with a green or yellow tip, more than one lifted at the same time, thus exposing a number of clusters of male (staminate) flowers simultaneously; bracts usually deciduous and occasionally persistent in a withered condition, especially in the later stages of blooming. Fruit bunch pendent and compact; individual fruits small, about 10 cm. in length and 4 cm. in diameter, angulate at maturity, abruptly narrowed at base into a short pedicel, and gradually at the stigmatic end into a short and broad beak; rind thick, pale-yellow in colour when ripe; pulp whitish and with seeds; seeds black, irregularly rounded, scarcely depressed, and about 5 mm. in size.

Distribution: Ceylon, S. India, Burma, Siam, Malaya, Java, Philippines and New Guinea.

2. *Musa acuminata* Colla: This is one of the important amongst the *Musa* species. It has also a rather wide distribution like *M. balbisiana*, but surpasses the latter species in its variability. Cheesman (1948) discusses this species in great detail, and a brief description of the species, as at present recognized, is as follows:

Plant stooling either sparsely or freely; pseudostems slender with varying development of brown-black markings from almost green to almost entirely black, sometimes reddish-brown in lower parts; leaf sheaths and petioles more or less glaucous or pruinose and extremely variable in the development of wax. Leaf blades oblong, truncate at apex, usually rounded at base, sometimes rounded on one side and acute on the other, varying from green or green tinged with purple to wholly purple on the lower surface, green above, with or without flecks or bars of purplish brown pigments, mid-ribs green, greenish yellow or more or less strongly tinged with red below; petioles long, slender or stout; petiole margins almost erect with an open adaxial channel, or strongly incurved over the channel and almost covering it, usually definitely developed where the petiole passes into the leaf sheath and closely appressed to the pseudostem, slightly bent outward away from the pseudostem occasionally, becoming scarious in this region, often bordered with a red line when young. Inflorescence sub-horizontal or pendent; peduncle and rachis usually more or less thickly pubescent, sometimes glabrous; male bud in advanced blooming ovoid to turbinate, usually acute; bracts convolute, imbricate at the extreme tip only, or rather strongly imbricate, various shades of purple or red, ovate, usually acute at apex, sometimes yellow at the extreme tip, outer surface more or less glaucous, faintly ribbed longitudinally, inner surface light red or yellowish, always paling towards the base; only one bract lifted at a time, bracts revolute on fading, and early deciduous. Fruit bunch

compact if borne vertically, assymetrical if borne sub-horizontally, fruits exhibiting marked geotropic curvature; individual fruit 8-13 cm. long, 1.5-3 cm. in diameter, sub-cylindrical, angles or ridges almost disappearing at ripeness, rather abruptly narrowed at base into a short pedicel and at apex into a prominent beak about 1.5 cm. long; pericarp about 2 mm. thick, bright yellow at full ripeness; pulp whitish or cream to yellow; seeds, when present, dull black, smooth or more commonly minutely tuberculate, irregularly angulate and depressed, about 7 mm. across and 3 mm. high.

Distribution: Fairly wide—Assam, Burma, Indo-China, Siam, Malay Peninsula and Philippine Islands.

3. *Musa paradisiaca* L: Linnaeus's names *Musa paradisiaca* and *M. sapientum* have led to some confusion. However, the identity of the original *M. paradisiaca* is clear enough and has never been seriously disputed. What exactly Linnaeus had in mind when he described his *M. sapientum* is not clear and observations made during recent years tend to show that cultivated bananas grouped under *M. sapientum* appear to be mostly of a hybrid origin. Therefore, the combination *M. sapientum* is not quite valid.

A grouping of banana varieties according to their resemblances in botanical characters to Linnaeus's *M. paradisiaca* appears to correspond to a grouping on resemblances to the fertile diploid species, *M. acuminata* Colla. *Musa paradisiaca* L. may be regarded as the 'type species', although a seedless cultivated form, and *M. acuminata* as its most probable 'wild' form. Both the cultigen and the fertile species are extremely variable. There seems to be some relationship between them yet till more is known about the gene-complex of *M. paradisiaca* it may be desirable to keep the 'type' and 'wild' species under different names.

In S. India the "Nendrans" with persistent bracts and male flowers represent this species. The deciduous or persistent nature of the male flowers on the rachis, which according to Linnaeus is the important character of this species, is not by itself a sufficient character on which to separate the species. The variety "Moongil" is similar to the 'Nendran', except that in the former no sterile flowers are produced and the inflorescence axis ends abruptly as a short, naked stump. This banana, which is akin to the "Horn plantain" known to occur in other banana tracts and previously recorded as *Musa corniculata*, is no more than a variety of *M. paradisiaca* (Venkataramani, 1948).

The Edible Bananas: The edible Musas have generally been classed either as "plantain" or "banana", depending on the edibility and palatability of the fruit—those eaten raw being called "bananas" and those used after cooking "plantains", these distinctions varying in

different regions. They have even gained specific status from some botanists, although they have never been well defined. The distinctions may have a genetic basis, but they may well be varietal rather than specific like similar differences, for example, in the mangoes. Such a distinction cannot, therefore, be valid, and just for the sake of convenience "banana" can be retained as representing all edible *Musas*. The two Linnean names, *M. paradisiaca* and *M. sapientum*, have largely influenced the nomenclature of the edible varieties and they need no further discussion at the moment. Latin binomials have been indiscriminately applied to many edible clones and their misuse has done much to confuse the study of the genus.

The edible forms of *Musa* appear to fall into four groups, one of which comprises the "fehis" of the Pacific Islands, which are evidently distinct from the bananas common in cultivation throughout the tropics. They are seldom cultivated, though edible, and are not regarded as "true" bananas. The cultivated varieties would, therefore, fall into three groups which can be associated with the two fertile *Eumusa* species, viz., *Musa acuminata* and *M. balbisiana*. One group comprises varieties showing predominantly the botanical characters of the former species and probably derived from it, the second group containing those showing the characters of the latter species and the third group consisting of those showing a blend of the characters of both species. Hybridization between these fertile species and synthesis, from this inter-specific cross, of an edible banana closely resembling an established horticultural variety have lent support to the hypothesis that at least some of the cultivated varieties are of hybrid origin (Dodds and Simmonds, 1948).

Cheesman (1948) interprets *M. paradisiaca* L. as a member of the group showing predominantly the botanical characters of *M. acuminata* Colla, and *M. sapientum* L. as a member of the third group with a blend of characters from the two fertile species. It may be of interest to add the following extracts regarding the *acuminata*—*paradisiaca* and *balbisiana* groups as propounded by Cheesman:

<i>Paradisiaca</i> assemblage	<i>Balbisiana</i> assemblage
1. Pseudostems slenderer than average.	Pseudostems robust.
2. Varieties showing chocolate-brown blotches on the leaves, even if only on young leaves of suckers, are almost certainly referable to this group.	This character is not recorded in this.
3. Margins of petiole often red-bordered and usually erect or spreading; at base where the petiole passes into the leaf-sheath they usually become scarious; if they remain alive, they may be slightly bent out away from the pseudostem.	Margins of petiole green or black-bordered and usually incurved, almost closing over the channel; at base they clasp the pseudostem very closely and do not become scarious.

<i>Paradisiaca</i> assemblage	<i>Balbisiana</i> assemblage
4. Peduncle most commonly pubescent.	Peduncle glabrous.
5. Male bud in advanced blooming tends to be top-shaped and acute.	Ovate or lanceolate.
6. Bracts often, though not always, convolute.	Nearly always imbricate.
7. Bract generally lift one at a time.	Two or more at a time.
8. Bract colour: usually reddish purple, though bluish-purple is not uncommon.	Generally bluish-purple.
Inside: bracts nearly always paler at the base.	Uniform dark crimson to the base.
9. Fruits usually longer and slenderer. Mature fruit nearly always curved.	Generally broader in proportion to their length than those of <i>paradisiaca</i> varieties. Geotropic response is confined to pedicel and the body of the mature fruit is straight.
10. Seeds, when present, strongly flattened.	Almost rounded.

It must, however, be borne in mind that these differences "are mainly those small ones that go to make up *facies*, and when each is examined singly it is found unreliable for universal diagnosis".

With this classification in mind, I am inclined to include the "Nendrans" of S. India under the '*acuminata*' or '*paradisiaca*' group. *Musa balbisiana* does occur in these parts (Venkataramani, 1949) and some of our cultivated varieties, such as 'Peyan', 'Ney Mannan', 'Kali' and others, exhibit some of the characters of this fertile species; they may, therefore, either bear a close relationship to this species or be of a hybrid origin. The grouping of all edible bananas under one particular *Musa* species would, therefore, appear undesirable. As already mentioned, the classification of the edible forms is entirely different from the general taxonomy of the genus. Classification and nomenclature of horticultural varieties are, of course, necessary from many points of view but as long as confusion exists regarding varietal names and as long as there is a bewildering synonymy there can be no true classification or description. The object of classification of horticultural varieties should be to bring together all those varieties which have important characteristics in common and this means that a detailed descriptive study of each and every known variety is an absolute necessity. Descriptive studies of our bananas, such as those of Jacob (1934; 1942 a, b) are certainly beneficial and if detailed verbal descriptions are supplemented with carefully chosen drawings and photographs, they would serve to illustrate the limits of the different groups.

The genus *Musa*, which has apparently received the attention of plant-breeders for the past many years, can still furnish a great deal of valuable data throwing light on many important problems of heredity. It is a genus that is difficult to collect and to study, nevertheless one sufficiently interesting and important not only in its economic but also in its more strictly botanical aspects.

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