FRUITS OF OCEANIA

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with collaboration from

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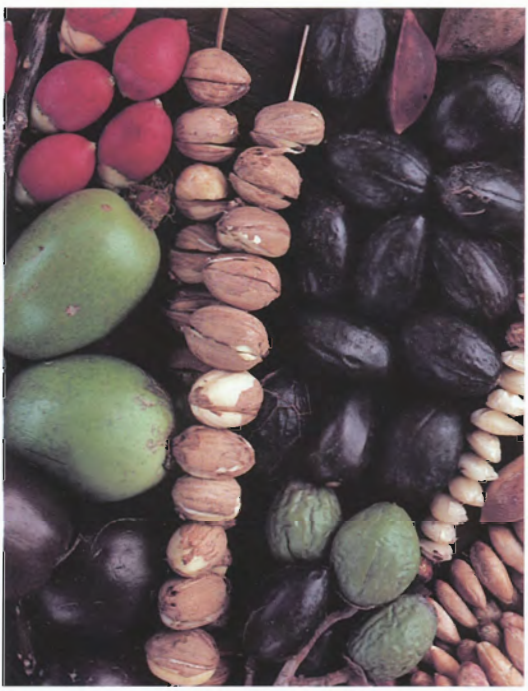

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Acknowledgments

French edition
Production of this book was made possible with the assistance of the Ministry of Foreign Affairs, which funded the research in Vanuatu, Papua New Guinea, Tonga and Samoa and also part of the cost of publication. From Melanesia to Polynesia men and women, heirs to and guardians of a long tradition of knowledge of the natural world, assisted our research and patiently passed on to us their comprehensive knowledge of these fruiting species, so poorly known by the scientific community and so full of potential for the future. It is to these people, working in government departments or belonging to rural communities somewhere in Oceania, that we convey our sincere thanks. It is to these people also that this book is dedicated, in the hope that this scientific presentation of their traditional knowledge has not in any way detracted from its reality.

Numerous colleagues and friends helped with production of this work. By name, for their time, their advice and their assistance, we thank particularly: M. Auffrey, linguist at the Institut des Langues Orientales, who during a two-month mission supervised and managed the entire linguistic part of the project; Alfreda Mabonlala, artist at ORSTOM in Port Vila, who with great talent and ability executed the majority of the botanical illustrations, and whose drawings were complemented by those of F. Yoringmal and S. Seoule; B. Evans, who generously gave us the benefit of his knowledge of the nuts of Solomon Islands; P. Ferrar (ACIAR), for having funded chemical analyses of the fruiting species of Vanuatu; B. Aalbersberg (USP Suva), for having conducted the analyses and C. Dignan (SPC) for having initiated them; G. Philips and M. Alpers, respectively in charge of the laboratories and Director of the Papua New Guinea Institute of Medical Research, Goroka; Haniteli 'O Fa'anunu, Director of the Ministry of Agriculture of Tonga; D. Eastburn (Murray Darling Basin Commission, Canberra), for the very fine photographs that he kindly provided showing the preparation of highland pandanus (*Pandanus jiulianettii*); the botanists who identified our herbarium specimens: M. Jebb (*Barringtonia*), A. Kostermans (*Evia dulcis*), T. Pennington (Sapotaceae) and M. Coode (*Terminalia*). Final drafting and editing of this work was undertaken at the Research School of Pacific and Asian Studies at the Australian National University in Canberra. The discussions that we were able to have with the researchers of that institution, and the comments that they provided, substantially improved the earlier draft of the manuscript.

Note on English edition by translator

I first learned of this work during a conference on Pacific nuts in Vanuatu, and it seemed highly desirable to have it available in English as well as French so that all countries of the Pacific could share its fascinating content. I undertook the translation as someone with training in Botany but with only a moderate knowledge of French. In this latter regard I was helped greatly by my colleague and friend Christine Moulet, whose assistance was talented and unstinting, and by my father Harry Ferrar, teacher of French and lexicographer. Klara Beresnikoff and Christine Moore also provided valuable help and Annie Walter explained various points of Pacific culture and other aspects of the work. Nevertheless, any errors that remain are my responsibility.

IRD kindly made available a full electronic copy of the French text and all the illustrations, and permitted ACIAR to publish the English translation. I am also most grateful to my colleague Peter Lynch (Publications Manager of ACIAR) for his assistance with technical production of the work.

Paul Ferrar
ACIAR, Canberra

The South Pacific

For key to French names see map on p. 82

Presentation

The fruits and nuts of Oceania have been little studied to date. This book deals with those plants that are specifically Oceanian, i.e. were present in the region before the arrival of the first Europeans (in the 16th century). It covers the woody species which, cultivated or wild, produce the great majority of fleshy and non-fleshy fruits of the Pacific.

Four regions served as study areas for this work: Vanuatu (the reference country for the whole work), Papua New Guinea, Samoa and Tonga. These countries are introduced by capsule summaries of general information at the start of the work (p. 21).

The inventory of fruits that we have given here is not exhaustive; for Papua New Guinea, for example, it concentrates on fruits utilised by the Ankave, a people in the interior of the country whose nutrition depends largely on the resources of the forests. This society bears testimony to the wealth of the forest species in this part of the world, and to the nutritional and cultural importance of certain plants such as pandanus.

This reference work thus mainly covers the local fruiting species, and excludes those introduced after European contact, palms, shrubby plants and vines.

The first two sections of the book deal with alimentation[1] in Oceania and with traditional arboriculture; they provide evidence of the great differences in utilisation of the local fruit trees between Melanesia and Polynesia. While in Melanesia the strongly rural communities still grow and eat their local fruits to a great extent, in Polynesia these species are less utilised and are tending to disappear. The reasons, historical and social, and the practical details of this progressive loss of interest in traditional foodstuffs, which in time could lead to nutritional imbalances, are presented in broad terms.

The last part of the book, and the most important, is the ethnobotanical inventory of individual species, arranged in alphabetical order of genera. The entry for each species is introduced by: the scientific name of the species and its family, the common names in English, French and Bislama (the lingua franca of Vanuatu), its mode of consumption and its possible toxicity. This is then followed by: the botanical description and the morphological variability of the species, observations on the species, the alimentary usages and other usages, other edible species in the genus, and finally a list of references cited for that species. The geographical spread is indicated in the form of a distribution map. The

[1] Alimentation is defined as the supplying of the necessities of life, including the processes of giving and receiving nutrition. It is therefore wider than just nutrition.

botanical description inevitably includes some technical terms, but a glossary provided immediately after the present section will help to understand the meanings of these terms.

The book concludes with a series of summaries to help the reader, whether amateur or specialist: a bibliography, a list of fruits eaten in the western Pacific, synonyms of species names, a detailed listing of vernacular names, an index of scientific names, an index of common names, and a listing of herbarium specimens.

We hope that all who are interested in the natural resources of the Pacific, whether it be to know them better, to protect them or to develop them, will find the information that they need in this reference book.

Glossary of Terms

The glossary for the French text was taken mainly from Florence (1997)[2]. The glossary for the English translation has also drawn extensively on Willis (1904)[3]. Some terms, already defined in the text, are repeated below for the sake of completeness.

Acumen – a narrow or tapering point, variable in shape, at the tip of a leaf.

Acuminate – ending in an acumen, tapering progressively to a long, fine point.

Acute – pointed (for example of a leaf tip).

Adventitious roots – root-like structures on a plant that perform the functions of roots but are derived from stem or leaf tissue, i.e. are not true roots.

Aerial roots – roots or root-like structures arising above ground.

Albumen – also called endosperm – the part of the seed which is filled with nutritive substances, and which surrounds the embryo which it nourishes.

Alternate – where leaves are attached alternately along a stem, not opposite each other (the alternative condition to this is opposite).

Annular – banded or thickened in rings or circles.

Apex – the tip of a leaf, flower or fruit, away from the stalk or point of insertion.

Aril – an exterior covering or appendage of a seed as an outgrowth that envelops the seed to a greater or lesser extent.

Aspermic – without seeds, not bearing seeds. Used here particularly in relation to breadfruit, to indicate varieties that produce fruits without seeds, which are thus sterile and must be reproduced vegetatively.

Axil – the interior angle between a leaf and the branch from which it arises (or between a small branch and a larger branch from which it arises).

Axillary – situated in, or growing from, the axil of a leaf or bract.

Bifurcating – dividing into two.

Blade – the broad, flat part of a leaf.

Bract – a leaf in whose axil a flower arises.

Buttresses – broadened, basal expansions of a tree trunk, standing out as thickened supports.

[2] Florence, J., 1997. *Flore de la Polynésie française*, Vol. 1. Paris, ORSTOM, coll. Faune et Flore tropicales 34, 394 pp.

[3] Willis, J.C., 1904. A Manual and Dictionary of the Flowering Plants and Ferns. Cambridge, University Press, 2nd Edition, 670 pp.

Calyx – the outer envelope of the flower, comprising all the sepals either separate or joined.

Capitulum (plural capitula) – a group of sessile flowers clustered together into a single, tight head.

Carpel – the gynoecium (female component) of a flower, made up of a basal ovary containing the ovules, surmounted by a style and a stigma. Carpels may be separate, or fused into a syncarp.

Cauliflorous – (of flowers and fruits) – growing directly from the trunks or older branches of a tree (as opposed to growing out of leaf axils).

Compound – leaf in which the single leaf-stalk bears more than one separate leaflet (the opposite condition is simple).

Cordate – (of leaf) – about twice as long as broad, and heart-shaped at the base.

Coriaceous – leathery.

Corolla – the inner envelope of the flower, comprising all the petals either separate or joined.

Cotyledons – the "seed leaves" which become the first leaf or leaves arising when an embryo germinates. Angiosperm seed plants are divided into the Dicotyledones (with two cotyledons per seed) and Monocotyledones (with one cotyledon per seed).

Crenate – (of leaf margin) – with rounded teeth and sharp notches between the teeth.

Crown – the head of foliage of a tree or shrub.

Cuneiform – wedge-shaped.

Cupule – part of a plant formed into a small cup, either as a single piece or made up of small scales.

Deciduous – of a plant where all the leaves fall from the plant at a particular time of year (e.g. in the dry season or in winter).

Decurrent – where a leaf expansion is continued as a wing down the stem.

Dehiscent – (of a seed pod or container) – splitting open when ripe.

Dentate – (e.g. of leaf) with small teeth pointing outwards.

Dioecious – where male and female flowers are borne on separate plants (the opposite state is monoecious).

Drupe – a fleshy fruit containing one seed, the endocarp of which is hard (i.e. a nut).

Ellipsoidal – a solid object (e.g. a fruit) which is oval in cross-section when cut across any plane.

Elliptical – (of leaf) – tapering equally to base and tip, and somewhat narrow.

Emarginate – apex of leaf with a deep and marked notch.

Embossed – (of a surface) – having a raised design.

Endocarp – hard shell or stone inside a fruit and surrounding the seed (see also under pericarp).

Entire – (of leaf or leaflet) – without notches in the margin.

Epicarp – (also sometimes called exocarp) – the outer skin of a fruit (see also under pericarp).

Epidermis – the outer layer of cells or skin (e.g. of a fruit).

Epiphytic – growing on other plants rather than directly in soil, but not parasitic on those plants.

Ethnobotany – study of the complex relationships between humans and their plants. Classifications, usages and modes of cultivation are always studied from the point of view of those who utilise the plants and according to the particular cultural contexts.

Exocarp – see epicarp.

Fluted – (of a tree trunk) – having a series of vertical furrows or grooves.

Follicle – a dry, dehiscent fruit consisting of one carpel and dehiscing along the ventral side only.

Fusiform – spindle-shaped.

Glabrous – without hairs.

Globular – roughly spherical, having the shape of a globe or ball.

Gynoecium – the female part of a flower comprising ovary, style and stigma (see also carpel and pistil).

Hermaphrodite – (of flowers) – having both male and female structures within the same flower.

Imbricated – (of scales or bracts) – arranged in rows that partially overlap each other (e.g. like roof tiles).

Indehiscent – (of a seed pod or container) – not splitting open when ripe.

Inflorescence – a grouping of flowers on a plant.

Infrutescence – a grouping of fruits on a plant, deriving from an inflorescence.

Kava – a sedative, slightly intoxicating drink, obtained from the root of *Piper methysticum* and drunk by men at nightfall throughout the Pacific.

Lanceolate – (of leaf) – lance-shaped, about three times as long as broad, tapering gradually towards the tip.

Lap-lap – a type of thick cake made by cooking a puree of grated yam, taro, cassava, banana or breadfruit in leaves.

Latex – a milky, usually white and often sticky fluid that exudes from cut or damaged stems of leaves of a plant.

Leaflets – the individual leaf-like structures of a compound leaf.

Lenticels – small respiratory pores in the stems of woody plants, appearing as a series of dots on the bark surface.

Luau – coconut milk salted with seawater and cooked in young taro leaves.

Marcotting – a procedure for vegetative multiplication of plants in which part of a branch of the plant (usually a tree) is put into contact with soil (often the soil is bound to the branch surface with plastic), and the branch roots into the soil before being detached from the parent plant.

Mesocarp – the central fleshy tissue of a fruit, between the outer skin (epicarp) and the hard shell or stone around the seed (endocarp) (see also under pericarp).

Monoecious – where male and female flowers are borne on the same plant (the opposite state is dioecious).

Morphotype – refers to the external shape or appearance of a particular plant.

Nakamal – Bislama term indicating a building (clan hut) for men.

Nalots – small balls of breadfruit paste cooked in coconut milk.

Ob – (applied to an adjective, it reverses the direction of tapering – see definitions below).

Oblanceolate – (of leaf) – about three times as long as broad, tapering gradually towards the base (in contrast to lanceolate, where the gradual tapering is towards the tip).

Oblong – (of leaf shape) – with sides parallel for some distance, the ends tapering rapidly.

Oboval – (of leaf) – egg-shaped, with the broader portion at the apex of the leaf (opposite condition is oval, where the broader part is at the base).

Obtuse – blunt, when applied to the shape of a leaf apex.

Opposite – where two leaves are attached opposite each other on a stem (the alternative condition to this is alternate).

Orbicular – (of leaf shape) – circular in outline.

Ostiole – a small aperture found on the fruit (fig) in the family Moraceae.

Oval – (of leaf) – egg-shaped, with the broader portion at the base of the leaf (opposite condition is oboval).

Ovoid – (of a fruit) – egg-shaped.

Palmate – a compound leaf in which all the leaflets arise from a single point of insertion (the opposite condition is pinnate).

Panicle – an inflorescence composed of clusters of flowers, themselves arranged in clusters on a central axis.

Paripinnate – a pinnate leaf with an equal number of leaflets on either side and without a single extra leaflet at the end.

Parthenocarpic – (of a fruit) – developing without needing to be fertilized.

Pedicel – the individual stalk of each flower of a group of flowers (see also peduncle).

Pedicellate – having a pedicel.

Pedunculate – having a peduncle (opposite: sessile).

Peduncle – the stalk of a solitary flower or fruit, or the single stalk of a group of flowers of fruits (see also pedicel).

Pendulous – hanging downwards.

Pericarp – the part of a fruit that covers the seed. May consist of an epicarp (outer skin), mesocarp (a fleshy mass of tissue under the outer skin) and an endocarp (a hard shell or stone around a seed).

Persistent – (of flowers or flower parts) – remaining unwithered on or around the fruit (as opposed to deciduous, where it shrivels and falls as the fruit develops).

Petals – the components of the corolla, or inner envelope of the flower; the petals may be either separate or joined.

Petiolate – having a petiole (opposite: sessile).

Petiole – a leaf stalk.

Petiolule – the stalk of a leaflet.

Pinnate – describing a compound leaf in which the leaflets arise from the sides of the central rachis (as in the leaf of a pea plant). The opposite condition is palmate.

Pistil – the female part of a flower comprising ovary, style and stigma (see also carpel and gynoecium).

Polymorphic – occurring in several distinct forms or shapes.

Pubescent – with fine, soft hairs.

Quadrangular – four-sided.

Raceme – inflorescence made up of pedicellate flowers on an unbranched axis.

Rachis – the elongated axis of an inflorescence, or the main axis of a composite leaf that bears the leaflets.

Rhizome – an underground stem or branch of a plant, often thickened and sometimes serving as a storage organ; looking like a root but distinguished from a true root by the presence of buds, nodes and often scale-like leaves.

Rosette – the shape in which a number of elements radiate symmetrically from a central point.

Rugose – ridged or wrinkled.

Sepals – the components of the calyx, or outer envelope of the flower; the sepals may be either separate or joined.

Sessile – without a stalk, attached directly at base (of leaf or fruit; opposite conditions are petiolate or pedunculate).

Simple – a leaf with only one leaf on the leaf stalk (opposite condition is compound, where there are several leaflets on each leaf stalk).

Spherical – shaped like a sphere or ball.

Stamen – the pollen-producing structure of a flower, usually comprising a filament bearing an anther.

Stigma – the part of the pistil of a flower that receives the pollen at fertilization.

Stipules – the pair of small leaflike appendages arising at the base of the leaf in many plants.

Style – the part of the female flower connecting the stigma to the ovary.

Sub – (as a prefix to any adjective) – nearly, e.g. subsessile = nearly sessile.

Subglobular – almost globular.

Sub-opposed – almost opposed.

Subsessile – nearly sessile (e.g. with a very short leaf or fruit stalk).

Syncarp – a fruit arising from a gynoecium made up of fused carpels or a fruit made up of elements that are totally united into one.

Tapa – cloth made from tree bark beaten flat.

Tarodière – a taro garden, usually irrigated and comprising a series of small pits inside which flows water coming from a single source.

Terminal – at the furthest point away from the point of attachment of anything. In the case of the crown of a tree, the uppermost part of the tree.

Trilobate – having three lobes.

Tubular – (e.g. of a corolla) – with the separate petals joined together to form a tube-like structure.

Undulate – (of leaf margins) – wavy.

Whorl – a number of leaves or flowers arranged in a circle around the same point on a stem or axis.

Wing – lateral, flattened, somewhat leaf-like expansions on a stem or fruit.

The Four Study Regions

Reference country for the study: Vanuatu

Papua New Guinea: the territory of the Ankave

A kingdom of many islands: Tonga

The archipelago of Samoa: western Samoa

Reference country for the study:
Vanuatu

The chain of islands of Vanuatu, situated on the "belt of fire" (the chain of active volcanoes) of the Pacific, to the northeast of New Caledonia, stretches for close to 900 km. It is made up of about 68 islands, the surface areas of which vary from less than 1 km^2 up to about 4,000 km^2. The islands, which are recent and high, have an average altitude of 500-600 m, with the highest peak in the archipelago being Tabwamasana on Santo, which reaches 1,879 m. In fact, the complex geomorphology of the archipelago has produced quite a contrasting mixture of physical relief formations in the islands, sometimes changing markedly over quite short distances. This process of division of the archipelago is mirrored by a fragmentation of the human societies, isolated one from another by natural barriers which were often terrestrial rather than maritime. Together with Papua New Guinea, Vanuatu represents Melanesia in this study.

Total land area

12,189 km^2.

Climate

Tropical, with two seasons – hot and very wet in summer (from November to March), followed by a winter which is dry and cooler. The leeward sides of islands suffer severe droughts, and the zones above 500 m are cold and dry. Finally, cyclones occur more or less regularly between November and April, particularly affecting the centre of the archipelago and the south. Their consequences may be catastrophic, and the destruction of gardens may force the populations to have recourse to foraged foods to ensure their survival.

Vegetation

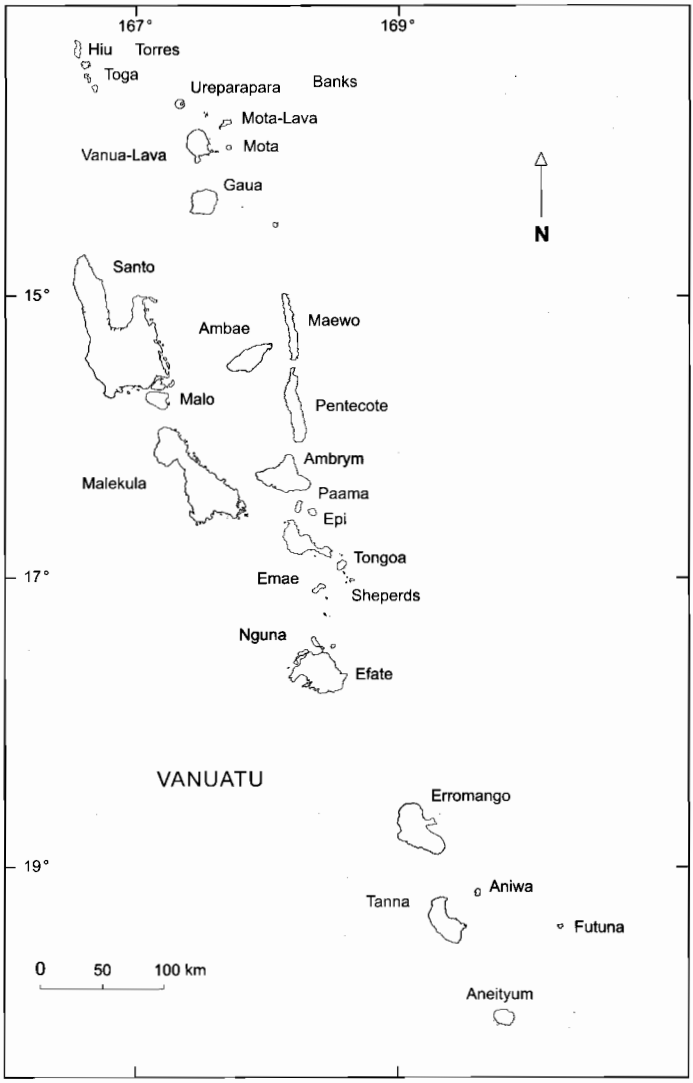
The flora of Vanuatu is young, relatively poor (about 1,500 species), with a rather low level of endemicity. The north of the archipelago has received some contributions from the flora of Solomon Islands, while the south has received some from Fiji. The primary forest, terribly depleted by human activities, is mainly found above 500 m. The majority of forests in Vanuatu are secondary, containing gardens throughout and rich in species of practical use. Spread in a band down the length of the coastline there is a coastal forest made up of pan-Pacific species.

Population

The population of Vanuatu is estimated as 142,419 inhabitants, with an annual growth rate of 2.8%. It includes numerous groups of peoples speaking over 100 different languages. Discovered by Quiros in 1606, placed under Franco-British administration in 1906 (the Condominium of the New Hebrides), Vanuatu became independent in 1980. The isolated populations of the interior of the islands were encouraged to resettle closer to the coast, but 82% of the population lives in rural areas. Nowadays one can see a continuous increase in the populations of the two main towns, Luganville and particularly Port Vila (annual increase of 7.3% in the urban population).

Economy

The rural populations engage in subsistence agriculture augmented by fishing and rearing of livestock. Since the 19th century new cash crops have been introduced (cotton, cocoa, coffee, etc.), coconut plantations have been established, and small cash stores have been opened in all the villages. The main exports are copra, fish, beef and also cocoa and timber. Even though much transformed by modernisation, the main elements of the traditional horticulture are still in place. Territorial rights, passed down from father to son since the land was first cleared, may be exchanged or ceded, even given up altogether if there are no longer any descendants to claim them. This general statement, however, hides the fact that there are notable local differences in detail from one island to another or between one group and another. These distinctions serve also as defining characteristics of the separate society groups of Vanuatu, and as such have undoubtedly helped to preserve the diversity and the traditional customs and ways of life. Aware of the value of its natural resources, Vanuatu is trying nowadays to balance a policy of development with conservation of its environment.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The Territory of the Ankave

Papua New Guinea:

Situated in the South Pacific, Papua New Guinea comprises the eastern part of the island of New Guinea (the largest non-continental island in the Pacific), the Bismarck Archipelago (New Britain, New Ireland, the Admiralty Islands), the northern Solomon Islands (Bougainville and Buka), the Trobriand and d'Entrecasteaux Islands, the Louisiade Archipelago and Woodlark Island. The capital is Port Moresby. Together with Vanuatu, Papua New Guinea represents Melanesia in this study.

Total land area

461,693 km^2.

Climate

Hot and humid, often cooler in mountainous areas. Average annual rainfall varies from 1,500 to 10,000 mm according to region.

Population

3.9 million people (1990 census). Annual rate of population increase: 2.5%. Percentage of population living in rural areas: 87%.

Main resources

Minerals (gold, copper) and oil.

The land of the Ankave

This is situated in Gulf Province, in the eastern central part of the independent nation of Papua New Guinea. It comprises three enclosed valleys covered in forest, in which dwell about a thousand people. A dense network of watercourses traverses the region. The year is divided into two seasons: the less humid from May to October, the rainier from November to April. The average annual rainfall is about 3,000 mm, which is intermediate between the drier region of Menyamya and the wetter one of Kerema. The temperature ranges between 15 and 25-30°C in January and between 25 and 28°C in July. It varies with altitude. The feeling of cold is always severe when it rains above 2,000 m. Between December and February, storms are very frequent on the ridges and peaks that separate the valleys. The long chain of ridges (between 2,200 and 2,800 m) which mark the easterly boundaries of the main valleys, separate the territory of the Ankave from that of other Anga groups to which they belong, but with the great majority of whom they were in former times in a semi-permanent state of war. Nowadays, this line of ridges also marks the boundary that separates the Ankave from the modern world.

The Ankave people

Isolated in the heart of Gulf Province, and among the poorest people in the country, the Ankave are neglected by the authorities in Kerema who have the responsibility for administering them. The nearest road stops at Menyamya, in Morobe Province, and to reach this from any of the valleys of the Ankave is a walk of two to four days. Independence (in 1975) marked the end of the temporary migration to the plantations that had begun in the mid-sixties. Nowadays the few Ankave who travel only leave their valleys to sell cloths of beaten bark to neighbouring communities, but scarcely ever reaching as far as the valley of Menyamya. They have very little contact with officialdom, missionaries or the market economy. In the complete absence of commercial production, their economy is scarcely monetarised and purchase of foodstuffs is rare. Nowadays there are still no schools, no hospitals and no market stalls in the valleys of the Ankave. In the valley of the Suowi – where the present study was carried out – the missionary presence has only been felt since the beginning of the 1990s. A census of the inhabitants of this valley was

taken for the first time in June 1990, which indicates just how isolated this population has been. The Ankave obtain from the forest most of their foodstuffs and the materials that they use for everyday living. They continue to utilise and to manage this environment in a way that is no different from when they first settled there, 150 to 200 years ago.

A kingdom of many islands:

Tonga

Archipelago situated in the South Pacific, made up of 170 islands of which 36 are inhabited nowadays. Physically, this region is a mixture of low coastal areas and raised, emergent land masses. Situated to the west of the International Date Line, the archipelago had the old name of the Friendly Islands, thus christened by Captain Cook because of the perceived friendliness of the inhabitants. The low coral islands and the high volcanic islands are divided into three groups, spread over 800 km from south to north: in the south, the main island of Tongatapu (260 km^2), in which is situated the capital Nuku'alofa, and 'Eua Island; in the centre the Ha'apai Islands (120 km^2); in the north, Vava'u (140 km^2). There are also Niuatoputapu and Niuafo'ou (called the Niuas, 18 km^2 and 50 km^2), which lie isolated to the north, and in the south of the archipelago the island of Ata, which has been uninhabited since 1910 because of its isolation and difficulty of access.

Total land area

670 km^2.

Exclusive economic zone

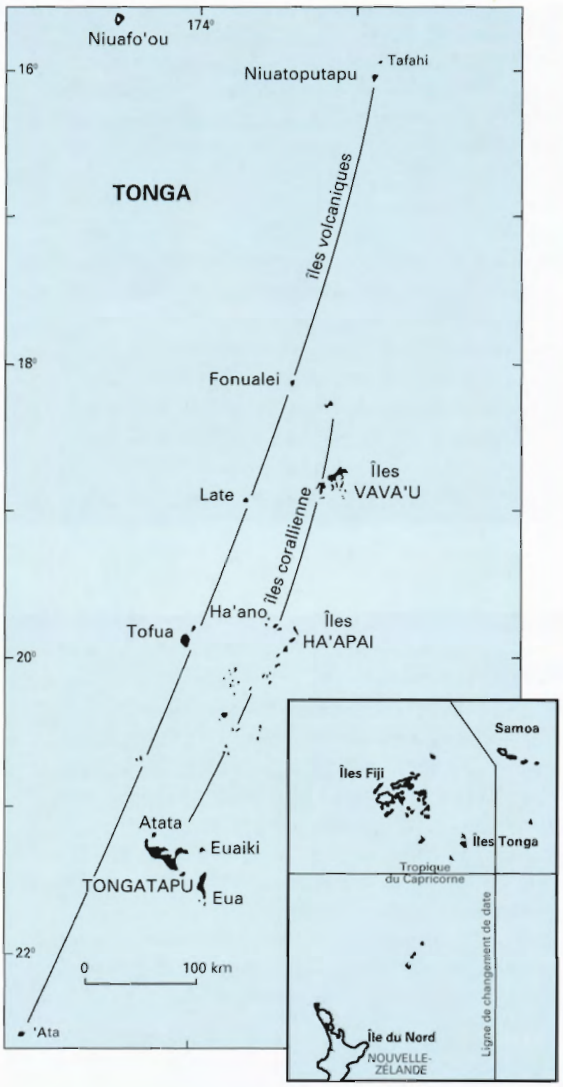
700,000 km^2.

Climate

Semi-tropical, with a wet season from November to April and a dry season from May to October. Cyclones occur between December and March. Median temperature of 23°C, with an average annual rainfall of 1,870 mm and 77% humidity.

Population

In 1921, 23,759 inhabitants of whom 43.5% were in Tongatapu and 'Eua; in 1986, 94,535 inhabitants of whom 67% were in Tongatapu (plus 35,000-50,000 who had emigrated to New Zealand, Australia and the United States of America). The population density is heterogeneous, with an average of 139 inhabitants/km^2 but a concentration of 230 inhabitants/km^2 in Tongatapu. In 1986, 63% of the population was under 24 years of age.



History

A Kingdom by divine authority since 950 AD, the monarchy acquired constitutional status in 1875 with King Tupou I. Tonga remains today the only kingdom in the Pacific where the sovereign Taufa a'hau Tupou IV exercises effective power, succeeding his mother Queen Salote Tupou III in 1967. The Kingdom, the only place in the Pacific to escape colonisation, was made a protectorate of Britain from 1900 to 1970.

Economy

Over 50% of the working population is engaged in agriculture. The economy of self-sufficiency is based on the growing of tuber crops, but this is giving way to a capitalist type of economy, and subsistence cropping is giving way more and more to commercial cropping for export. Successively, such developments have been: banana (since 1908, with a progression in fits and starts, and a renaissance in 1940), then watermelons, pineapples, vanilla, tomatoes, capsicum, peanuts. For about the last five years or so it is the growing of squash for export to Japan which has monopolised all the effort, to the detriment of subsistence production and of other cash cropping. Far behind the primary production sector of the economy is the service sector in which public servants (officials; civil servants) predominate, and a secondary manufacturing sector that is quite weak.

The archipelago of Samoa:
Western Samoa

The archipelago of Samoa includes the islands of what was formerly Western Samoa, now Samoa, which are part of the present study, and American Samoa. The western part comprises mainly the two large islands Savai'i and Upolu, in the latter of which is located the capital Apia and the main airport. The islands are high and volcanic (highest peak 1,858 m), with patches of thick forest (often damaged by cyclones and by cutting for domestic and industrial use), and coastal plains that are narrow except in a few places where the flat, fertile land broadens out. The mountainsides are steep and precipitous.

Total land area

2,935 km^2.

Exclusive economic zone

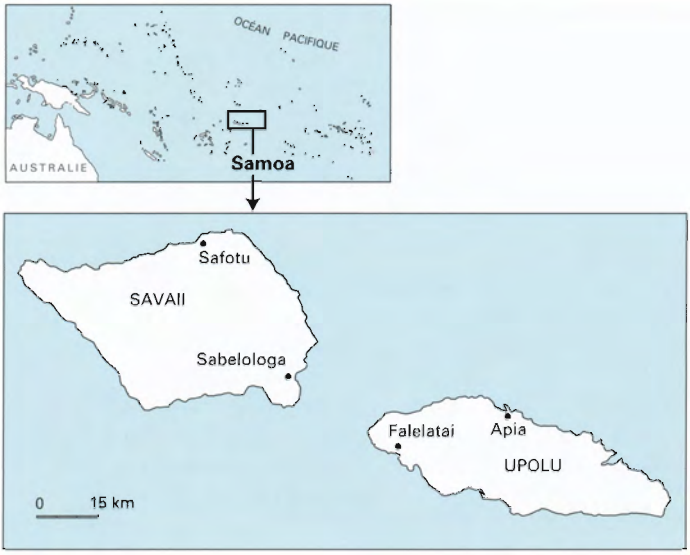
120,000 km^2.

Climate

Humid tropical, with a drier, cooler season between April and September. The climate becomes milder with altitude.

Population

In 1980 there were 156,000 inhabitants, of whom 110,000 were on the island of Upolu and 46,000 on Savai'i (plus 50,000 who had emigrated to New Zealand, American Samoa, the United States and Australia). The figure was the same in 1986 (the population increase having been balanced by emigration up to about 1992). The majority of villages are on the coast.



Ratio of rural to urban zones

Samoa has 350 villages and no real town. The capital Apia is administratively a conglomerate of villages each governed by its council of customary chiefs. There are 35,000 people overall in this urban cluster, plus another 40,000 in the villages along the 30 km of road between Apia and the main airport. More and more the populations of these villages are living in a cash economy, based on salaries earned by various members of the extended families. The remainder of the population (80,000 people) lives in a rural manner, dependent entirely on their crops.

History

Western Samoa was a German colony (1899-1914), then entrusted by the League of Nations to the guardianship of New Zealand. In 1962 it became the first independent nation of the Pacific and was endowed with a constitution based on the western parliamentary model. However, the members of parliament are chosen from among the chiefly families (*matai*) and are elected only by the latter. From within the parliament is chosen a cabinet and Prime Minister, by internal election. At Independence two heads of state, from the two highest families of the land, were installed for life: one has since died, the other has now remained in power for thirty-three years. On his death the new head of state will be elected from within the parliament, for a renewable term of five years. Since 1990 the parliamentarians have been elected by universal suffrage, but the eligibility to vote remains limited to the head of each family (about 15,000 people, of whom 90% are male).

Economy

Classed among the poorest countries because of its low income, little by way of exports, and the almost complete absence of local artisanal or industrial manufacturing, Samoa has nevertheless not starved. Until the most recent times, the country had a three-part economy: one third of resources came from cash remittances from expatriate Samoans, one third from international development assistance and one third from export crops. The main export commodities (copra, cocoa and banana) fell between 1980 and 1987. By 1990 exports of taro to expatriate Samoans in New Zealand were so profitable that they led to a diminution in fishing and a change in consumption habits of the population. Since 1990 this trend has been reversed, attributable to a 10-20% fall in employment for expatriate Samoans, two cyclones that devastated the country, and in 1994 an epidemic that destroyed 95% of the taro.

Introduction

What did they look like, the untouched islands that were discovered by the first human communities to land on Oceanian shores? Which species of plants were the newly arrived people able to eat? We will doubtless never know exactly, but it is likely that in these lands there were growing some food plants that were already known to the new migrants. Some fruit trees or littoral plants that are spread by marine currents, wind or birds would have been present in these islands, having arrived ahead of the first humans. Such virgin territory no longer exists, having been taken over by the peoples of the Pacific. But did it ever exist? Long before the arrival of Man these islands had been subject to indirect human influence, receiving seeds of new plants that were being utilised by Man in other distant lands. Plants with practical uses, especially food plants, preceded humans, then accompanied them and finally followed them. Humans planted species that they brought with them by canoe in the earliest voyages, those that they acquired in the course of subsequent journeys, and those that they exchanged with neighbouring communities; they also learnt to use other species, those that they already found *in situ*, and those that continued to arrive, spread by natural means. From one century to another human communities grew and extended, and the land around them became changed by the human influence. Each new wave of migrants that arrived at an island of Oceania, each contact made between islands, brought with it knowledge of new edible species that were from then on adopted and multiplied, though they may also sometimes have been abandoned or forgotten. Little by little the island communities, ever more settled into their new territories, developed the land, accumulated plants with practical uses, and developed eating habits that, despite the extreme ecological and cultural diversity of this part of the world, showed a certain homogeneity.

The arrival, from the 16th century onwards, of European explorers brought nothing that was really new, because other significant waves of migration had already spread across the islands. Nevertheless, it did intensify and speed up the processes that were already taking place. It brought about extensive and rapid movement of plant material throughout the Pacific, and led to enormous introduction of new species originating from other continents. Then followed the adoption of new agricultural practices, the introduction of commercialised products and of currencies, and above all a new philosophy, a new way of looking at the world. This caused a profound upheaval to the relationship between

humans and their environment, which had been based on mythology, lore and techniques that were now thrown into question.

All facets of this world, that while not necessarily harmonious was certainly in balance, but above all was different, were noted, described, evaluated and judged by the first Europeans and by those who followed them. The alimentation of the island peoples, the quality of their plant resources, their cuisine and their habits at the table, their knowledge and their myths were all sifted through the screens of western thought of the 18th century and later. The opinions that emerged from this evaluation were modified over time: sometimes favourably, more often unfavourably.

The first accounts of the travellers and the missionaries are themselves often contradictory. Some, like Tasman (Dumont d'Urville, 1989) or Cook (1777), were impressed by the quality of the agricultural practices and the "refinement of the culinary art" (Mariner, 1806 *in* Martin, 1817, 2: 333) which they observed in Tonga. Others, visiting the same places, took an opposite and bleak view of the alimentation of the indigenous peoples, whom they described as "bands of starving people, foraging for something to eat" (letter of Father Calinon, October 1845, *in* Duriez-Toutain, 1994: 411). This came about because each person saw just a snapshot portion of a more complex whole. Feasts could be followed by periods of great scarcity; in some societies the food of the chiefs was not the same as that of the common people; a traveller passing through would thus not have the opportunity to see the whole picture, which would only be accessible to someone who stayed for a long time in the one place. The ideas that were formed about Oceanian societies, the judgements that were made on their practices and the level of sophistication of their knowledge, were also influenced by the development of European knowledge and thought. Only now are people reassessing the correctness and importance of the knowledge that had been developed by societies adapting to an environment that only they knew fully, and only now are we realising that the forests of Oceanian islands hold invaluable food resources for the peoples of the Pacific and for the whole world.

Even though some refused to credit Oceanian cuisine with much subtlety, and though others denied gustatory or nutritive merit in the foods of the Pacific, there is in fact an Oceanian alimentary style that is entirely original, and is based on a choice of particular plants, on modes of cooking, on tastes, on rules of hospitality, frequency of meals and an understanding of food needs. This is what is described by the term "traditional alimentation", this

combination of practices and behaviour, which is quoted as the general situation existing in pre-European times, but in fact only relates to a single point in time, namely that when the first travellers made the observations. Nowadays, this traditional alimentation still exists to an extent in societies that are in course of change in these countries. The changes that are happening have to do with the type of plant or food that is used as well as the mode of preparation or consumption. Traditional alimentation is adaptive, evolutive and creative. Adaptive, because it incorporates new plants and techniques into a combination of practices in a much wider cultural context, itself based on the myths and beliefs belonging to the particular society. Evolutive, because this cultural complex is not set in stone, but may be altered from contact with other cultures or in relation to changes in environment, resulting in different modes of alimentation. Creative, because of new ways to cultivate a plant, or to utilise it or prepare it, or even of seeing the world emerge in the course of these adaptations and evolutions, in response to practical problems and to an underlying and significant aesthetic sense.

It is relatively easy nowadays to list the fruits that have been introduced to the Pacific since the 16th century: fruits such as mango, pineapple, papaya, lime, guava, custard apple, orange, grapefruit, mandarin, passionfruit, avocado or watermelon. However, it is much harder to define the centres of origin and original distributions of other fruiting species because they were spread more widely by humans during earlier aboriginal migrations.

Thus a large number of fruiting trees, to limit the scope of our study to this group of plants, are present over a vast area, from the Indo-Malayan Region to the eastern Pacific. This is the case with the sea almond (*Terminalia catappa*), Indian mulberry (*Morinda citrifolia*), Tahitian chestnut (*Inocarpus fagifer*) and candlenut (*Aleurites moluccana*). These species have on occasions spread even more widely, such as to the islands of the Indian Ocean or those of the Caribbean, where they have been flourishing for hundreds of years. Other species are found from western New Guinea to Vanuatu or Fiji: such is the case with canarium nut (*Canarium indicum*), the Melanesian fig (*Ficus wassa*) and *Gnetum gnemon*. Some species are distributed roughly from Vanuatu (or even Solomon Islands) to Samoa and Tonga. Among these are the dragon plum (*Dracontomelon vitiense*), the Oceanian fig (*Ficus scabra*) and *Garcinia pseudoguttifera*. Finally, some species are endemic to certain islands, such as the Vanuatu fig (*Ficus granatum*) in Vanuatu or

Pittosporum pullifolium in New Guinea. It therefore appears that in Solomon Islands and Vanuatu one finds both the western species and the eastern species, while the very rich flora of New Guinea contains a considerable number of species that are not found outside that island. The more easterly islands of Polynesia either never acquired or have lost a good number of fruiting species that are eaten in Melanesia. In this connection it should be borne in mind that the richness of individual floras decreases progressively from New Guinea to Polynesia.

This difference in geographical distribution of species is also evident at the end of this work, in the list of fruits eaten (p. 277), and in the ethnobotanical inventory of species (p. 79). It explains the fact that less information has been collected from Tonga and Samoa than from Vanuatu and Papua New Guinea, regions that are geographically and geologically different in nature, richer from the start in fruit and nut species, and less urbanised. This apparent imbalance of coverage in the text, in which there is almost constant reference to Melanesian distributions but much less to those in Polynesia, is thus only a reflection of the different situation between the geographical areas considered in this comparative approach.

In parallel with this, consumption of fruits and nuts remains regular and abundant in the countries that are still mainly rural, such as Papua New Guinea, Solomon Islands and Vanuatu. For example the Ankave, who occupy an isolated area of forest in Gulf Province, throughout the year eat fruits and nuts collected from the forest or cultivated. Likewise the majority of societies in Vanuatu cultivate fruit trees and regularly eat fruits and nuts. But when one reaches the islands of Polynesia, the situation changes. Consumption of fruits and nuts is often replaced by consumption of other, more modern foods that are nibbled in the same manner during the day. It is noteworthy also that species introduced subsequent to contact with Europeans are becoming ever more dominant, to the detriment of the local species.

The Melanesian countries are thus the custodians of a heritage that is both unique and diversified in respect of plant species with fruits and nuts. As is well known, deforestation is occurring in a number of locations and is causing these native fruit and nut trees to disappear. It is therefore becoming urgent to learn how to know and protect these trees.

In this context of change, we may ask with some disquiet what the future will be for traditional arboriculture in the Pacific, and for the indigenous species that this involves. These practices and these species constitute a heritage of Oceanian societies. They are well

adapted to local conditions and represent resources that could be developed, improved and spread. They also provide an alternative to exploitation of the forests. We therefore hope that the peoples of the Pacific will continue to be able to exploit this plant resource, which has been bequeathed to them by their ancestors, and that they will be able in the future to preserve and develop this resource for their profit, according to their proper cultural and aesthetic considerations.

Traditional Alimentation in Oceania

Alimentary plants of Oceania

Oceanian alimentation is based on root crops (roots or rhizomes) and on the starchy fruits of certain trees. These plants are for the most part cultivated in gardens in land that is newly cleared, sometimes by burning a patch of forest or secondary vegetation on an ancient fallow. These are vegetatively propagated plants, which are multiplied by cuttings or planting of suckers, and which are grown individually. Trees with starchy fruits are cultivated in villages or around gardens, and are multiplied either by vegetative means, as with breadfruit, or by sexual means as with Tahitian chestnut.

These staple foods are complemented by leafy green vegetables, cooked fruits, seeds or inflorescences, meat or fish and other marine organisms. Finally, fresh or dried fruits are eaten in season, outside normal mealtimes. Fruits and vegetables may be cultivated in gardens or around the villages. They are more often wild, and may be the object of organised foraging expeditions or may be gathered casually.

In addition to this alimentation, which is described as traditional, there are nowadays in most regions commercial products such as sugar, flour, rice, canned fish or meat, even frozen products which sometimes – or in some places often – replace the natural products that were utilised in earlier times.

Root crops

The two main root crops that are characteristic of Oceanian diets are yams and taros. Later also came sweet potato and cassava. Each society favours the growing of one or two species of root crops, around which the calendar of cultivation is organised. There is a marked preference for one or other root crop, which depends above all on what can be grown in the particular environment, but also on cultural aspects of choice. The main root crop or crops are in general those that are the commodities of customary exchange and to which special status and prestige attach. They are symbols of the abundance and wealth, sometimes even of the virility, of those who grow them. Each one of them is diversified into numerous clones or cultivars, which have slightly different appearances or tastes or textures or nutritive qualities, or even usages.

Yams

Yams (*Dioscorea* spp.) are grown in the great majority of Oceanian gardens.

The most important is *D. alata*, the root crop preferred by Tongans, which is planted from

May to December and harvested from December to June. It is also preferred by certain societies in Vanuatu which possess a hundred or so different clones of it. The agricultural calendar of the majority of Oceanian societies is organised around this culture.

The yam *D. esculenta* is likewise cultivated throughout Oceania. It is predominant in certain parts of Papua New Guinea and the Loyalty Islands. The cultivars selected in the Loyalty Islands are moreover of such quality that they have partly replaced the older local cultivars in certain parts of Vanuatu.

D. nummularia, incorrectly called "wild yam" in Vanuatu, is an ancient yam which is grown in forest areas, at the foot of large trees on whose branches the yam vines can climb.

D. bulbifera, without doubt the oldest of all Oceanian yams, is a wild plant that is unfit to eat without careful preparation. However, certain edible cultivars have been selected and are grown in gardens.

D. pentaphylla is a wild-gathered yam that is little exploited.

Finally, *D. trifida* is sometimes encountered, known in Vanuatu as the African yam even though it originated in tropical America from where it was introduced to the Pacific.

Taros

Taros (*Colocasia, Alocasia, Xanthosoma* and *Cyrtosperma*) are grown with the same degree of importance as yams, and they assume prime importance in for example Samoa.

Far and away the most common is *Colocasia esculenta*, which is planted throughout the year in Melanesian and Polynesian gardens, sometimes in rainfed areas in humid forests and sometimes under irrigation. Cultivated amongst yams, or in special taro gardens or in a *tarodière*[4], this is in Vanuatu the root crop of the peoples of inland areas.

Alocasia macrorrhiza is a hardier taro, the root and stalk of which are rich in crystals of oxalates that irritate mucous membranes, requiring the plant to be cooked for a long time before it is eaten. Its culture is important in western Polynesia (Samoa, Tonga, Wallis and Futuna), but it is little utilised elsewhere. In Tonga it is planted from July to October and harvested from August to December, in other words just before *Colocasia esculenta*.

Xanthosoma sagittifolium (or macabo, cocoyam, tannia), originating from America and introduced during the European era, is a large taro found throughout Melanesia and western Polynesia. It is grown in the lowlands of New Guinea (up to 1,500 m altitude among the Ankave) and in Vanuatu

[4] A taro garden, usually irrigated and comprising a series of small pits inside which flows water coming from a single source.

where it is called "taro Fiji". In New Caledonia it is known as "New Hebrides taro", and in Fiji as "Tanna taro" (Barrau, 1962). In New Guinea it is called "taro kong-kong", thus indicating its origin as Hong Kong. Its cultivation is quite easy, and it is tending to replace *Colocasia* in many places.

Cyrtosperma is the largest of the taros, and can reach 4 metres in height. It is found mainly from the Philippines and Indonesia to Cook Islands, via Micronesia. Itis less common in Melanesia where its importance in the subsistence economy is slight.

Sweet potato

Sweet potato (*Ipomoea batatas*) is grown throughout Oceania, but it is in New Guinea that its cultivation is most important because it is the staple food for the people of the Highlands. Elsewhere it is grown as a complement to yams or taros, being eaten in the period between the harvests of these two main root crops. Gardens in Vanuatu and Tonga contain on average ten or so cultivars of sweet potato, while the Ankave of Papua New Guinea cultivate twenty or so cultivars.

Cassava (manioc)

Cassava (*Manihot esculenta*) is a plant of American origin that was introduced to Oceania at the beginning of the 19th century. Planted throughout the year, it grows in five months to one year and produces very good yields. However, its nutritional value is poor. Its cultivation is more developed in western Polynesia (Wallis and Futuna, Samoa, Tonga) than in island Melanesia (Vanuatu). In New Guinea cassava is grown as a supplementary food.

Wild gathered root crops

The forest also provides wild root crops, which it appears were eaten regularly in earlier times and are still used in times of food shortage. Alongside wild yams (*Dioscorea bulbifera*) one finds cordyline (*Cordyline fruticosa*) which is eaten in Polynesia, *Amorphophallus campanulatus*, common in New Guinea but rare to extremely rare elsewhere, and *Tacca leontopetaloides* whose tuber provides a starch that is used to make a porridge. Consumption of these wild-harvested root crops is tending to disappear nowadays. Cordyline, for example, is no longer eaten in Samoa and Tonga except in times of food scarcity.

Vegetables

The original stock of vegetables, the composition of which varies from one region of the Pacific to another, has been considerably enlarged since European contact which with better communications allowed an enormous introduction of new species such as maize, tomato, cucumber, onion and pumpkin. Along-

side a series of plants, too numerous to list, that are grown or cooked locally, there are some plants that are very widespread and are eaten in numerous areas.

Cultivated vegetables

Cultivated vegetables include *Abelmoschus manihot* (*aibika, bele*, edible hibiscus, *choux canaque*), the green leaves of which are eaten from Sulawesi to Fiji, and two species of pitpit (*Saccharum edule* for its inflorescence, and *Setaria palmifolia* for its heart), as well as sugar cane (*Saccharum officinarum*) which we include here although it is not a vegetable in the strict sense. These plants, grown since ancient times, show much diversity. The Ankave of Papua New Guinea, for example, distinguish 14 cultivars of *Saccharum edule*, 6 cultivars of *Setaria palmifolia* and over 30 varieties of sugar cane.

Wild-gathered vegetables

Oceanians gather from the forest the young fronds of various species of edible fern, and the young leaves of certain trees such as wild fig (*Ficus* spp.) and *Gnetum gnemon*. They also eat the young leaves of taro, cassava and sweet potato and the fruits of certain plants such as *Trichosanthes* spp. and *Melothria* spp.

Fruits and nuts

Fruiting trees may provide starchy fruits which may be used as the basic ingredient of a meal to replace root crops, or they may provide fresh fruits and dried fruits.

Breadfruit

Breadfruit (*Artocarpus altilis*), an Oceanian plant *par excellence*, is cultivated throughout the Pacific, generally by vegetative means except in Melanesia where sexual propagation is mostly used. Breadfruit is a very diverse species, with an average of 30 or so different cultivars in northern Vanuatu (with more than 100 occurring in the island of Malo alone) and 10 or so in Tonga.

In Melanesia the forms with seeds are very abundant, while the parthenocarpic clones (i.e. without seeds and multiplied by suckers) are rare. In Polynesia the situation is reversed, and the parthenocarpic clones predominate. The tree is extensively grown in villages and around gardens.

Breadfruit is an important food in Vanuatu, where it is eaten in the interval between two harvests of yams. In Samoa it complements a diet based on taro. In New Guinea the species is mainly used for its edible seeds. The fruits, produced abundantly and seasonally, were in earlier times preserved by fermentation in pits or by drying in many regions of the Pacific. These techniques have tended to disappear nowadays.

Bananas and plantains

Domesticated bananas of Oceania belong to two main groups: firstly *Eumusa* which comprises the common bananas, and secondly *Australimusa* which includes *fe'i* (or *fehi*) bananas which have an erect inflorescence and are a characteristic type of Oceania.

The first are cultivated from suckers in all Oceanian islands and represent an important subsidiary food throughout the year. In Samoa and in certain parts of New Guinea, they are a supplementary staple food in an important subsistence culture. Bananas are hybrid plants which were greatly diversified by pre-European societies. European contact allowed introduction into Oceania of new species (for example *Musa nana*, originally from tropical Asia) and facilitated spread throughout the Pacific of numerous clones that were previously specific to just one region.

The *fe'i* banana (named by some authors as *Musa troglodytarum* and by others as *Musa fehi*) is found from New Guinea to the Marquesas Islands. It is mainly multiplied from suckers, although fertile forms exist in New Guinea, Solomon Islands and Vanuatu. Its fruits are eaten cooked.

Tahitian chestnut

The Tahitian chestnut (*Inocarpus fagifer*) is present throughout the Pacific and produces large seeds, which when cooked are eaten in season. It is a cultivated and diverse species, with from four to twenty different cultivars according to region. In Vanuatu the species is more abundant in the south of the archipelago than in the north. In earlier times it was used to a greater extent and was more abundant than it is today.

Pandanus

Species of pandanus with an edible pericarp or seeds are found in Oceania, particularly in New Guinea where two of them provide a seasonal staple food for the local populations. These are red pandanus (*P. conoideus*), from which a sauce is made that is spread on cooked root crops, and *karuka* (*P. jiulianettii*), the oily seeds of which are eaten fresh or smoked. Elsewhere, in Vanuatu for example, the islanders eat the small seeds of *P. dubius* and *P. tectorius*.

Coconut

Coconut (*Cocos nucifera*), which probably originated in Oceania and spread out widely from there, provides through its different varieties the staple edible fruit in the diet of Polynesians and of the coastal populations of Melanesia. Coconut water, which is always sterile, is contained within the nut and provides a fresh and much appreciated drink. The albumen in its different stages of maturity is a daily food, most often eaten in the form of a sauce. The milk,

creamy or more liquid, is a medium for cookery. Following European contact, coconut has become an export commodity.

Sago

We also make mention of the sago palm (*Metroxylon* spp.) even though it does not bear edible fruits, because it provides a starch (sago) obtained from the trunk of the tree. The sago palm grows wild or cultivated in New Guinea where it represents a staple food for people of the lowlands. Elsewhere the plant is grown for its starch or instead (as in Vanuatu where people no longer eat sago) for its leaves which are used for covering the roofs of houses.

Other fruits

Fleshy fruits and dried fruits are provided in abundance by assorted species, often localised and generally more numerous in Melanesia than in Polynesia. This book is dedicated to these species.

The fruit trees provide all manner of foods: starchy fruits rich in carbohydrates, fresh fruits that provide vitamins, nuts eaten raw or cooked that often contain protein (certain of which are sold commercially in local markets: *Canarium* nuts, sea almond and cut nut, for example), and finally young leaves that are eaten as vegetables.

One may consequently ask whether harvesting from these trees was not one of the main modes of subsistence for the first (aboriginal) colonisers of the Pacific. But whatever the situation, their exploitation in favoured places integrates nowadays with the growing of annual garden plants and their consumption makes complete an Oceanian meal.

The traditional Oceanian "meal"

In this work we use the term "meal", but it has a significance both qualitative and quantitative that is much greater than the same term when used by western societies or in urbanised areas. In the latter situations the term indicates food that is taken each day at regular hours, in a prescribed cultural context, and it excludes foods that may be eaten between times.

In Oceania, and especially in Polynesia, the tendency is generally to eat when hunger is felt, and after physical exertion, and when food is available. Moreover, food may never be refused when it is offered. Much may be eaten on festive or ceremonial occasions, multiplying the meals and then fasting on the days preceding or following the occasion. Furthermore

nibbling, or eating of food in small snack quantities, is an important part of overall nutrition.

The rhythm and composition of meals varies according to circumstances, seasons and years, but also according to the region. Food always has importance from the social point of view, but it may acquire a value beyond just the social worth because it becomes the object and focus of formal exchanges as part of social and ceremonial obligations within and between communities. In this way it comes to have great value to individuals and to communities in western Polynesia, where food plant resources were in earlier times more meagre than they were in Melanesia.

Rhythm and composition of everyday meals

The rhythms of meals fluctuate with the structure of the day of each society. The composition of the meal, its methods of preparation and its timing fit in with a particular way of life, and in their detail they are the best adapted to the particular human community, evolving progressively according to the influences that bear on the community.

In Oceania, starchy foods form the staple of the diet, since cereal crops are absent from the region. Their consumption is culturally so important that in many societies the same word is used to indicate both the food and the meal itself. The starchy staple varies according to season, but also according to the particular society under consideration. For example, in Vanuatu taro is eaten more by inland communities than by those on the coast; it is the predominant staple in Samoa, while in Vanuatu it is eaten to about the same extent as yams. Between December and February breadfruit becomes the main food for coastal populations in Vanuatu.

Various dishes are served as accompaniments to this main staple, the abundance and diversity of which varies according to the day, the season and the occasion. They comprise various boiled leaves, fruits of certain trees or other plants, fish, shellfish or meat. None of these by themselves constitutes a meal, but they break the monotony of the staple food and above all provide a balanced diet. Each season brings its harvest of particular wild or cultivated plants, and the introduction of new species has allowed significant enlargement of this choice of foods.

The most important and the fullest meal, which may be the only meal of the day in some regions, is taken late in the afternoon, at nightfall or in the evening. It is hot, substantial and generally comprises several dishes. There is always a dish of a root crop, banana or sago, with one or more other dishes as accompaniments.

Vegetables are always served; fish and meat much less often. In Tonga, Samoa and Vanuatu, pork is served on Sundays or during feasts. Other meats or fish are eaten two or three times a week, in small amounts. In Tonga, fish and crust - aceans are eaten on the spot, to an extent that is not quantifiable, by men as they fish and by women and children as they forage along the seashore.

Another meal, hot but less elaborately cooked, is eaten in the morning on getting up. It usually consists of a dish of a root crop or bananas, sometimes livened up with cold leftovers from the day before. There are, however, some dishes that are typically served in the morning, such as in Vanuatu certain *lap-lap*[5] dishes of breadfruit.

At the end of the morning, labouring in gardens may be broken with a light snack, prepared and eaten on the spot or made up of cold leftovers from the morning. It may comprise a grilled root vegetable, roasted bananas, nuts for nibbling or freshly picked fruits, even just a coconut to slake the thirst and ease the pangs of hunger.

Finally, the day is punctuated by constant picking of fruits and nuts, or snacks of pieces of root crop that the eaters have brought with them.

This snacking provides an opportunity for short breaks in the labours of gardening, for chat with people encountered along the way, or for stops when returning home. These snack foods vary with season and with region; they provide individual intake that is hard to measure in amount, but that is important qualitatively as a complement to the starchy staple throughout the year.

Drinks are never taken during a meal, but a drink is often served at the end. It may be fresh water, sometimes livened up as in Tonga with the juice of a golden apple (*Spondias cytherea*), or coconut water or a tea made from orange leaves. Drinks, like fruits, are taken outside mealtimes and mainly comprise fresh water or coconut water.

The abundance and diversity of the diet varies according to the season. Monotonous during the period between the two yam harvests, it becomes gargantuan during major feasts. It may also come close to famine after a violent cyclone, or in earlier times during wars. Periods of abundance may be followed by periods of food scarcity, when collection of wild foods and eating of snacks (nibbling) predominates over consumption of prepared meals.

[5] A type of thick cake made by cooking a puree of grated yam, taro, cassava, banana or breadfruit in leaves.

Feasts and meals in times of scarcity

Feasts

Feasts are characterised above all by an abundance of the staple food, which must be the most prestigious of the root crops, and by a diversity of accompanying dishes and the presence of meat or fish.

The social and other implications of the feast vary according to its duration and to the abundance of dishes that are prepared and brought along, then eaten and distributed. The feast always marks important social occasions and accompanies all ceremonies intended to maintain and reinforce the mutual relations between one community and another. It is planned for long in advance, by cultivation of a sufficient quantity of root crops, and is prepared over several days. It is never in itself the purpose of a social gathering, but it is the symbol of it and the achievement of it.

Certain meals, while not really falling under the definition of feasts, still have wide social implications and are organised to offer a dish that is special and much appreciated. Thus the Ankave families of Papua New Guinea take turns to organise collective meals during which are served the oily red sauce prepared from red pandanus or that obtained by macerating the fruits of *Pangium edule*, according to season.

In Polynesia, funeral ceremonies can last for several days and are accompanied by conspicuous consumption of food, much greater than that of normal days.

In Tonga, the meals of chiefs have particular importance and are outside the normal type. They are more frequent and more regular than those of the common people. Each of them is prepared by cooks whose status is among the lowest in the hierarchy. Each meal comprises a starchy food, together with a great diversity of accompanying dishes. They are regulated, moreover, by strict protocol.

In Melanesia, in contrast, there is no difference between the food of people of high rank and those who are commoners. Each person, whatever their status, eats in the same way. No member of the community may lay claim to the food for themselves, and there is in fact an obligation on all to see that the food is shared equitably. In the cuisine of Vanuatu there is always a pot filled with a cooked root crop that is intended to be nibbled during the day by children and by passing adults. Likewise, a gift of raw food, root crop, a packet of edible hibiscus leaves or a basket of fruits is always made to a chance visitor, who must always accept the gift.

In Samoa feasts centre around pork, taro and *luau*[6]. There is no special meal for chiefs as such. Status is indicated by being served ahead of others (each guest receives their food on a platter made by plaiting a

[6] Coconut milk salted with seawater and cooked in young taro leaves.

coconut leaf). Young people do not have a place in the "circle of honour" of guests, but wait at the edges and receive the leftovers, which are often plentiful. In fact the platters for people of high status are quite conspicuously provided with a surfeit of food, but custom dictates that those of high status are given much but eat little, at least at the time. They continue eating after they have returned home, with food that has been brought back from the feast by younger members of the family.

Meals in times of shortage

Periods of fasting, the significance of which seems to be greater in western Polynesia than in Melanesia, follow feasts during which large quantities of food have been eaten. These periods of shortage are generally caused by natural disasters, the most frequent and regular of which are the advent of cyclones. In a few hours these can entirely destroy food gardens and ruin the harvests from fruiting trees. In earlier times wars, during which one group of people would destroy the gardens and fruit trees of another group, had the same effect.

In such situations human communities have had recourse either to products that could be foraged or to products that were preserved. Among the foraged products would be plants that are not very abundant or ones that are toxic and require a long preparation before they can be eaten. They are utilised very little or not at all except during periods of shortage, but they are carefully conserved in the forests in anticipation of such times of scarcity. Among these may be listed *Pangium edule, Entada phaseoloides* and *Cycas rumphii* in Vanuatu.

In Tonga and in coastal villages of Samoa, in times of shortage the men turn towards the sea and there gather seaweeds, shellfish, fish and seabird eggs, by means of which they are able to survive. It is then that certain lesser plants, if they fruit at the right moment, may become important. Likewise, in earlier time the roots of cordyline were baked in ovens of hot stones.

The preserved products are fermented pastes of breadfruit or taro, salted or fermented pastes of banana, smoked nuts and dried breadfruit. These are prepared during times of plenty, when the harvest of seasonal fruits greatly exceeds the need of the community, or immediately after a cyclone in order to save some of the fruits that have fallen to the ground.

In fact the food shortage consequent upon a cyclone does not occur during the days or even the week immediately after the event. At that time the villagers have at their disposal the products of their gardens that have been able to be saved and an abundance of fruits that have been knocked to the ground,

many of which are not far off reaching maturity. Serious food shortages threaten a number of weeks later, when the plants in the gardens are dead and the fruits have rotted.

It is then that the salted banana pastes begin to be used, and later the fermented breadfruit pastes as well as products of foraging. The pits of fermented breadfruit, and the smoked nuts, keep for several years. While in Vanuatu a number of communities continue to prepare these preserved products in the traditional ways, in Samoa only some old people can still recall the times when breadfruit was fermented in pits.

Finally, nowadays in times of food scarcity the communities of the Pacific turn to imported products such as rice, tinned fish or meat, and even bread. In Samoa, perhaps through the influence of the Chinese community, rice has been present for a long time. It is also the commodity that international aid distributes as a priority to disaster-struck communities after a cyclone.

Social aspects of nutrition

Gastronomy or the art of food preparation

Oceanian cuisine is subject to two main imperatives: under normal circumstances and particularly at the time of feasts, it is necessary that large quantities of food can be prepared relatively quickly, capable of satisfying the appetite of a family that is often extended, or of honouring what may be more than a hundred guests; in times of scarcity, it must be capable of transforming foods that are often toxic or unpalatable into edible dishes. Oceanian food is not served in portions, but as a large spread of foods that can be divided satisfactorily among a variable and often unpredictable number of guests.

The daily cuisine is everywhere done by women, who often help one another in the preparation of the main meals. In contrast in Tonga and in Samoa the cuisine, at least nowadays that for feasts, is the responsibility of men. In Samoa the traditional cuisine (cooking in an earth oven) is always a male task. Only cooking in pots (boiling in water), an additional method introduced by missionaries, is a woman's job; before then

boiled dishes were cooked by placing a hot stone into a bowl, and that was men's work.

Preparation of foods

Root vegetables may be peeled, by a motion from the body outwards, then cut up into large pieces and carefully washed. They may also be grated; in this case the intact root crops are wiped clean. Large leaves of vegetables, such as those of cabbage and certain taros, are either cut into very thin strips, or are left whole in order to wrap a paste of banana or grated root vegetable. In every case they are examined one at a time, and every bit blemished or chewed by an insect is cut out. The fruits of Tahitian chestnut are sometimes peeled before being boiled. It is then necessary to extract the seed of each one to avoid any bitterness. Fruits that can be cooked, such as those of the dragon plum (*Dracontomelon vitiense*), have their stones removed. Small wild figs are washed carefully and picked over. All the products thus prepared are arranged on banana leaves or food-wrapping leaves (*Heliconia* spp.), and are covered to avoid spoilage while waiting to be cooked.

Modes of cooking

The mode of cooking that is best adapted to Oceanian cuisine is without doubt braising in an oven of hot stones, called an earth oven or a Polynesian oven, which is done in two steps. First of all a pit is filled with stones, usually of volcanic origin, and with wood which is burned in order to heat the stones. Later, the embers and some of the hot stones are quickly pulled out, then the pit is lined with leaves on which are spread the food items, themselves wrapped in leaves. The whole is then covered with the hot stones that had previously been removed, and finally some more leaves which seal the chamber completely. As they slowly cool, the stones give out a constant heat which allows the food to cook over a number of hours.

This mode of cooking is obligatory for feasts, because it permits the cooking of impressive amounts of food and allows the preparation of the traditional dishes served on such occasions: either a mixture of root crops, vegetables, and meat or fish, sprinkled with coconut milk (which is commonly called "*le four*"), or it may be large cakes of grated root crops, stuffed with leaves or meat and sprinkled with coconut milk (the *lap-lap* of Vanuatu).

In everyday cuisine this method of cooking is used once or twice a week to make "*fours*" or *lap-lap* that is smaller and less elaborate. In such cases the cook uses the pit and the stones that are present in all kitchens.

Nowadays in urban situations it is possible to use the oven of a gas stove to cook certain dishes that are traditionally cooked in an earth oven, provided that the recipe is simplified; the tastes of the dishes are accordingly also modified.

As kitchens are nowadays equipped with metal cooking pots, foods are boiled in fresh water, sometimes with the addition of some seawater or water flavoured with aromatic leaves. They are cooked on an open fire, or in urban areas on a gas cooker. This is the common mode of cooking for the preparation of everyday family meals.

Before the introduction of cooking pots, this mode of cooking was virtually absent from Oceanian cuisine. It was achieved with the help of hot stones put into the liquid held in wooden vessels, or by using small, cylindrical bamboo containers filled with water or coconut milk and put to heat over an open fire. This is not suitable for cooking large quantities of food and was thus used only for cooking vegetables or small amounts of root vegetables. This method of cooking in bamboo containers is still used daily by isolated communities whose kitchens are not equipped with metal cooking pots. This is the case among the Ankave, who cook unpeeled root crops beneath ashes, then scrape away the burnt skin and eat them, or they peel the root crops and cut them into pieces, place them in bamboo containers over a flame, and cook them together with leafy vegetables.

Fish and unpeeled root crops were, and still are, generally grilled over live coals. In this way the dishes are prepared for a family meal or, more often, a snack meal. This is the mode of cooking preferred by those working in gardens, by men in the *nakamal*[7] or by women who chatter away as they weave mats.

Flavours and gastronomy

The flavour of meals seems insipid to the Western palate and few seasonings are used, apart from turmeric (*Curcuma longa*) and ginger (*Zingiber zerumbet*), or nowadays chilli in small amounts. Aromatic leaves are sometimes used to flavour the water for cooking root crops. Nevertheless, the creation of sauces allows the food dishes to be livened up. The main ones are (in all coastal areas of Oceania) coconut milk, and (in New Guinea) the sauce from red pandanus (*Pandanus conoideus*) and from *Pangium edule.*

However, among those for whom this is the normal food, the flavours are more varied than they might appear. Two different varieties of taro, or of yam or banana or breadfruit, do not have the same taste. Moreover, different varieties are subject to different methods of preparation. For example, the variety of breadfruit used for roasting is not the same as that used for the preparation of *lap-lap.* The time of cooking likewise differs for each variety.

[7] Bislama term indicating a building (clan hut) for men.

Regional styles may be distinguished, based partly on different products but also on the combinations of foods and the differing methods of preparation. These come to modify the basic and relatively simple food. According to the society, the preference maybe for leaves of wild fig with yams or taros, leaves of cabbage with cassava or banana, chicken with this or that root crop. There are some regional cuisines that are quite dry, using very little by way of fatty ingredients, and others that use an abundance of coconut cream and are much oilier. In Vanuatu, the methods of preparation of *lap-lap* vary slightly from one island to another. Some basic recipes are utilised by the households of an entire region, while others are localised to a single society or even a single village. Even though westerners sometimes deny the existence of any sort of gastronomy in Oceania, the multitude of recipes that may be found in this part of the world truly bears witness to its existence.

Etiquette and customs at the table

In Vanuatu, chiefs and commoners eat in the same manner, without any great precedence during a family meal. There is no fixed time for the meal, which is not the object of any particular ceremony. When the dishes are ready they are served on banana leaves, and all members of the family, men and women, may come and help themselves.

Generally the women, seated with their legs folded to one side, eat apart with their children. During this time the men are in the *nakamal* and drink *kava*[8]. On returning home they quickly take their meal, which has been kept warm, and often an infusion or a weak tea which the women have prepared if the men wish. It is not uncommon for an unexpected guest to turn up at a mealtime, and they will join the family or simply share a yam before leaving again.

In earlier times in Tonga, food for chiefs was more abundant and comprised special dishes. For example, turtle was a chiefly food while commoners gladly ate rat and lizard.

Men, sitting cross-legged, eat before the women who take their meal with the children. In this strongly hierarchical society, the elder members also eat before the younger ones. There does not seem to be any particular conviviality

[8] A sedative, slightly intoxicating drink, obtained from the root of *Piper methysticum* and drunk by men at nightfall throughout the Pacific.

in the act of eating, apart from feasts in the course of which the exchange and distribution of food, as well as the protocol, takes on a major importance. Each person eats quickly, with out any conversation.

At the end of the meal, damp coconut fibre is passed around for cleaning the hands. The etiquette at the table is very strict for chiefs: a lesser person may neither drink nor eat before a superior one. Nobody may therefore eat before the chief, nor he before the elders of his family. Likewise, as a sister in this society is superior to her brother, the latter will never eat in her presence.

In Tonga, as in Vanuatu, everyone may join without invitation in a feast. The food is distributed by the chief or by the host family to all those invited. In Tonga the portions vary qualitatively according to the status of the person (member of the group or guest), but in Vanuatu the portions are more or less the same. However, food is never refused when offered. In Samoa, feasts relate to a community (family or village). Those of high status are said to receive more food than the others, but eat less there and then. The main attention is given to the order of seating within the dwelling (the important directions being opposite to the centre of he village and the forest), to the right to sit within the first circle that is formed and served, and very markedly to the order in which the guests are served. Even within the inner circle each guest must be served in turn, following the hierarchy that is already shown by the seating position that each one occupies.

Exchange of foods

Food products, raw or cooked, form the basis of a network and system of exchange between individuals and groups. The giving and the distribution of these products is in most cases more important than their consumption, and they are symbols of wealth and even of hierarchy. The importance of the food is such "that it creates, maintains and directs the social relationships" (Young, 1971: 146).

Among the Ankave of Papua New Guinea, the sauces made from the fruits of red pandanus and *Pangium edule* are always eaten at the time of communal meals which each family organises in turn, and for which they cook large quantities of root crops in half-sunken ovens. Portions of cooked sweet potato and taro are placed in leaves of *Cominsia gigantea*, which are lined up on the ground so that a man can pour the sauce over them. Although this relates to items of plant origin, this method of distribution closely resembles the rules governing the ceremonial exchanges of pork in the Western Highlands of the country.

In Tonga, the sharing of a pig or the distribution of baskets of food give an indication of the social importance of each person in the group according to the pieces chosen or the size of the baskets, which are offered publicly.

New modes of nutrition

The factors relating to food and feeding are subject to adaptations and changes that may partly or even wholly obscure the original modes of nutrition, or the old and the new may coexist together. This diet of vegetable origin (80% of the foods are starchy and combined with fruits, nuts and seeds of plants) has a low content of protein in the form of feathered and furred game, poultry, pork, fish and shellfish. It can nowadays be seen to have transformed to varying degrees according to the region, the extent of western presence and the extent to which the process of monetarisation has advanced, which may range from the initial stage of non-monetary exchange and barter to capitalist type economies.

New products

The advent of new products, natural or processed, allowed considerable enlargement in the choice of vegetables and fruits and increased the variety of species available locally, as also in the variety of animal protein. When no equivalent traditional product existed, the commercial products were rapidly adopted. This was the case with salt and with sugar. Other manufactured products such as canned fish or corned meat have taken their places in the ceremonies of exchange, insofar as they are now the products of value and status, and the symbols of a new wealth.

But soon these new products replaced the traditional products, because they were easier to prepare and better adapted to modern lifestyles. In Samoa canned fish and mutton flaps from New Zealand are found in all the small village stalls, even those furthest away from the capital, and they are what is eaten unless a chicken has been killed (which is done mainly for feasts) or someone has had time to catch a fish.

A widespread transformation of societies

A new range of foods based on preserved food, salted or frozen meat and fish, rice and bread, sugar and industrially made snack foods (cakes, sweets, fizzy sweetened drinks) have now made their appearance, mainly in urban areas. As the medium for cooking, butter and oil have at great expense replaced coconut milk. This is very often poor quality oil that is not good for high temperature cooking. Nevertheless, frying is developing as a new mode of cooking.

Mainly in Polynesia and in urban Melanesian areas, imported products were eaten at first out of "food snobbery" because they were scarce, expensive and had a status value. Little by little they spread into everyday cooking to the point where they supplanted traditional fresh products.

The major transformation of Oceanian nutrition does not rest entirely with the introduction of new types of food, but also in the excessive consumption of preserved products and snack foods. Nutritional imbalances have appeared, and local economies have become unbalanced through massive importation of manufactured foodstuffs.

The use of such foods nowadays has passed beyond simple food snobbery and seems connected with new lifestyles and economic conditions. Indeed, in urban areas and for those on fixed salaries working to set hours, the traditional snacking in the course of a day is no longer satisfied by fresh fruit but has been replaced by chips, soft drinks and chewing gum. It is nowadays much cheaper to eat rice than taro or yam, and a good number of town dwellers do not have access to a garden and must purchase almost all their food needs in groceries or in the market (apart from that brought to them by relatives living in rural areas or that exchanged between communities).

The changes to nutrition are founded on changes affecting societies throughout Oceania, which are as much economic or related to urbanisation as they are demographic.

In Tonga, a parcel of land was normally allocated as a garden to each young man at the age of sixteen years, according to the Constitution of 1875, but this has not been possible for a number of years now because of the population increase. This has mainly impacted on people in the main island of Tongatapu, where 60% of the entire population of the archipelago lives, following domestic migration from outer areas towards the centre. In many places land is increasingly reserved for cash crops (such as that of squashes in Tonga), to the detriment of traditional cultivation and the equilibrium of gardens in which the rotation of crops also included periods of fallow. Yams, taros and even sweet potato are no longer affordable by ordinary people and are replaced by rice, wheat flour, preserved foods and factory-made delicacies.

In many families, cooking in an oven of hot stones is reserved for Sundays; the little parcels of foodstuffs for braising are nowadays wrapped in aluminium foil rather than banana leaves which take too long to collect from gardens; corned beef often replaces the fish and the chicken that was formerly in the parcels prepared in this traditional method of cooking.

A different alimentary repetitiveness has arisen with these imported products, accompanied by greater regularity in the timing of meals, giving an impression of improvement which belies the loss of the original balanced diet for which the imported products are an inadequate substitute.

Parallel to this, efforts to improve the local species, if poorly executed, risk favouring species and varieties liked by western palates to the detriment of plants adapted to the tastes and needs of Oceanians. The inevitable loss of genetic diversity of these local species will increase alarmingly, and will progressively and insidiously suppress the elements that gave originality to Oceanian nutrition and permitted the survival of local communities. Certain small regional dishes, such as dragon plums (tambol) in coconut milk or papaya stuffed with canarium nuts, *lap-lap* filled with taro leaves or baked *poire-tortue* (the fruit of *Burckella fijiensis*) will no longer be able to be made because it will not be possible to obtain the ingredients. At the very most they will become in their turn luxury dishes for well-to-do families before they disappear altogether from the culinary repertoire of Oceania. They are still, however, treats for village families who thanks to them can have a slight break from the monotony of the daily diet.

It should not be thought that the peoples of Oceania are giving in passively to this slightly exaggerated situation that we have depicted. First and foremost, nutrition in rural areas (at least in Vanuatu and Papua New Guinea) remains largely based on traditional root crops, consumption of fruits and nuts and on local resources.

In other ways Oceanian societies are developing several strategies for adapting to the new conditions. For example, the recent construction of a covered market in Port Vila nowadays permits residents of Efate to obtain fresh produce every day of the week. It seems quite likely that this market, by offering the possibility of commercial sale of garden produce, has stimulated such fresh production both qualitatively and quantitatively. Increasingly products may be found there that are more varied, more abundant and more suited to the local purse: imported products, to be sure, but also plants of the forest whose attraction is so great that the local people and even expatriates will get up early in the morning to obtain them. Hot cooked dishes of the traditional cuisine sold at affordable prices may also be bought there, which stimulates the creativity of the cooks and also indirectly protects the local gastronomy from the complete abandonment that is feared.

For all that, the transformation of these subsistence economies towards the conditions of a capitalist economy produces an illusion of abundance, and leads to very real nutritional imbalances. This is why the products and the cuisine of the Pacific must be recognised, valued and protected. The nutrition will inevitably be subject to evolution, like that which has already occurred in the past. The important thing is to enable the peoples of Oceania to let this evolution happen while fully preserving the equilibrium that has been characteristic until now, and the flavours that have given Oceanian food its distinctiveness.

People of Oceania

Above: Chief Joseph Vira (Malo, Vanuatu).
Below: Enock Saro (standing on left) and the informants of Maewo (Vanuatu).

Mela Ruigi (Erromango, Vanuatu).

Above: Jenny Vira (Malo, Vanuatu).
Below: Chanel Sam, curator of the Herbarium in Port Vila.

Traditional alimentation in Oceania

(Photo: G. Bourday)

(Photo: G. Bourday)

Above centre: Nangai nuts (Canarium) are broken one at a time between two stones.
Above left: They may then be grated to obtain a powder that is sprinkled on lap-lap.

Arthur Kalokul (left) and Richard (right) (Efate, Vanuatu).

(Photo: P. Bonnemère)

William (Ankave, Papua New Guinea).

Ekimani Taufa (Tonga).

(Photo: M.-C. Bataille Benguigui)

The people of Oceania have excellent knowledge and understanding of their environment and of the plants that they utilise.

(Photo: M. Bourke)

Above: Assorted food dishes

(Photo: J.M. Bompard)

Above: In Solomon Islands and in Vanuatu, Canarium nuts are dried and packed in sachets (Solomons) or jars (Vanuatu), then sold in local cash stores.
Below: Children eating Canarium nuts on the island of Vava'u (Tonga).

(Photo: J.M. Bompard)

(Photo: B. Allen)

On the island of Boisa (Papua New Guinea), galip nuts (Canarium) are broken open in large numbers before being taken to the mainland to be exchanged for sago.

(Photo: J.M. Bompard)

Assorted nuts. Port Vila Market.

Nuts traditionally cultivated in villages or fruits of the forest are sold, often on skewers, in urban markets.

(Photo: P. Bonnemère)

Above: Among the forest-dwelling Ankave, the sauce of red pandanus (Pandanus conoideus) is collected in a Heliconia leaf and then poured over pieces of root crop, usually during communal meals.
Right: Vertical skewers: skewers of Tahitian chestnuts (Inocarpus).
Far Right: In Gaua (Vanuatu), nangai nuts are dried in their shells and kept in special baskets for years.

(Photo: J.M. Bompard)

(Photo: C. Sam)

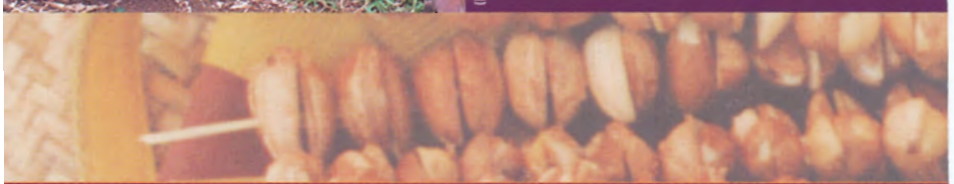
Horizontal skewers: skewers of fresh cut nuts (Barringtonia).

(Photo: J.M. Bomparol)

(Photo: M. Bourke)

(Photo: M. Bourke)

Above: Child breaking open sea almonds (Terminalia catappa) between two stones, Milne Bay (Papua New Guinea).
Below: In coastal regions, the sauce of red pandanus is prepared in a metal cooking pot and then spread over the root crops with the help of a spoon or ladle.



Traditional Arboriculture in Oceania

From the simple gathering of fruits in the forest to the planting of cash crop orchards, the exploitation of fruiting trees has undergone a slow intensification over the centuries, the consequences of which have borne at the same time on the progressive selection of certain species and on the modification of the landscape.

Traditional arboriculture is an important component of subsistence systems in Oceania, but this importance varies with time and according to geographical location.

The traces found today from archaeological excavations reveal ancient utilisation of fruits and nuts. In East Timor fragments of candlenut[9] have been found that date back to 3000 B.C. (Bellwood, 1985: 191). igs undertaken at Mussau have revealed an important assemblage of fruiting species (endocarp of candlenut, Burckella, Canarium nut, coconut, golden apple, sea almond; seeds of taun tree, pericarp of Tahitian chestnut, etc.) dating from 1200 to 1800 B.C. (Kirch, 1989). A complex of fruiting species, dating from a more recent period (from 50 B.C. to 1100 A.D.) have been brought to light on the southern coast of Viti Levu (Bellwood, 1979: 204).

If it is difficult from these traces to conclude the existence of a real cultivation of fruiting trees rather than a simple consumption of gathered fruits, it does seem clear that arboriculture has been established in the whole of Oceania since the second millennium B.C. It widened out later on, as is shown for example by the great abundance of pits for fermentation of breadfruit found in the Marquesas Islands, an indirect sign of a major exploitation of breadfruit, from 1200 A.D. (Kirch, 1984).

It is quite difficult in the existing state of knowledge to define precisely when and where arboriculture began to appear. It was a progressive process, from simple picking of fruits in the forest, to protection of trees being utilised, then to their transplantation close to domestic areas, and finally their cultivation. In ancient times it was not an important component of food production, though it was practised even in ancient times in some areas such as the Santa Cruz Islands (Yen, 1974) and the islands surrounding Papua New Guinea. Arboriculture then intensified progressively, to the level seen nowadays where it is a major component of food production.

The development of these practices seems to have taken place very early in the islands situated around Papua New Guinea, in Solomon Islands and then in Vanuatu. In these island environments, less rich in food resources, with limited space and subject to the hazards of periodic droughts and cyclones, the communities were forced to develop, if not to invent,

[9] The identification of the species cited here under their English names is given in the third part of this work (p. 79). An index of common names is also given at the end of the book (p. 311).

new practices for subsistence. It was then that arboriculture, as a system for exploitation of a natural resource, had to be developed. It is noticeable even today, throughout the islands of Melanesia, that the smaller the island the greater the density of fruiting trees and above all the better the quality of the cultivated fruits and nuts. Arboriculture is thus better developed in the islands of Vanuatu than among the forest-dwelling populations of Papua New Guinea (as among the Ankave). In Vanuatu, certain small islands situated opposite much larger islands (as with Lamen Island opposite Epi) have been transformed into veritable orchards.

It should likewise be noted that if the number of cultivated fruit trees decreases from west to east in the Pacific, so too does the number of different species involved in arboriculture. From prehistoric times one thus sees, from Papua New Guinea towards Polynesia, an impoverishment of the flora (since the beginning of human settlement), an intensification of arboriculture and a clear diminution in the number of species cultivated.

Everything has happened through the human communities progressively intensifying the care given to their trees, in order to increase the production of food resources which had become insufficient for reasons not yet determined: either because the available species were less numerous, or because a given species no longer naturally produced enough food. Arboriculture thus became a more and more important component of subsistence systems.

Paradoxically, and doubtless for different reasons, arboriculture seems to have undergone a net decline later in the islands of Polynesia, so that nowadays it is less important there than in Melanesia.

The modes of utilisation of the land vary from one society to another, and their study is largely outside the scope of this book. We will give, however, by way of brief examples, the cases of two rural societies of Melanesia, the Apma of Vanuatu (central Pentecost) and the Ankave of Papua New Guinea, and then that of more urbanised societies of Tonga (in Polynesia), in order to illustrate the very different contexts within which arboriculture is practised nowadays. Then we will analyse the different aspects that this presents in Melanesia and more particularly in Vanuatu.

Not all fruit trees receive the same amount of attention and not all profit from the same degree of care. Some are scarcely protected at all, while others by contrast are cultivated and are concentrated near gardens or villages. The majority receive some sort of care and are the objects of various practices, which depend on the abundance of the species, its natural

habitat, the nature and degree of utilisation of the plant, and the strength of the attraction that it holds for an individual or for a society.

Modes of utilisation of the land

The case of the Apma

The territory of the Apma, like that of many societies in northern Vanuatu, is made up of juxtaposed pieces of land on which each member of the community has a right of use. The villages are small in size, rarely exceeding fifty inhabitants, and generally comprise one couple, their married sons, and the children of those sons. More or less at every generation one son will leave to found a new village, some distance from the first one, on a patch of virgin forest or more often on land previously the site of an ancient hamlet or an ancient garden. After that, each hamlet is only occupied for two or three generations and is then abandoned.

In addition, each family clears a patch of forest annually for cultivating yams. In the second year this garden diversifies, with taro, sugar cane, maize and edible hibiscus being planted in it. It is then cultivated for another year or two before being abandoned. Each family thus cultivates two or three gardens per year, one of which is newly planted with yams. In general the piece of land cleared is larger than is used in the first year, so that the next year yams may be planted on the adjacent land that has already been prepared, and the crops in the garden can be diversified that year.

The gardens are thus most often situated close to one another. However, there comes a time when one will be further away. This is the case with rainfed (non-irrigated) taro gardens, placed at slightly higher altitude, or with certain strategic gardens opened up at the limits of the territory simply to claim the rights that are held over that land.

Thus the Apma horticulturists do not move far, and spend almost all their time in their villages, which they leave in the morning to go to the garden and to which they return in the evening to sleep there. The garden areas are situated an hour's walk away, rarely more. Foraging of fruits takes place in the area between the village and the garden. It may happen, however, that a temporary shelter is put up at a more distant yam garden, and this is then occupied during the period of harvest of these root crops. As for fruiting trees, they are generally transplanted or protected close to the domestic areas.

However, a continual rotation may be observed, over several generations, in the occupation of the land by the villages, the gardens and the fallows. Abandoned sites of settlement not more than a hundred years old are clearly marked by an assemblage of fruit trees which are occasionally harvested. It is there that one may find, for example, old Canarium nut trees (*Canarium* spp.), large taun trees (*Pometia pinnata*) or large cut nut trees (*Barringtonia* spp.).

The case of the Ankave

Among the Ankave, things are different. In establishing their hamlets and villages between 1,000 and 1,400 m in altitude, the Ankave are exploiting a series of ecological niches which are spread between 500 and 1,400 m, even in the hostile environments that are found at altitudes of 2,000 m. These different zones are regularly visited according to the rhythms of maturation and fruiting of the trees.

From October to December, the people move to the highest parts of their territory and they collect from the ground the fruits of the highland pandanus (*Pandanus jiulianettii*). From the months of April-May they install themselves for some weeks in the lower parts of the land where *Pangium edule* grows, in order to macerate the fruits of this tree. In June in the same areas they go to eat breadfruits (*Artocarpus altilis*). As for the red pandanus (*Pandanus conoideus*), it grows at the higher altitudes, and it is this differential fruiting according to species and altitude that causes the people to have to move around.

In consequence, the Ankave spend half, even two thirds, of their time away from the hamlet that is their principal residence, even though these may be scarcely more than half an hour's walk away. With this is associated a marked wish among Ankave families for isolation, which wish they nevertheless breach on several occasions: the collective consumption of red pandanus or of *Pangium edule*, the occasion of *ad hoc* markets for selling of pork meat, the death of a near relative, an initiation ceremony or the conclusion of a period of mourning.

With this annual mobility is allied a second that corresponds to the cycle of the gardens and stretches over several years. When a family opens up a new garden, every two or three years, they frequently clear a portion of their land opposite the preceding site. It may even happen that an Ankave opens a garden solely for the purpose of affirming their right of usage over a portion of forest. But, while the Apma gardener truly does exploit the garden opened up in order to affirm the right of use, cultivating it like the others for three to four years, the Ankave gardener

encloses it poorly, thus allowing pigs to get into it. The garden, quickly ruined, is then abandoned without ever having been tended with any care.

The case of Tonga

In Tonga the first travellers from outside (Tasman in 1643, Cook in 1777, La Pérouse in 1787, Labillardière in 1793) all bore witness to a habitat scattered with a series of dwellings, mostly coastal, surrounded by lands cultivated in a manner that was "very dense and carefully looked after". At the beginning of the 19th century, civil strife forced the people to gather into villages to preserve and defend themselves. This tendency was further encouraged by the arrival of missionaries and the beginnings of education and of trade. In 1882 a subdivision of land was established in which every male at the age of sixteen was given a space in the village for building his dwelling (an *api kolo* of 0.125 ha) and a garden outside the village (an *api uta* of 3.34 ha) where he could grow root crops for food.

The traditional utilisation of land in these volcanic soils, or coralline soils enriched with volcanic ash, is as a mosaic of plots planted with a great diversity of species and associations of root crops. This cultivation is undertaken in an environment of secondary vegetation at various stages of regrowth, beneath the shade of a great variety of useful trees, protected or planted (Thaman, 1976). In these gardens the Tongans traditionally practise a rotation of crops over a ten-year period (in the order: yam, taro, sweet potato, cassava) and the alternating of cultivation on a third of the land and fallow on the rest. Each year they move the yam cultivation to a regenerated piece of fallow (reoccupied) and cleared by burning of the secondary vegetation that had grown back there (Crane, 1979).

Nowadays the massive increase in population (which has increased five-fold since 1920) and the development of cash cropping has meant that these periods of fallow have disappeared. This has led to intensive utilisation of fertilizers which, as is beginning to be evident, presents certain dangers.

Species foraged and species cultivated

Species foraged

The majority of plant species that produce edible fruits or nuts may be considered as species that are foraged. Thus in Vanuatu, where about forty species of edible fruits are known, about thirty species are never cultivated. Disseminated by ocean currents, by birds, by bats, these species reproduce spontaneously. Their growth is, however, protected by humans who leave in place the germinating seedlings and then the trees. These species are each designated by a particular name, with which a second term may sometimes also be associated that is intended to distinguish the different forms.

The territory exploited by each community is never very large, and each person knows the locations of all the useful trees and is thus able to harvest them according to their needs. In season the harvest may occupy the entire community. For most of the time it is opportunistic and occurs randomly as people walk in the forest or while they are out on a hunt. However, when a cyclone or a particularly serious drought has damaged or even destroyed the gardens, the villagers need to have systematic recourse to the foraged species to ensure their subsistence. This is perhaps the main interest in this type of plant. They represent reserves on hand, an emergency nourishment however long they take to prepare but available during times of hardship. Thanks to these species the gardener can maintain relative nutritional independence, and likewise economic and political independence.

In the forests of the Ankave a number of trees with fruits or nuts grow spontaneously: *Finschia chloroxantha, Castanopsis acuminatissima, Gnetum gnemon, Sterculia*, and also *Ficus* and *Elaeocarpus*. Each species is only represented by a small number of individuals, for which most Ankave know the location but without giving any special care to the trees. Their fruits are eaten, raw or cooked according to the sort, in an opportunistic manner as the people move through the forest, and are only exceptionally picked to be taken back to the village.

Species protected

The fruits and nuts of certain species are gathered in abundance and eaten regularly. However, they are not the objects of real cultivation. In Vanuatu, for example, the majority of sea almonds (*Terminalia catappa*), Burckella

(*Burckella obovata*) and dragon plums (*Dracontomelon vitiense*) grow spontaneously in their natural environment. The sea almonds are situated in open spaces on the shore, which is generally where the villages are established, while the Burckella are found in forest up to 300 m altitude.

These two species reproduce very well spontaneously, and provide fruits that are destined to be eaten on the spot. The children from the villages gather sea almonds in abundance, while the hunters in the forest regale themselves with Burckella. However, gardeners transplant seedlings closer to domestic areas, or to an altitude where the species is less frequent or absent altogether, thus extending its distribution. One may therefore encounter a Burckella in a village, or a sea almond above 400 m altitude.

The main species exploited in semi-cultivation by the Ankave is *Pangium edule*. Each season, after treatment of the fruits on the spot, some seeds remain at the foot of the trees and give rise to young trees, and in time to little orchards which are then looked after.

Species cultivated

Finally, certain species are regularly cultivated. These are the ones that are eaten most of all, that produce the most abundant harvests and for which the availability is widest. The majority among them have a wide geographical distribution: the Canarium nuts (*Canarium* spp.) are present (all species considered together) from Indonesia to western Polynesia; breadfruit is cultivated throughout the Pacific to Southeast Asia; the Tahitian chestnut is found from Malaysia to the Marquesas Islands.

These fruits are staple foods for Oceanians, and it is probable that their distribution actually reflects the geographical regions in which the ancestors of the island peoples of the Pacific dwelt in earlier times. Their spread results, at least for the most part, from human activity. These are generally coastal species, which are scarcely found above 1,000 m, even 600 m. They are ten in number: *Artocarpus altilis, Barringtonia edulis, B. novae-hiberniae, B. procera, Canarium harveyi, C. indicum, Spondias cytherea, Inocarpus fagifer, Pometia pinnata* and *Syzygium malaccense*. In Vanuatu all are found in the villages or close to domestic areas.

Through the centuries the cultivators have progressively gathered together the better forms of these species, on which they have exerted a gentle but continuous selection pressure. Multiplication, even though it can occur spontaneously, is assured by the planting of ripe fruits or of germinated seeds, or by transplanting young seedlings of sufficient vigour. In the end the

care given to these trees is minimal: the young seedlings are however protected from the sun, and weeds are eliminated. Dead or damaged branches are cut off, and the tree is pruned in order to reduce its height. When a tree is no longer productive it may be felled, or it may be kept to attract flying foxes[10] which are then captured more easily, except in Tonga where their consumption is banned by tradition.

The Ankave of New Guinea really only cultivate two species: red pandanus and *Terminalia kaernbachii* which fruit poorly in the high areas and are found mostly in the eastern valley of the territory, below 800 m altitude.

The fifteen cultivars of red pandanus fruit at intervals of several weeks apart, during the period of heavy rains from September to April-May. In the overall diet their consumption proves important because of their content of protein and fats. It is a very much appreciated food to which the Ankave attribute the property of regeneration of the blood.

As for the nuts of *Terminalia kaernbachii*, they are in general eaten grilled, but may be prepared like the kernels of *Pangium edule* when the harvest is particularly abundant and the fruits are at risk of rotting before they can be eaten.

Selection pressure

Intraspecific diversity of cultivated species

All the cultivated species comprise several forms to which the gardeners give particular names, which is not the case with foraged species. The number of cultivars varies from one species to another, and from one region to another. Certain communities in Vanuatu distinguish up to a hundred different cultivars of breadfruit, twenty cultivars of canarium nut and nineteen cultivars of Tahitian chestnut. The Ankave distinguish fifteen varieties of red pandanus according to the shape of the fruit and the period of fruiting, while the Wola of the Western Highlands of Papua New Guinea only distinguish four (Sillitoe, 1983).

Because reproduction is sexual, there is systematic redistribution of genes in each generation of trees, which makes it difficult to get identical multiplication of these forms. Only breadfruit and to a lesser degree the golden apple, which may be propagated by asexual means, provide cultivars with stable names.

[10] A type of fruit-eating bat common in Oceania.

However, it is undeniable that repeated selection of the same forms, generation after generation, has resulted in production of particular cultivars, clearly identifiable by name and recognisable by the colour of their fruits, the shape of their nuts and all other morphological characters. In the absence of any genetic study, we ignore the correlation between the genetic pool of these cultivars and their rich diversity of form. Since the trees have a long life-span, generally exceeding a human lifetime, it is quite difficult to determine the genealogical complexity of such vegetative forms. Certain trees with fruits of particular characteristics will nevermore provide exactly the same form and, in the absence of vegetative multiplication, their names will disappear with them.

Management of diversity

However it has happened, the repeated and continuous selection of the largest, sweetest, least fibrous fruits, the nuts that are largest or have the softest shells, the trees with abundant production or those that fruit a little before or a little after the main season, has led to the improvement and diversification of these species.

Generally the gardeners, aware of slight variations in form, taste, colour and size of fruits that they are utilising, have a tendency to conserve each distinct cultivar, from preference, necessity or prudence. From preference because some individuals like to build collections that include cultivars not known to other people. From necessity because the different cultivars of a single species are not all eaten in exactly the same manner: certain cultivars of breadfruit cook more quickly than others, all Tahitian chestnuts do not have the same taste, each among them is therefore a slightly different food. Finally from prudence because certain cultivars are available before or after the others, or are more resistant to problems than the others.

The most popular cultivars are, however, propagated more frequently than the others and are therefore more abundant. If circumstances require it (most often through lack of available land), the least utilised cultivars are cut out. There is therefore an ongoing erosion of the genetic stock in favour of cultivars that correspond best to the tastes and the needs of the gardeners. Beyond the results provided by agronomic research, it is these tastes and these requirements that need also to be taken into account if the multiplication of certain cultivars is undertaken.

Modification of landscapes

A place for each species

These practices of selecting and assembling the better forms have resulted, over time, in a profound transformation of the landscape. The fruiting trees are found mainly in or near villages, gathered into small plantations, near the gardens whose boundaries they mark, along frequently used footpaths, or in some cases in the forests where they are dispersed.

The trees in the villages are those that are used the most. The smallest, like the cut nut, are planted close to dwellings and are regularly collected by children. So too breadfruit trees, whose dark foliage adorns the village, and some sea almonds planted for the shade afforded by their large crowns of horizontal branches. There is always a patch of land reserved for fruiting trees, at the edge of the village. There one finds, among the coconut palms, the cut nuts, the breadfruit trees, the Tahitian chestnuts, the golden apples, as well as species relatively recently introduced such as grapefruit and oranges.

The fruit trees are also planted around the gardens. The midday meal, a simple snack eaten on the spot, often comprises fruits eaten raw or, in season, a breadfruit quickly grilled.

Nowadays, because the pressure on land is becoming ever greater from the population explosion, these trees, spread between the cultivated plots, are often felled. The gardeners tend increasingly to concentrate their fruit trees into plots reserved for that purpose.

In the forest, apart from the spontaneous species, one also finds habitually cultivated species that have reproduced spontaneously or that are evidence of an ancient place of settlement. It is there that new cultivars may often be discovered. The forest trees generally possess fruits of poorer quality, and they are mainly utilised for their wood.

Each individual only plants a certain number of trees in their lifetime, but more than half the fruit trees counted in a village will have been planted by the current generation or the preceding ones. It is the cumulative effect over time of these small individual actions that progressively modifies the environment and results in creation of the existing landscapes.

Long term management of land

In reality, arboriculture is only one aspect of the considered management of the whole territory. The domestic zones, the cultivated spaces, the assemblages of useful species which stand out in the landscape and are

in harmony one with another in the exploited territory are not fixed and may be abruptly modified.

For example, the communities living on small islets opposite much larger islands may decide to open almost the whole of their gardens on the large island, following agreements with the communities of the main island or in order to affirm their right of usage over the land on which they are situated. In this case the islet is transformed into a huge orchard, over the span of a single generation. This situation must have occurred quite often in the past since one can see that these islets are often veritable reservoirs of improved fruiting trees. One illustration of such happenings is provided by the archipelago of Tonga of which the oceanic islands, denuded of populations, were planted in the last century with coconuts exploited for copra.

The migration of a community from the interior to the coast is accompanied by increased planting of fruiting trees in the new site of habitation and the progressive and partial abandonment of the genetic stock patiently built up in the course of preceding generations. In this case, the trees at the ancient site of settlement are used as a source of living material for replanting, and clearance of new domestic land combines with protection of every useful tree that is found there, which may have been planted by an ancient community.

Arboriculture is thus bound up with the fundamental history of each community, and with the historical events that the community has been obliged to face.

Conclusion

Arboriculture is a fragile activity, because it is split into a great number of small operations occurring over a long period, and because it is protected solely by the wisdom and knowledge that go with it. It is also made fragile by virtue of the changes in usages linked to outside pressures (changes to modes of nutrition, impact of the cash economy).

Several thousand years old, it must nowadays adapt to new economic circumstances. Among the species wisely conserved by successive generations of gardeners, among the cultivars slowly selected by the ancestors, which are the ones that will survive the current day transformations of agriculture?

Which are the places where this rescue is still possible? Melanesia, and particularly island Melanesia, still possesses a living arboriculture. Western Polynesia, which already started with a more limited, less diverse inheritance of species and cultivars, seems by comparison to have temporarily forsaken the traditional cultivation of the local species. Melanesia thus appears to be the

holder of an important genetic stock, and the Melanesians are owners of precious knowledge. This biodiversity and this knowledge must be protected and utilised for reintroduction into other islands of the Pacific, such as Samoa and Tonga, of fruiting species of good quality, ideally adapted to local conditions.

At the same time, certain species such as canarium nut, cut nut, sea almond, *Burckella obovata*, golden apple, Tahitian chestnut, even *Burckella fijiensis* and Finschia, have some economic potential. Many among these are actually produced in sufficient quantities for commercialisation, at least locally, and could therefore provide supplementary incomes to local growers. It is not desirable at this stage to increase the planting of these species greatly, particularly while their agronomic characteristics are still not well investigated; however, even now it would be possible to utilise the existing surpluses in a commercially viable way, by processing them and selling them in local markets. Demand from consumers is strong, and the first attempts at commercialisation that were started in Solomon Islands and Vanuatu have proved clearly that they can succeed. The local fruiting species of Oceania cannot by themselves alone improve the economies of the countries of the western Pacific. Nevertheless they are part of the local heritage, and if rapid attention is not paid to them they are destined to disappear, when they could, by their diversity and their good adaptation to local conditions, contribute to diversifying the crops and improving the standard of living of rural communities. We now describe these species one by one, while recommending that the necessary research for their protection and their development be undertaken without delay.

Ethnobotanical Inventory of Fruiting Species

The fruits (fresh or dried) which we present here comprise the great majority of species utilised in the western Pacific. Each species is treated in a separate entry, listed in alphabetical order of genus. Each entry starts with a box giving the name of the species, its botanical family, common names in English and French, the name in Bislama (the lingua franca of Vanuatu), the nature of consumption of the species, the part eaten, and whether there is any toxicity known.

This is followed by: the botanical description[11], any morphological variability, ecology and modes of exploitation, alimentary usage and other uses, other edible species in the genus, and bibliographic references. Geographical distribution is presented by a series of maps. Below are explanatory notes on these categories of information.

Common names:
Common names given to species are so numerous that it is impossible to list all. We indicate in bold type the names (in English and French) that are best established in the literature, and after them the names that are also quite often used. With the French names, the name of the fruit is given first followed by the name of the tree in brackets (Bizet & Walter, 1996). Some species do not have common names.

Vernacular names:
A multitude of vernacular names exist, thanks to the variety of languages that occur in Oceania, especially in Melanesia. In the box entry for each species we quote (if it exists) the name in Bislama, the lingua franca of Vanuatu which is the reference country for the whole of the present work. A list of the most commonly used vernacular names in Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Samoa and Tonga is given at the end of the work (p. 289).

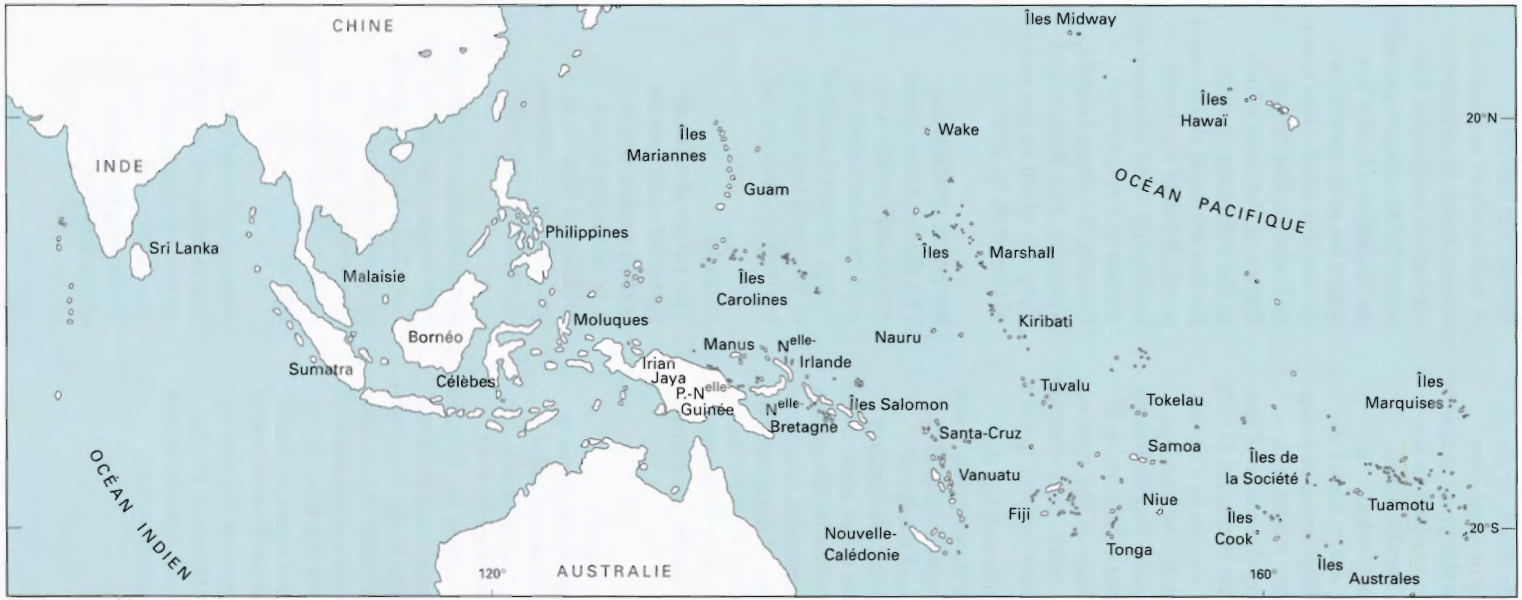
Botanical description:
The descriptions given are based for the most part on observation of living material studied in Vanuatu (not just on herbarium specimens).

Altitude
The range of altitude given for each species is that within which it is normally found. Additional figures in brackets are extremes of altitude recorded.

Geographical description:
The maps indicate the distribution of the species at the moment of first European contact; the arrows indicate subsequent spread.

Bibliographic references:
The references, given in the shortened form of author(s) plus date, refer to the Bibliography at the end of the work (p. 261).

[11] The botanical descriptions unavoidably use technical botanical terms, but a Glossary near the start of this work (p. 13) should allow the terms to be easily understood.



The South Pacific

Key to French names:

Australie	= Australia	Îles de la Societé	= Society Islands	Îles Salomon	= Solomon Islands	Nelle Bretagne	= New Britain
Célèbes	= Sulawesi	Îles Hawaï	= Hawaii	Inde	= India	Nelle Irlande	= New Ireland
Chine	= China	Îles Mariannes	= Mariana Islands	Malaisie	= Malaysia	Nouvelle Calédonie	= New Caledonia
Îles	= Islands (Austral, Caroline, Cook, Marshall, Midway)	Îles Marquises	= Marquesas Islands	Moluques	= Maluku	P.-Nelle Guinée	= Papua New Guinea

Species
Aceratium oppositifolium D.C.

Family
Elaeocarpaceae

Consumption
In times of food scarcity.

Part eaten
Fruits.

Toxicity
None.

Description

Small tree (6-15 m) with a straight trunk. Leaves simple, lanceolate (6-11 x 2.5-3.5 cm), base rounded, margins undulate; 6-11 pairs of secondary veins; petiole 0.5 cm long. Flowers arranged in a pendulous raceme; calyx yellow-green, pubescent (2 cm); corolla yellow and as long as the calyx. Fruits green, then dark red when mature, oval (3-5 x 2-3.5 cm), with 3-5 more or less distinct faces.

Morphological variability

Wheatley (1992) indicated the existence of trees with white flowers, and Borrell (1989) noted trees with rose-coloured flowers.

Geographical distribution

Indonesia, Papua New Guinea, Solomon Islands, Vanuatu.

Alimentary uses

In Vanuatu the fruits are eaten cooked in times of food shortage. In Indonesia they are eaten raw or cooked.

References

Backer & Bakhuizen van den Brinke (1963), Borrell (1989), Wheatley (1992).

Species
Adenanthera pavonina Linnaeus

Family
Fabaceae

Common names (English and French)
Coral pea
Red sandalwood
Red bead tree
La cardinale (cardinalier)

Name in Bislama
bisa

Consumption
None in Vanuatu; occasional in Tonga; more regular in Samoa, as in India.

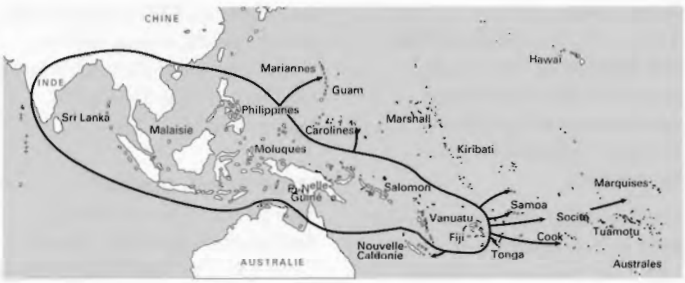
Part eaten
Seeds.

Toxicity
Considered to be toxic in some places, but regularly eaten in others.

Description

Tree of medium height (6-20 m), crown not very dense. Leaves compound, long (15-40 cm), made up of 3 to 6 opposite pinnate leaves (7-16 cm long); petiole 5-8 cm long; each pinnate leaf with 5-10 leaflets, alternate or sub-opposite, dark green, slightly glossy, elliptical (2-4 x 1.1-2.2 cm), base asymmetrical; veins invisible. Flowers grouped in dense spirals on an elongate axillary raceme; calyx minute; 5 bright yellow petals, lanceolate (4-5 mm); numerous stamens. The fruit is a brown pod, narrow and long, swollen at the parts where the seeds are, coiling round on itself when ripening and then opening to liberate the seeds; seeds bright red and glossy, round or very slightly cordate (0.8 cm in diameter), flattened (0.5 cm thick) and hard.

Adenanthera pavonina.



Adenanthera pavonina: species indigenous to India, Sri Lanka, Burma, Malaysia, Indonesia including the islands of Indonesia to the Moluccas (Maluku). Also found as far as southern China, Vietnam, Cambodia, the Philippines and north-east Queensland in Australia. Probably introduced in ancient times to all the islands of Melanesia as far as Fiji, from the Indo-Malayan Region (Smith, 1985). Later aboriginal or European introduction to Fiji; European introduction further eastwards (as far as the Marquesas) and to Micronesia (Marianas and Caroline Islands). Introduced to New Caledonia at a date unknown.

Morphological variability

Nielsen (1983) recognised two varieties. The first, var. *pavonina*, is native to India, Sri Lanka and Myanmar. The second, ar. *microsperma* (T. & B.) Nielsen, grows in South East Asia and in western Malaysia. Backer & Bakhuizen van den Brinke (1963) regarded this latter variety to be a distinct species (*Adenanthera microsperma* T. & B.). The existence of these two species or varieties explains the different alimentary uses from one Pacific island to another.

Ecology and exploitation

In Vanuatu the tree, although not very abundant, is found in all the islands, from sea level to 400 m. It thrives in places that are somewhat dry, in calcareous soils, in open woodlands and in places disturbed by human activity. It is much rarer in the south than in the north. It is a naturalised tree that is neither maintained nor transplanted. Its multiplication occurs through seeds dispersed by birds, though germination is slow. It fruits at the height of the dry season (June to August). Flowering occurs three to four months earlier, from February to April. Outside Vanuatu, the tree is generally naturalised in all Pacific islands, as in Fiji where it occurs from sea level to 600 m altitude (Smith, 1985). It is cultivated (from seeds or by cuttings) in India, in Guam and doubtless in other tropical regions. In northern India it may be found up to 1,200 m altitude.

Alimentary uses

In Vanuatu the seeds are not eaten except in certain villages on Santo. In Australia they are said to be toxic (Cooper & Cooper, 1994). The roasted seeds are eaten in India, in Wallis and above all in Samoa where they are sold in markets. Finally in Tonga children nibble them raw.

Other uses

The shiny red seeds of the red bead tree are used everywhere for making necklaces and bracelets that are nowadays sold to tourists.

In Guam, in southern India and in Sri Lanka the seeds are also used as weights, being very uniform in size and weight (0.26 g).

The timber is used for making paddles and for above-ground frameworks of houses. It is used for making artisanal objects such as kava bowls (Tonga), or when cut into boards for carved furniture (Wallis). The red wood is sometimes used as a substitute for red sandalwood (*Pterocarpus santalinus*), which doubtless accounts for its English name of red sandalwood tree. In India it is used as a dye, and all parts of the plant (seeds, roots, leaves, bark) are used in traditional medicine (The Wealth of India, 1985).

Other edible species

The genus *Adenanthera*, distributed from southern China to the Indo-Malayan Region and Australia, comprises 12 species. *A. pavonina* is the most widely distributed species, and is the only one that is eaten.

References

Backer & Bakhuizen van den Brincke (1963), Cooper & Cooper (1994), Corner (1988), Dupuy & Guiot (1992), Nielsen (1983), Parham (1972), Peekel (1984), Smith (1985), Stone (1970), *The Wealth of India* (1985), Whistler (1991), Yuncker (1971).

Species
Aleurites moluccana (L.) Willdenow

Family
Euphorbiaceae

Common names (English and French)
Candlenut
Candleberry tree
La noix de Bancoul (bancoulier)

Name in Bislama
Kandeltri

Consumption
Two to three kernels at the most.

Part eaten
Kernels.

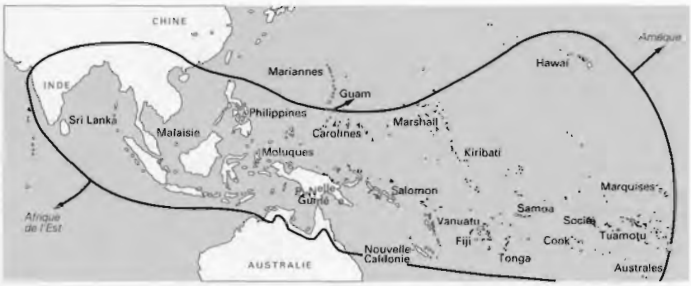
Toxicity
Causes nausea and vomiting if consumption is more than two to three kernels. Cooking reduces or eliminates the toxic effect.

Description

Tree of variable height according to region (10-35 m). Leaves simple, alternate, furnished with a fine whitish covering that gives the foliage a pale green appearance; oval or trilobate (8-22 x 3-10 cm), base cordate; petiole 5-16 cm long. Flowers numerous, grouped in terminal bunches, greenish, small in size. Fruits green, then chestnut-brown at maturity, rounded (3-7 cm in diameter); peduncle less than 1 cm; containing one to two rounded nuts (2 cm in diameter), slightly flattened, furnished with grooves and very hard; the nut encloses an oily, white, rounded kernel.

Morphological variability

The size of the nut contained within the fruit varies from one region to another, and may reach up to 4 cm in diameter. A variety of *Aleurites moluccana* is found in Vanuatu (Maewo), introduced from Solomon Islands, of which many seeds can be eaten without any problem. It is therefore likely that several varieties of candlenut occur that are toxic to greater or lesser extents. Montrouzier (quoted by MacKee, 1994) distinguished three varieties, two of which contained a purgative oil and one of which had seeds that were edible and non-toxic. According to Brown



Aleurites moluccana: species present from India to the Marquesas Islands and from Guam to Australia. Wild in southern India, naturalised in the remaining countries. Undoubtedly introduced in very early times to Pakistan, China, north-eastern Australia, the Philippines, Malaysia, and all the islands from Sumatra to Tonga, including New Caledonia to where some authors believe that it could have been indigenous. Introduced by aboriginal peoples to the Society Islands, the Marquesas and Hawaii, and then by Europeans to Guam (from the Caroline Islands), to East Africa and more recently to America.

(1935), the inhabitants of Hivaoa and Fatuhiva also distinguish two forms of candlenut tree according to the shape of the leaf. Finally, Cooper & Cooper (1994) described the occurrence in Australia (Queensland) of two varieties of candlenut: *A. moluccana* var. *moluccana* and *A. moluccana* var. *rockinghamensis*. The latter variety is distinguished by the presence of 3 to 4 nuts in the fruit. Both varieties are toxic, but a small number of nuts may be eaten after being grilled.

Ecology and exploitation

Present in all the islands of Vanuatu, the species is quite common. It grows spontaneously from sea level to 200 m altitude, on calcareous soil or damp ground. The tree is not planted because seed germination is poor, but seedlings are protected. The flowering and fruiting seasons are difficult to define precisely. In Papua New Guinea the species is found from 0-1,800 (2,160) m altitude (Bourke, personal communication); in Fiji it is found from sea level to 825 m altitude. The species is abundant and cultivated in the Indo-Malayan Region, in Polynesia and in Hawaii. In the Pacific islands the culture of this species was more important in earlier times than nowadays, and it is more important in Polynesia and in Hawaii than in Melanesia. In Fiji it is not found in forests, but occurs close to villages or at sites of ancient settlement; in Samoa it is not common except at particular spots; in Tonga it is common; in New Caledonia it is protected or planted; in Guam it is rare.

Alimentary uses

The seeds may be eaten raw in very small quantities (2-3 seeds). More than that causes nausea, and even vomiting and abdominal pains. The seeds may be roasted, which renders them less toxic. In Vanuatu, consumption of these toxic seeds is infrequent. In Java, on the other hand, they are

Plant part	Method of preparation	Utilisation	Location
Nut	Burnt to produce soot	*tapa* tattoos	Samoa Samoa-Marquesas
		cosmetic for eye-lashes	Malaysia
	Soot mixed with bark of *Bischofia javanica*	*tapa* tattoos	Tonga
Pulp	Juice pressed from pulp	dyestuff	Fiji
Internal bark	Juice pressed from bark (brown-red)	*tapa*	Austral Is – Cook Is, Marquesas
		fishing nets	Hawaii
Seeds	Ground and made into an ink	*tapa*	Wallis
Roots	Ground and made into a brown dye	*tapa*	Fiji
		dyestuff	Java

Table 1. Different methods of preparing colouring agents from parts of candlenut tree

crushed and made into a sauce to accompany vegetable and rice dishes. Likewise they are used as a condiment in Hawaii and in Malaysia, after being roasted, crushed and mixed with salt and chilli. These seeds have a delicious flavour, but need to be eaten with caution.

Other uses

This species is greatly utilised in many regions, though not much in Vanuatu. In earlier times the nuts were threaded on to the midrib of a coconut palm leaf and lit. They burned slowly one after another, producing a feeble light. This usage, which has nowadays largely disappeared, was well known in many regions where the species was found, and gave the popular name of candlenut to the plant.

A brown or black dye may be obtained from the fruits, the bark or the roots. It is mainly used for producing designs on materials and on beaten bark (*tapa* cloth), but may also be used to colour fishing nets and tattoos or as a cosmetic (Table 1).

The oil extracted from the seeds was used in Fiji for polishing wood, in Tonga for making paints and varnish then used for *tapa* cloths, and in the Philippines for making soap, and paints for boats and artisanal objects. This oil is extracted in large quantities in the Philippines and in China. Fijians use the oil as a cosmetic for the hair and skin. Similar usage is found in Tonga, where the crushed nuts also provide a substitute for soap, and in Wallis where the crushed seeds are used for softening and scenting the hair. Medicinal uses are numerous throughout the area where this species is found. In Fiji, for example, an infusion of leaves or bark is used to treat mouth ulcers, crushed seeds to treat skin lesions and wounds, an infusion of bark to treat fevers and diarrhoea (O'Rourke, 1995). The fruit also plays an important role during childbirth (Seemann, 1862): it is placed in the mouth of the newborn child so that the juice cleans the throat of the child and helps it to cry. The seeds are laxative, the fruit is an expectorant, and

the leaves, bark and roots are used in many medicinal preparations.

The wood is used in Rapa and the Austral Islands for making canoes.

In Hawaii the shell of the nut, which may be attractively polished, is used for making necklaces and jewellery (Neal, 1965). In the past the nuts were also first pierced and subsequently buried in taro pits (Brown, 1935). The seed rotted, and the shell then acquired an attractive black colour. Some of them were then carved.

Other edible species

The genus comprises six species present in Asia and the Pacific. No other species of *Aleurites* appears to be edible. However, four of the species produce an oil that is used in paints and varnish or for burning in lamps:

cordata (Thunb.) R. Br. Ex. Steud.: Japan, recently introduced to Hawaii and New Caledonia;

fordii Hemsl.: indigenous to central and western China, cultivated in many tropical regions including Hawaii; produces an oil called tung oil; in Fiji cultivated at experimental stations;

montana (Lour.) Wils.: Indochina and south-east China, known by the name *abrasin*; produces an oil identical to tung oil; cultivated in Fiji at experimental stations; recently introduced to Hawaii and in many tropical regions where it is cultivated;

trisperma Blanco.: indigenous to the Philippines; recently introduced to Hawaii.

References

Brand Miller *et al.* (1993), Brown (1935, 1954), Burkill (1966), Christophersen (1971), Cooper & Cooper (1994), Corner (1988), Dignan *et al.* (1994), Dupuy & Guiot (1992), Hemsley (1894), MacKee (1994), Neal (1965), O'Rourke (1995), Parham (1972), Seemann (1862), Smith (1981), St John (1960), Stone (1970), *The Wealth of India* (1985), Whistler (1984b), Wichman & St John (1990), Wilder (1934), Yuncker (1971).

Fruits and Nuts of Oceania

(Photo: M. Bomparo)

(Photo: A. Bizet)

Above: candlenuts for sale in a market in Tonga. Oil is extracted from these nuts.
Middle: candlenuts (Aleurites moluccana).
Left: coral pea (Adenanthera pavonina).

(Photo: P. Bonnemère)

Breadfruit shows great variability. Note the differences in form, colour and texture among these specimens from Vanuatu.

Above: Wild form of breadfruit (Artocarpus altilis) from Papua New Guinea.
Right and far right: Cultivars from Vanua-Lava (Vanuatu): fruits and detail of the epidermis.
Below: Breadfruits for sale in the market in Apia (variety ulu aveloloa).

(Photo: J.M. Bompard)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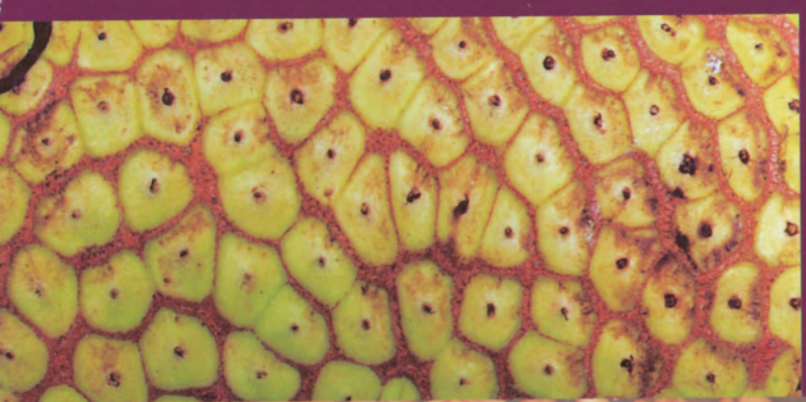
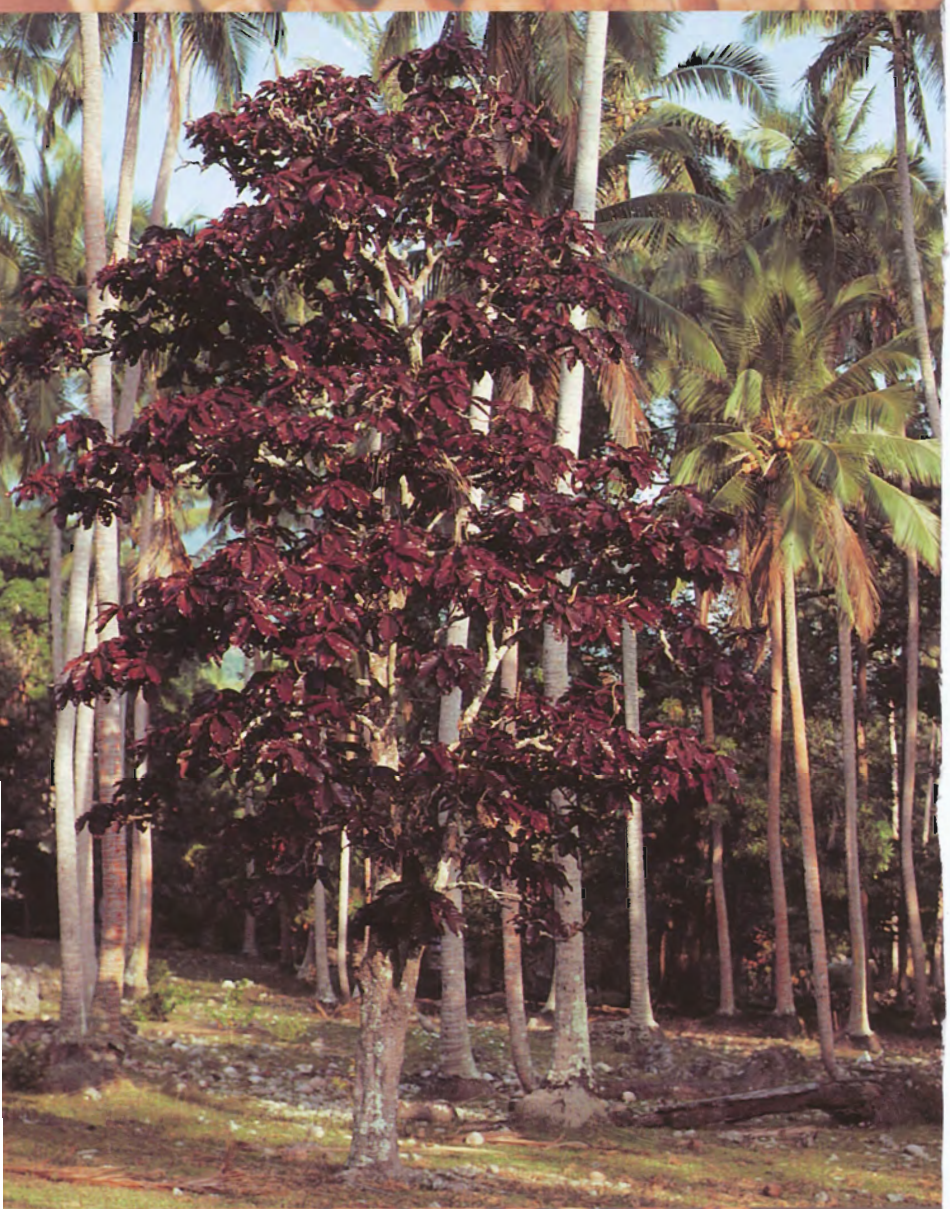
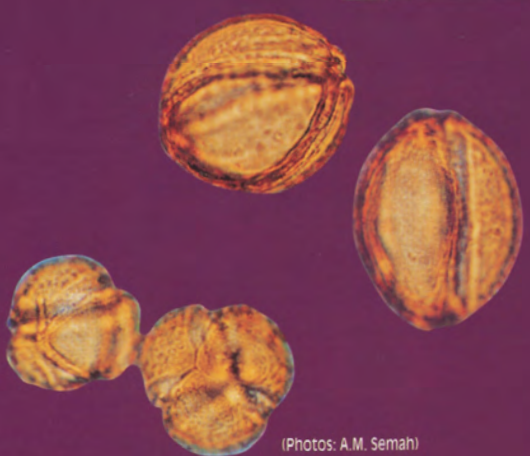




Raw, grilled or boiled, cut nuts are eaten everywhere in abundance.

Right: Inflorescence of Barringtonia edulis. Note how the calyx splits into several lobes.
Left: Cut nut with red foliage, typical of Vanuatu (Barringtonia edulis).
Below: Barringtonia edulis, magnified views of nut. Above: end-on. Middle: detail of groove. Below: lateral view.



(Photos: A.M. Semah)

In Vanuatu each community has its own collection of cut nuts. Here are several types.

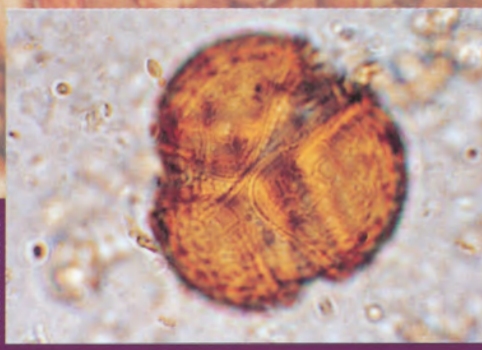
Above: Barringtonia edulis. Fruit red and elongate, with a red endocarp.
Left: Barringtonia edulis. Green fruit, elongate with a red endocarp.
Right: Wild Barringtonia edulis from Fiji.

Left Barringtonia edulis. Very elongate fruits from Maewo.
Below: Barringtonia edulis. Form found in Tanna.

(Photo: J.M. Bompard)

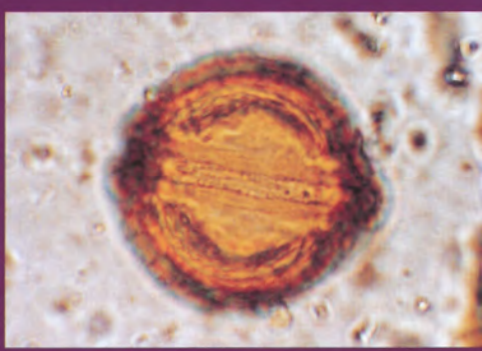
(Photo: J.M. Bompard)

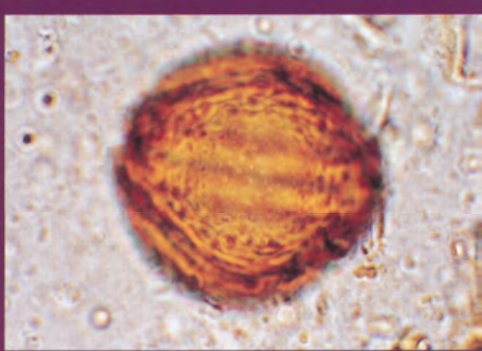
Above: Barringtonia novae-hiberniae. Note the round shape of the fruit, typical of Vanuatu, and the long petiole of the leaves.
Below: Different types of Barringtonia novae-hiberniae fruit observed on Lamen Island (Vanuatu). Note the ring-shaped calyx of the fruits.



(Photos: A.M. Semahi)

Often growing spontaneously, with round fruits and small kernels, another species of cut nut is Barringtonia novae-hiberniae.



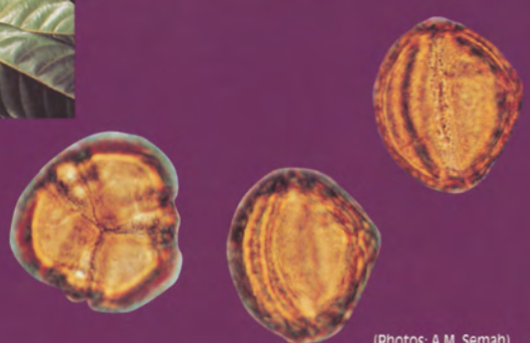


Above: Barringtonia novae-hiberniae, magnified views of nut. Above: end-on. Middle: detail of groove. Below: lateral view. **Left:** Fruits and inflorescence of B. novae-hiberniae showing the large apical pore of the flower buds.

Above: Barringtonia edulis. Round fruits, resembling those of B. novae-hiberniae. **Below:** Infrutescence of Barringtonia procera (in the absence of leaves and flower buds, it can be confused with that of B. edulis).

(Photo. J.M. Bompard)

Above: Barringtonia novae-hiberniae. Fruits of very small size observed on Lamen Island (Vanuatu).
Left: Edible cut nuts of Vanuatu, not identified and growing spontaneously, very close to B. novae-hiberniae from Solomon Islands.
Below: Barringtonia procera, magnified views of nut. Left: end-on. Middle: lateral view. Right: detail of groove.



(Photos: A.M. Semah)

Barringtonia procera, another species of cut nut, does not tolerate shade well and requires much care. Always cultivated, it is found in different forms.

Above: Cylindrical red fruits with white endocarp.
Right: Cylindrical red fruits with red endocarp.

Above: Pear-shaped green fruits with red endocarp.

(Photo: G. Bourdy)

Above: Bundles of smoked cut nuts (Barringtonia) are hung under the eaves of houses where they keep for several months.
Below: Fruit of Burckella fijiensis.

(Photo: J.M. Bompard)

Above: Burckella fruit of elongate shape
Below: Burckella fruit (Burckella obovata). round in shape and smooth-skinned, cultivated and quite rare.

In order to savour the flesh of these fruits when fully ripe, people must thwart the efforts of fruit bats which are very fond of them.

The quality of their edible fruits justifies the protection of these species, certain of which are on the point of disappearing.

Above: fruits of Burckella sp. (Cassidispermum megahilum).
Below: Burckella richii. Found at Mataika, Vava'u, Tonga.

(Photo: J.M. Bompard)

Species
Artocarpus altilis (Parkinson) Fosberg[12]

Family
Moraceae

Common names (English and French)
Breadfruit
Le fruit à pain (arbre à pain)

Name in Bislama
bredfrut

Consumption
Abundant and regular.

Part eaten
Cooked pulp and seeds.

Toxicity
None.

Description

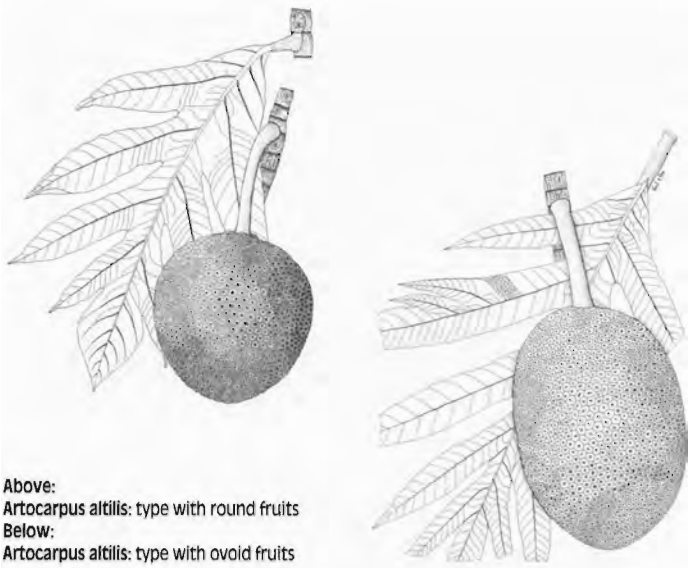
Tree of medium height (15-20 m), with a straight trunk, smooth and massive, the diameter of which may exceed 1 m. Leaves simple, dark green and glossy on their upper surface, light green and matt on the underside; large (20-60 x 20-40 cm); base pointed or rounded; margins entire, or deeply divided into 6-9 lobes; petiole massive, less than 5 cm long. Flowers grouped in a male inflorescence (elongate and pendant) or a female inflorescence (green, spherical or oblong), the two present at the same time on a single tree. Fruits (syncarps) formed from the whole female inflorescence, pale yellow to yellow-orange in colour, round, oval or oblong and variable in size; outer skin marked with hexagonal patterning that is more or less flattened, and with or without a small spiny point in the centre of the hexagon; pulp more or less dry, in colour cream to dark yellow; seeds chestnut brown and more or less abundant except absent in aspermic (seedless) varieties.

Morphological variability

Breadfruit is a species that shows great diversity in Vanuatu, mainly in the north of the archipelago. Each community recognises different cultivars according to the size of the tree, the shape of the leaves (more or less divided), the size or the shape of the fruit, the presence or absence of spines on the epidermis and its colour, the texture, colour and taste of the flesh, the numbers of seeds, or the fruiting season of the tree. Some cultivars produce fruits

[12] Breadfruit has been well reported in the literature, to which we refer our readers for more information. See in particular Ragone (1998, 1991, 1997).

We present here mainly observations made in Vanuatu, because of a lack of information available from other sources for that country.



Above:
Artocarpus altilis: type with round fruits
Below:
Artocarpus altilis: type with ovoid fruits

that can be kept for a long time; others bear fruit for a longer period of the year. The number of different morphological types recognised by horticulturists ranges from 10 to 120. However, it is certain that identical cultivars are found on more than one island, and a genetic study will be essential for classifying them. Whatever the situation, Vanuatu appears to be an important centre of diversity for breadfruit, and a key locality in the domestication of this species.

Seeded forms predominate in Melanesia (New Guinea, Solomon Islands and Vanuatu), while seedless forms predominate in Polynesia where the tree is therefore propagated by suckers.

Ecology and exploitation

In Vanuatu the tree grows abundantly up to 600 m altitude. The adult tree likes the sun and is found mainly in open spaces, villages, gardens and the edges of footpaths. It may be found in secondary forest, where it usually then indicates a site of earlier settlement. It is a cultivated tree. Breadfruits in Vanuatu always contain seeds, of varying numbers. There exist some fruits, very rare, that are considered seedless, though they do in fact contain some seeds. Multiplication is by planting of fresh, ripe seeds, or vegetatively by transplanting of suckers. Fruiting occurs between December and February, followed sometimes by a further small production of fruits in June to August. Some cultivars fruit out of season. In Papua New Guinea the species is typically found from 0-1, 250 m altitude, but has

Artocarpus altilis: the centre of origin of breadfruit, long thought to have been Polynesia, is probably in fact New Guinea. In the pre-European times the species was spread by human activity from New Guinea to the Society Islands, Hawaii and the Marianas, via all the islands of the Pacific. It was introduced to the Philippines in ancient times from Guam (Ragone, 1991). Since then breadfruit has been introduced throughout the tropical world.

been found up to 1,450 m (Bourke, personal communication). Among the Ankave of Papua New Guinea, fruiting occurs in the month of June.

Alimentary uses

In Vanuatu breadfruit is cultivated for its fruits, which are cooked in various ways. They may be grilled, braised in an oven, sometimes cut up and boiled, and often grated and cooked in a *lap-lap*. The mode of cooking of each cultivar is according to the texture of its flesh. A fruit with softer, more flexible flesh lends itself well to being made into *nalots*, small balls of paste cooked in coconut milk; a large fruit with firm flesh is better roasted in its skin and then cut into pieces. Further, some cultivars are eaten in the morning, while others that can be cooked quickly are kept for unexpected visitors. In fact the methods of cooking and preparation of breadfruit are very numerous, and form part of the local gastronomy. The seeds are sometimes eaten separately, grilled or boiled. They are nibbled after being removed from fruits that have previously been cooked. Young leaves that have not yet unrolled are also eaten, cooked by steaming. Pigs are fond of the uncooked fruits. In earlier times breadfruits were preserved all over Vanuatu by fermentation. Numerous techniques for preservation existed, sometimes in pits dug out in the ground, sometimes in natural hollows in coralline rock. These methods of preservation have tended to be lost, though they are still practised by several communities in Vanuatu, such as those of the Banks Islands, Pentecost, Malo, Ambrym and Emae. In New Guinea it is the seeds of breadfruit that are eaten, generally grilled, by the Ankave.

Other uses

In Vanuatu the sap of breadfruit is used as bird-lime for trapping birds, for covering damage to yams caused during their harvesting, and for caulking the timbers of canoes. The wood

is used as firewood or as timber for craft work. It is also used for making canoes, oars and outriggers. In Tonga the bark of small branches was formerly used for making tapa cloth. Nowadays two varieties (of the nine present in the country) are used in traditional medicine. An infusion of leaves or bark is used to treat mouth infections in children, abdominal and stomach disorders, and skin inflammations. A decoction of the bark is used to treat intestinal disorders, fever and general aches and stiffness. The ash of burnt leaves is mixed with coconut oil, and the resulting paste is applied to burns. In Wallis the timber is used to make cross-beams of houses and poles of canoes. The sap is used for caulking canoes.

References

Barrau (1957), Dignan *et al.* (1994), Dupuy & Guiot (1992), Purseglove (1991), Ragone (1988, 1991, 1997), Walter (1989).

Species
Barringtonia edulis (Miers) Seemann

Family
Lecythidaceae

Common names (English and French)
Cut nut
La velle (vellier)

Name in Bislama
navele

Consumption
Regular.

Part eaten
Kernels.

Toxicity
None.

Description

Tree of medium height (8-20 m), crown not very dense. Leaves simple, joined in rosettes at the ends of branches, shiny green, long and oboval (25-71 x 8-25 cm), thick and lightly undulate; petiole thick, less than 5 cm long. Flowers spirally arranged on a pendulous rachis (50-100 cm); calyx green or crimson, divided into 3-4 sepals, persistent; flower buds with an apical pore 2-4 mm in diameter; 4 cream or rose-coloured petals; numerous yellow or cream stamens, sometimes rosy at their tips; central style longer than the stamens, persistent. Fruits grouped along the rachis, red or green, ovoid or elongate (8 x 5 cm on average); sessile or pedunculate; containing one white kernel (2.5 x 1.5-3 cm).

Barringtonia edulis.

Morphological variability

In Vanuatu several forms of *Barringtonia edulis* occur, according to the colour, size and shape of the fruit. Each community possesses its own collection of cut nut trees, and each morphotype has its own particular name. Future research will be able to define the varieties that occur

Barringtonia edulis: Solomon Islands, Vanuatu, Fiji (but not Santa Cruz). Introduced to New Guinea (Madang region).

among these numerous morphotypes. One may distinguish:

- trees with red foliage, quite rare (the foliage of the cut nut tree is usually dark green). These trees have inflorescences that are entirely red – calyx and petals – and red fruits;
- trees with very elongate fruits (7-11 cm long), and others with fruits that are almost round, while the majority have ovoid fruits;
- trees with red fruits and trees with green fruits. The epidermis of the fruit is red or green; the other parts (epicarp, mesocarp, endocarp) are usually beige or white, but may be red in certain cultivars. The combinations of these colours have led to definition of several types (Table 2);
- trees in which the shell of the fruit is flexible and easy to break, while typical trees have fruits with a very hard mesocarp.

Besides these, in the south of the archipelago *B. edulis* generally has ovoid fruits,

Type	Frequency
RRWW	Rare
RGWW	Frequent
RGWR	Exceptional
RGRW	Rare
GRWW	Exceptional
GGWW	Frequent
GGRR	Exceptional

Table 2. Different types of *Barringtonia edulis* according to fruit colour

Key:
R = red; W = white; G = green
1st letter = colour of epidermis
2nd letter = colour of epicarp
3rd letter = colour of mesocarp
4th letter = colour of endocarp

quite like those found in Fiji, while in the north of Vanuatu one finds very elongate fruits, like those found in Solomon Islands.

Ecology and exploitation

In Vanuatu *B. edulis* grows in all the islands, up to 600 m altitude. The species is found in a cultivated state in villages, gardens and along tracks and roads. In secondary forests the species generally indicates the sites of former settlements. The forests of Tanna and Efate contain many spontaneously germinated trees, but it is difficult to be sure that they are really wild trees. Cultivated for centuries, the tree does germinate in the

wild from fruits dropped on the ground or spread by flying foxes. Such trees are less frequent in the north of the archipelago. Humans transplant young saplings, or plant whole ripe fruits directly into the ground close to dwellings. The species is carefully protected, and the best varieties and also the rare ones are selected. In Maewo, some horticulturists practise marcotting[13] of *B. edulis*, with greater or lesser success, for propagation of interesting forms.

Flowering occurs several times per year, even continuously, with the flowering period varying according to island and individual tree. The fruits reach maturity during the two months after flowering. The period of availability of the fruits extends over several months in any particular region, and over the entire year throughout the length of the archipelago. Production varies greatly from tree to tree. The flowers are fragile, and on certain trees fall before fruiting. Other trees with shorter inflorescences may be more productive. One note: this tree flowers again and fruits very quickly after cyclones. Outside Vanuatu the species is cultivated in Solomon Islands (from seeds, or sometimes from cuttings); it occurs wild, or occasionally cultivated or semi-cultivated, in Fiji.

Alimentary uses

Throughout the area of distribution of this species, the kernels of *B. edulis* are eaten raw, grilled or boiled. Sometimes they may be crumbled into *lap-lap*. The kernels, slightly dried, are sometimes threaded on the midrib of a coconut palm leaf and then given to children or sold in markets. In Gaua, the cut nuts are peeled, bound up in a piece of the bark of *bourao* (*Hibiscus tiliaceus*), then smoked and kept for several months over the hearth. Unsmoked, the kernels last at most for one or two weeks.

Other uses

Fallen branches or felled trees are used as firewood. The wood is of poor quality and is not used for manufacturing purposes. In traditional medicine the leaves are used for treatment of inflammation of the ear, the sap extracted from the bark for ciguatera poisoning, for coughs and for urinary infections; the form with red leaves is used for abortions or as a contraceptive.

Other edible species

According to Payens (1967) the genus comprises 39 species. In the Pacific the following species have edible kernels:

B. novae-hiberniae Laut. (*cf.* p. 114);

B. procera (Miers) Knuth (*cf.* p. 117);

B. seaturae Guppy: wild species endemic to Fiji.

References

Evans (1991), Jebb & Wise (1992), Payens (1967), Smith (1981).

[13] A procedure for vegetative multiplication of plants in which part of a branch of the plant (usually a tree) is put into contact with soil (often the soil is bound to the branch surface with plastic), and the branch roots into the soil before being detached from the parent plant.

Species
Barringtonia novae-hiberniae Lauterbach

Family
Lecythidaceae

Common names (English and French)
Cut nut
La velle (vellier)

Name in Bislama
navele

Consumption
Regular and abundant.

Part eaten
Kernels.

Toxicity
None.

Description

Small tree (7-15 m), open crown, denser than that of *Barringtonia edulis*. Leaves simple, joined in loose rosettes at ends of branches, glossy green, oboval (23-58 x 8-23 cm), flexible and flat, veins green or crimson, petiole slender, 2-7 cm long. Flowers set spirally on a terminal or lateral, pendulous rachis, which is fairly short (25-76 cm long); calyx green or crimson, entire (sometimes divided) and annular, persistent, flower buds with a large, upper apical pore up to 4 mm in size; 4 pale green or cream petals, numerous stamens yellow tinged with rose; style persistent. Fruits arranged close together on the rachis, red or green, circular or ovoid (4.2-6.7 x 5.2-9.0 cm); pedunculate; containing one white kernel (2-5 x 1.3-3.5 cm).

Barringtonia novae-hiberniae

Morphological variability

The variability of this species is less marked than that of *B. edulis*. Nevertheless several types may be distinguished, each with its own name in the local language.

Barringtonia novae-hiberniae: New Guinea (north-east coast), Bismarck Archipelago, Solomon Islands, Santa Cruz, Vanuatu.

In particular there are:

- trees with red foliage, varying from dull red to deep violet (the foliage of this species is usually glossy green)
- trees with green fruits or with red fruits. As with *B. edulis*, several types may be distinguished according to the combination of colours of different parts of the fruit (Table 3).
- trees with very small fruits (4 cm in diameter)
- trees with fruits whose shell is soft and easy to break.

In Vanuatu *B. novae-hiberniae* has fruits that are relatively homogeneous, ovoid or circular, while in Solomon Islands the fruits are distinctly oblong and elongate (8 x 4.2 cm on average).

Type	Frequency
RRWW	Rare
RGWW	Frequent
GGWW	Frequent
GGRW	Rare

Table 3. Different types of *Barringtonia novae-hiberniae* according to fruit colour

Key:
R = red; W = white; G = green.
1st letter = colour of epidermis
2nd letter = colour of epicarp
3rd letter = colour of mesocarp
4th letter = colour of endocarp

Besides these, one cultivar of *B. novae-hiberniae* found in Ambrym produces fruits whose consumption induces a certain degree of dizziness like intoxication. These are therefore only eaten in small quantities. Yen (1974) likewise noted that consumption of seeds of *B. novae-hiberniae* in the Santa Cruz Islands led to mild headaches in certain people. In this regard it is noteworthy that certain species of *Barringtonia* are toxic, for example *B. asiatica* (L.) Kurz, which is used as a fish poison.

Ecology and exploitation

In Vanuatu *B. novae-hiberniae* grows from sea level to 600 m altitude. It is found particularly in villages, in garden areas, in forests modified by humans, and even in dense forest. Abundant in the islands of Epi and Emae, it is also present in Ambrym, Pentecost, Maewo and more rarely in Efate. No specimen has ever been found in Erromango or

Tanna. This is a cultivated species, but wild-germinated plants are often found in forests, spread by flying foxes. Wild forms do exist, but it is difficult to distinguish them from wild-germinated domesticated plants. The tree is tolerant of shade. Flowering tends to be continuous, fruiting following two months after formation of flowers. Fruits are thus available throughout the year. The fruits are generally tightly packed on the infrutescence and the tree is very productive. As with other *Barringtonia* with edible fruits, this species fruits quickly after cyclones. In New Guinea the species grows from sea level to 700 m altitude, in Solomon Islands from sea level to 90 m altitude. Forest forms, probably wild, have been seen in the Santa Cruz Islands (Ndeni), in Solomon Islands and in New Guinea. The species is likewise cultivated in these three regions. In Solomon Islands and in the Santa Cruz Islands the species flowers two to three times per year.

Uses

Identical to those of *B. edulis* (*cf.* p. 111).

Other edible species

See *B. edulis* (p. 111).

References

Evans (1991), Jebb & Wise (1992), Payens (1967), Peekel (1984), Smith (1981), Yen (1974).

Species
Barringtonia procera (Miers) Knuth

Family
Lecythidaceae

Common names (English and French)
Cut nut
La velle (vellier)

Name in Bislama
navele

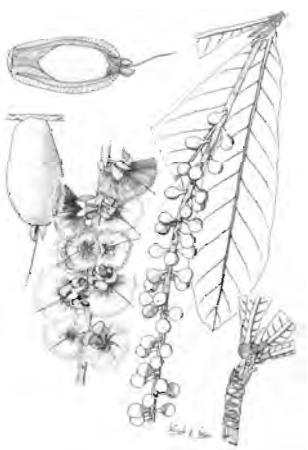
Consumption
Regular and abundant.

Part eaten
Kernels.

Toxicity
None.

Description

Tree of medium height (8-20 m), trunk slender and thin, branching very little, crown narrow and very loose. Leaves simple, joined in rosettes at the ends of branches, shiny green, lanceolate and narrowing in the lower third (35-70 x 12-24 cm), coriaceous; margins undulate; petiole thick, less than 1 cm long or absent. Flowers set spirally on a long, pendulous rachis (42-130 cm long); calyx green or red, divided into 2-3 lobes, persistent; flower buds with an apical pore less than 2 mm in diameter; 4 yellow or cream petals; numerous yellow stamens; style central and longer than the stamens. Fruits red or green, elongate or pear-shaped (5-13 x 3-6 cm), sessile; containing one white kernel (2-6 x 2-4 cm).



Barringtonia procera

Morphological variability

The fruits of *Barringtonia procera* vary in size, shape and colour. Thus in Vanuatu may be found:

- dwarf trees, the height of which does not exceed 2 m. These trees are quite rare, but are found in most islands of Vanuatu. They bear very poorly. Improvement of their productivity would produce orchards with trees of reduced height, easy to harvest;
- trees with cylindrical fruits, 8 cm or longer (most fruits of this species are less than 8 cm), present in the north of Vanuatu;
- trees with green fruits or red fruits (Table 4).

Type	Frequency
RRRR	Exceptional
RGWR	Exceptional
RGRW	Exceptional
RGRR	Frequent
GGWW	Frequent
GGWR	Exceptional
GGRR	Frequent

Table 4. Different types of *Barringtonia procera* according to fruit colour

Key:
R = red; W = white; G = green
1st letter = colour of epidermis
2nd letter = colour of epicarp
3rd letter = colour of mesocarp
4th letter = colour of endocarp

In Vanuatu (Emae) a single specimen is known that has on the same tree, though not in the same infrutescence, both green fruits and red fruits;

- trees with a soft mesocarp which is easy to cut.

In general *B. procera* in Vanuatu has fruits that are longer and more cylindrical than those in Solomon Islands.

Ecology and exploitation

In Vanuatu the species is found mainly in villages and in gardens, at low altitudes. It is always cultivated, does not tolerate shade well, requires much care, and is rarely found as wild-germinated specimens. It is more frequent from the Torres Islands to Pentecost and Malekula, but is still well represented as far as Efate. It is likewise present in Futuna, but has not been recorded from Tanna or Erromango where it is without doubt very rare. Flowering and fruiting occur once per year, usually in the wet season from September to March. The number of trees that fruit in the off-season seems quite high. The trees are not very productive, being not much branched, slender and frail, and bearing few infrutescences. Nevertheless, their fruits and their kernels are usually larger than those of other edible *Barringtonia* species. In Papua New Guinea it is found from 0-500 (600) m altitude (Bourke, personal communication). It is a species that is always cultivated, and no wild specimens are known. In Solomon Islands it flowers twice to three times per year.

In its entire area of distribution, *B. procera* thus appears to be a cultivated species, of which no wild form is known.

Barringtonia procera: Solomon Islands, Santa Cruz, Vanuatu. Possibly introduced to the Bismarck Archipelago and certainly to New Guinea (north-east coast).

Uses

The same as those of *B. edulis* (*cf.* p. 111).

Other edible species

See *B. edulis* (p. 111).

References

Evans (1991), Jebb & Wise (1992), Payens (1967), Smith (1981).

Species
Burckella fijiensis (Hemsley) A.C. Smith & S. Darwin

Family
Sapotaceae

Common name (French)
La poire-tortue (poirier-tortue)

Consumption
Localised in Futuna; abundant in season.

Part eaten
Pulpy flesh.

Toxicity
None.

Description

Tree of medium height (10-20 m), trunk straight and massive; crown tall and dense. Leaves simple, alternate, oboval or oblanceolate (14-25 x 6-10 cm), apex rounded, base narrow; 9-13 pairs of leaf veins, petiole 3-4 cm long. Flowers arranged 20 to 30 in a terminal bunch; calyx green with 4 sepals (2 internal and 2 external), of large size (1 x 1 cm), with a brown, downy covering, persistent; 8 light green petals, lanceolate; 30-32 stamens. Fruits situated at the ends of branches, brown in colour when ripe; pear-shaped and slightly concave (8 x 6 cm); peduncle thick and 3 cm long; style persistent; fruit with abundant latex; 1-2 bulky, flattened seeds (6 x 5 x 3 cm), the dorsal part light brown and glossy, the ventral part pale beige and matt; margins irregular and furnished with protuberances.

Morphological variability

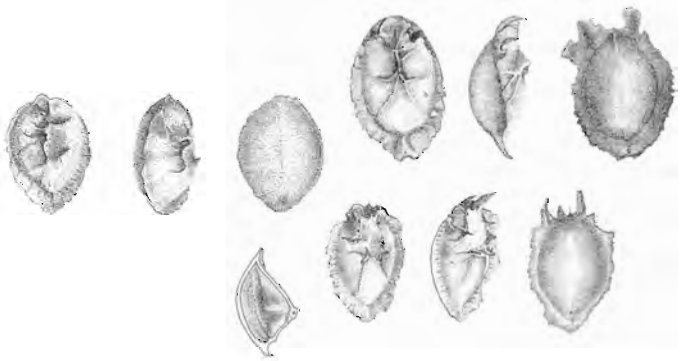
In the various local languages there are no special names to distinguish different types of this tree; however, the species appears to be very variable in size and taste of the fruits and their degree of sweetness; also in the seed, which varies in the degree of indentation of the margin, and in the ventral protuberances which may vary in number and how pronounced they are.

Ecology and exploitation

In Vanuatu this species is strictly localised to the island of Futuna, where it is very abundant from sea level to 200 m altitude. Large plantations exist in the vicinity of Mission Bay. The species is cultivated, but numerous self-germinated plants are also found. It was probably introduced from Fiji by the people of Futuna who came from the islands of the

Burckella fijiensis

central Pacific. The tree is very localised, and several local sources of information indicated that when the plant is transferred to other islands it does not bear fruit. It is propagated using very ripe fruits, seeds or cuttings of the branches. Propagation by cuttings is, however, difficult to achieve. The tree is robust, coping with shade as well as full sun, and dryness as well as humidity. However, it is susceptible to cold. The fruits reach maturity between October and December. In Fiji the species grows from sea level to 825 m altitude. It is the most common *Burckella* in Fiji.



Seeds of **Burckella fijiensis**. Illustration by F. Yoringmal

Burckella fijiensis: Fiji. Aboriginal introduction to Vanuatu (Futuna and probably Aneityum).

Alimentary uses

The fruit of *Burckella fijiensis* is edible and is eaten abundantly when in season. A ripe fruit can be distinguished by its soft and fragrant pulp, and by its dark brown seed. The delicious flesh, which has a distinct and delicate taste, is eaten fresh or roasted. Curiously, the edible nature of this fruit has not been noted in the Floras of Fiji (Smith, 1981; Parham, 1972).

Other uses

The wood is used for making the frameworks of houses in Vanuatu and Fiji. The leaves are medicinal.

Other edible species

In 1892 Hemsley mentioned for the first time the existence of seeds collected in Fiji and Solomon Islands the shape of which resembled the shell of a small turtle. He called these *Chelonespermum*, and put them in a specific classification. Later other authors described as new the species that had already been identified by Hemsley, to which they also added new species (van Royen, 1959; Whitmore, 1966; Parham, 1972). Smith (1981), and later Pennington (1991), incorporated the genus *Chelonespermum* into *Burckella*, and made *C. fijiensis* Hemsley a synonym of other described species. Those authors never indicated the edible nature of the fruits. Pennington (1991) then distinguished 14 species of *Burckella* in the western Pacific (from Maluku and Papua New Guinea to Fiji, Samoa and Tonga), which others in earlier times identified as *Chelonespermum*. Only *B. obovata* and *B. sorei* were mentioned as having edible fruits:

B. obovata (G. Forster) Pierre (*cf.* p. 123)

B. sorei van Royen: species endemic to Solomon Islands (Guadalcanal, Malaita and Santa Ysabel). Closely related to *B. obovata*, it can be distinguished by the smaller leaves and flowers. Its edible nature is noted on sample BSIP 2477 from Santa Ysabel.

We also note two other species the fruits of which may be edible:

B. richii (A. Gray) Lam: present in Tonga, more rarely in Fiji, and in the cultivated state in Samoa where it is very rare. It is called *kau* in Tonga and *au* in Samoa. No name has been noted for Fiji (*cf.* also *Cassidispermum megahilum* Hemsley, p. 127)

B. thurstonii (Hemsley) Lam: species endemic to Fiji, closely related to *B. fijiensis* from which it may be distinguished by its pilose corolla and its greater number (40) of stamens.

References

Gillespie (1930), Hemsley (1892), Lam (1942), Lam & van Royen (1952), Parham (1972), Pennington (1991), Smith (1981), van Royen (1959), Whitmore (1966), Yuncker (1971).

Species
Burckella obovata (G. Forster) Pierre

Family
Sapotaceae

Common names (English and French)
Burckella
Bukbuk
La doule (doulier)

Name in Bislama
naduledule

Consumption
Regular but not abundant.

Part eaten
Pulpy flesh.

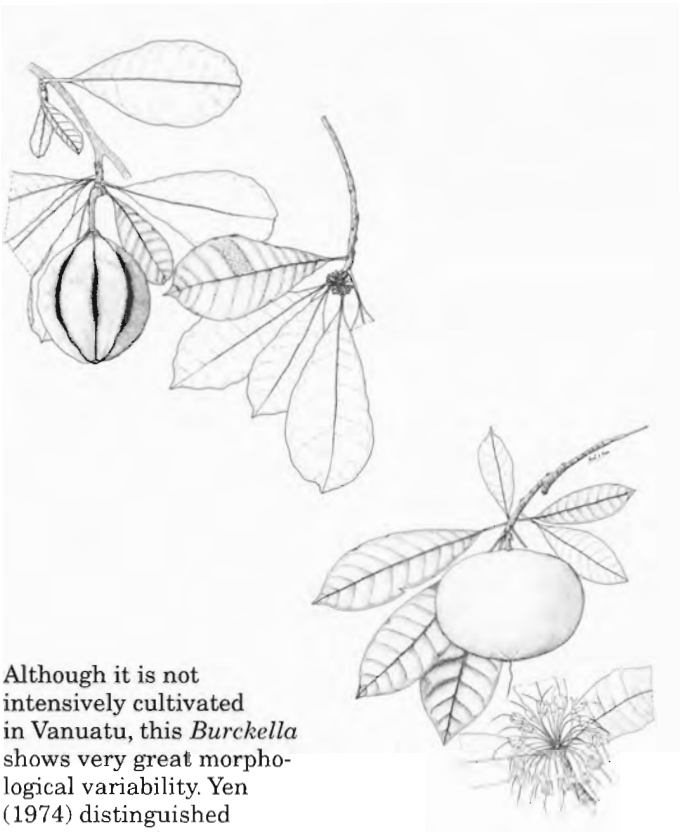
Toxicity
None.

Description

Tree of medium height (15-20 m) in Vanuatu and tall (15-30 m) in Papua New Guinea; trunk straight and massive; crown dense. Leaves simple, mid-green, oval (10-30 x 4-11 cm), apex rounded and slightly acuminate, narrowed at the base; 10-18 pairs of veins; petiole 2-4 cm long. Flowers numerous (30-40) arranged in a terminal cluster; calyx green, with 4 sepals (2 internal and 2 external) that are small in size (0.2-0.4 cm), glabrous, persistent; 8 white or cream petals joined at their bases (0.8-1.2 cm); 12-13 stamens. Fruits green, rounded (5-12 x 4.5-9 cm) or elongate (8-14 x 4.6-7 cm), bearing 5 longitudinal grooves.

Morphological variability

Two main types of this *Burckella* fruit are found in Vanuatu – the elongate and the rounded, of which the latter may sometimes be very large. The former are commoner than the latter, and have the reputation of being sweeter. The rounded form may be further subdivided into smooth fruits and crenate (wrinkled) fruits, the former of these always being cultivated. The taste of the fruits varies from tree to tree, and villagers select and transplant those with sweet fruits and juicy flesh. Inside both types of large fruit, the elongate and the round, the morphology of the different parts is likewise variable.



Although it is not intensively cultivated in Vanuatu, this *Burckella* shows very great morphological variability. Yen (1974) distinguished three forms of the fruit in the Santa Cruz Islands, with elongate, round or cylindrical fruits.

Ecology and exploitation

In Vanuatu this *Burckella* is found in damp forests in zones of less than 300 m altitude. The species is wild but maintained by the villagers who know the locations of many of the trees. They may occasionally be replanted nearer to a village, using a seed from a very ripe fruit or one that has already germinated. It is particularly abundant on Tanna and the Torres Islands. The species is mainly spread by flying

Above
Burckella obovata: type with round, crenate fruits
Middle
Burckella obovata: type with round, non-crenate fruits
Below
Burckella obovata: type with elongate fruits

Burckella obovata: Maluku, Aru Islands, New Guinea, Solomon Islands and Vanuatu. Introduced to Fiji where it is rare and always in the cultivated state.

foxes, which eat the flesh of very ripe fruits and thereby compete with humans for this fruit. Flowering occurs between September and November and the fruits reach maturity at the start of the year (February to May). Production is very variable from one tree to another. In Papua New Guinea the species grows up to 390 m altitude (Bourke, personal communication). It is wild, but sometimes planted in villages. It is also cultivated in Southeast Asia, and in the coastal regions of the Santa Cruz Islands. In Solomon Islands the species is not cultivated outside Guadalcanal and Malaita.

Alimentary uses

Burckella fruits, together with the golden apple, are the largest edible native fruits of Vanuatu. They are harvested before maturity (to beat the fruit bats) by picking them directly from the tree, and then laying them in baskets where they ripen within a few days. They are eaten raw between meals, occasionally while walking in the forest or more regularly when in season. But they are mainly a food of secondary importance, generally eaten away from the village. However, in Tanna where the species is abundant, the fruits are brought back to the villages when in season and are sometimes sold in the local markets. This forest fruit is only sold very rarely in the markets of Port Vila. *Burckella* fruits are likewise eaten in New Guinea, in Mussau, in the Bismarck Archipelago, in Guadalcanal, in the Reef Islands, in Malaita, in the Santa Cruz islands, in Anuta and in Tikopia. In the last two of these islands, the fruits are conserved through fermentation (Kirch & Yen, 1982) in pits identical to those used for conservation of breadfruit. In Solomon Islands the *Burckella* fruits are generally smaller and have a bitter taste, so they are rarely eaten except in the islands listed above. As in Vanuatu, the edible fruits are collected just before maturity and laid in baskets to finish ripening (Henderson & Hancock, 1989). In the Reef Islands the fruits are also eaten after being cooked in an oven.

Other uses

In Vanuatu the wood is used for making frameworks of houses, the cross-beams of canoes, and paddles. The latex is used for "setting" or fixing the colour and design of tattoos. Juice extracted from the grated bark is used for treatment of asthma and for promoting the lactation of sows. In Hiu for treatment of sick people the leaves are crushed and then heated; the person applying the treatment then puts the leaf mixture in their mouth and spits it forcibly on to the body of the patient. In Solomon Islands the wood provides a good timber for all sorts of constructional work and for making of canoes. Henderson & Hancock (1989) recorded that communities on Santa Anna used the leaves of *Burckella* for rendering their earth ovens water-tight. For this reason the species is much sought after. The flesh of the fruit produces a dye for certain communities of Papua New Guinea.

Other edible species

See *Burckella fijiensis* (p. 120).

References

Foreman (1971), Henderson & Hancock (1989), Kirch & Yen (1982), Lam (1942), Lam & van Royen (1952), Peekel (1984), Pennington (1991), Powell (1976), Smith (1981), Whitmore (1966), Yen (1974).

Species

Burckella sp. (*Cassidispermum megahilum* Hemsley)

Family
Sapotaceae

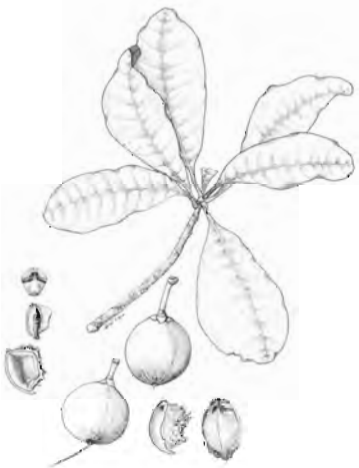
Consumption
Localised in the region of Lawa on Malekula.

Part eaten
Pulpy flesh.

Toxicity
None.

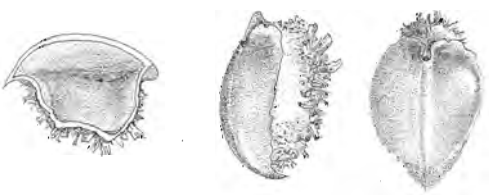
Description

Tree of medium height (15-20 m); massive trunk; crown rounded. Leaves simple, grouped at the ends of branches, medium green above and light green below, oboval to oblong (10-14 x 3.6-5. 4 cm), apex rounded and slightly emarginate, base narrowing to a point; margins slightly undulate; 10-12 pairs of fine yellow veins; petiole slender and 2 cm long. Flowers not seen. Fruits yellow-green at maturity, shining, spherical (5 cm in diameter), epidermis smooth and glossy, covered with numerous vertical grooves; peduncle 3 cm long; calyx with 4 sepals (2 internal and 2 external), small in size (0.3 x 0.5 cm); bulky seed (4 x 3 x 2.5 cm), the dorsal part dark brown and shiny, furnished with a slight median longitudinal ridge, the ventral part furnished with numerous hard spines and protuberances (Herbarium specimen CSV1026).



Burckella sp.

Seeds of **Burckella sp.** Illustration by F. Yoringmal



Geographical distribution
Observed in Vanuatu (region of South-West Bay in Malekula), but probably also occurring elsewhere in the Pacific. Further collections are needed, since the material at our disposal does not permit a more exact definition of the species.

Ecology and exploitation
This tree, common locally, grows at the sea's edge. It is wild, protected by humans and spread by fruit bats that feed on the flesh of the fruits. The production of fruits is important, distinctly more so than that of *Burckella obovata*. This seems to be a species heading towards extinction, and the good quality of its edible fruits justifies rapid preservation of the germplasm. It is a species with very narrow distribution, since it is known only from a single village in Vanuatu.

Alimentary uses
The fruits are eaten regularly when in season. Cooked according to need, they are baked on embers slightly before or just as they reach maturity. On the other hand when fully ripe the fruits may be eaten raw between meals, most often at the foot of the tree from which they came.

Other uses
The wood, of good timber quality, is used for constructional carpentry.

Other edible species
See *Burckella fijiensis* (p. 120).

References
Hemsley (1892), van Royen (1959).

Species
Canarium harveyi Seemann

Family
Burseraceae

Common names (English and French)
Canarium nut
Pili nut
La nangaille (nangailler)
Noix de Kanari (noyer de Kanari)

Name in Bislama
nangai

Consumption
Regular and abundant.

Part eaten
Kernels.

Toxicity
None.

Description

Tree slightly smaller than *Canarium indicum* (15-20 m); trunk massive and straight; crown large, less dense than that of *C. indicum*. Leaves made up of 3-4 pairs of lateral leaflets and one terminal leaflet; petiole 4-7 cm long; leaflets opposite, oboval (11-37.5 x 4.5-15 cm), partially deciduous at the time of fruit ripening; stipule situated on the petiole 1 cm from its base, rounded (0.5-1.4 x 0.5-1 cm), deciduous. Flowers arranged in axillary panicles (10-20 cm long), numerous; 3 cream petals; species naturally dioecious, but man over centuries has managed to select trees that bear either male flowers and hermaphrodite flowers or female flowers and hermaphrodite flowers at the same time. Fruits in groups of 4-6, green then black at maturity, ovoid (3-6 x 2-4 cm), slightly flattened on one side; the nut has 3 chambers of which two may contain a white kernel covered with a thick brown skin or membrane.

Morphological variability

Botanists distinguish several varieties of *C. harveyi*, two of which are found in Vanuatu: *C. harveyi* var. *nova-hebridiense* in the north and *C. harveyi* var. *harveyi* in Erromango and more rarely in Futuna. They are differentiated mainly on the shape of their nut. A transverse section of th e nut of the variety *harveyi* is triangular, while that of the variety *nova-hebridiense* shows three dorsal crests and one ventral crest.

Canarium harveyi: present from Solomon Islands to Tonga. Introduced in European times to Niue and Samoa.

In reality there are also many intermediate forms, particularly common in the centre of the archipelago. The vegetative parts of the plant do not seem to show clear differences from one variety to another. The botanical status of these varieties is thus debatable. The species shows less variability than does *C. indicum*. There exist, however, forms with a shell that is easy to open, and very rarely forms with three kernels.

Canarium harveyi

Ecology and exploitation

In Vanuatu the species is found in all the islands, but it is particularly abundant in the north (Banks and Torres Islands), in the centre (Epi, Emae and the Shepherd Islands) and in Erromango. Numerous wild trees have been observed in Erromango. The species is likewise present in Futuna. Elsewhere it is cultivated, but is harder to maintain than *C. indicum*. Propagation is by planting the endocarp of very ripe fruits of which the pericarp is black and soft. Some horticulturists prefer to dry the endocarp slightly before planting. Fruiting occurs some weeks before that of *C. indicum*, between October and March. The production is less important than that of *C. indicum*. In Solomon Islands the species is cultivated and fruits from October. A certain number of trees may fruit precociously during the year, or may fruit twice in one year (Evans, 1991).

Uses

The uses are the same as those of *C. indicum*. The kernels, which are oilier, are nevertheless preferred to those of *C. indicum* for sprinkling on *lap-lap*. The

very abundant sap of the tree was used in earlier times as a fuel in small lamps. It is used nowadays to caulk the hulls of canoes.

Other edible species

Numerous other species of *Canarium* have kernels or flesh that is edible. We list here the species that occur in Southeast Asia and in the Pacific (for further information see Verheij & Coronel, eds, 1992).

C. album (Lour.) Raeuschel: Vietnam and southern China; seed and flesh edible;

C. decumanum (Rumph.) Gaertn.: Borneo, Maluku, New Guinea; sometimes cultivated, of little importance; edible seed;

C. hirsutum Willd.: New Guinea, Solomon Islands, Philippines;

C. indicum L.: see p. 132;

C. kaniense Lauterbach: New Guinea; edible seed;

C. luzonicum (Blume) A. Gray: endemic to the Philippines; edible seed;

C. oleiferum Baillon: New Caledonia; edible seed;

C. ovatum Engl.: species indigenous to the Philippines, known by the name of *pili* nut. Edible seed. Second nut cultivated in the Philippines, of very great economic importance;

C. patentinervium Miq.: Thailand, Malaysia, Indonesia; edible seed;

C. pilosum Bennett: Indonesia, Malaysia, Brunei; edible seed;

C. pimela Leenh.: indigenous to southern China, in Indonesia and in Brunei; edible flesh;

C. salomonense Burtt.: New Guinea and Solomon Islands; introduced specimens can also be found in Vanuatu; edible seed;

C. schlechteri Lauterbach: indigenous to New Guinea, New Britain; edible seed;

C. vanikoroense Leenhouts: Solomon Islands (Vanikoro), Fiji, probably also the Banks Islands and the north of Vanuatu (a single specimen collected: CSV945); edible seed;

C. vitiense Gray: western New Guinea, north Queensland, Vanuatu (CSV453), Fiji, Samoa and Tonga; mesocarp edible but little eaten;

C. vrieseanum Engl.: Indonesia and the Philippines; edible seed;

C. vulgare Leenhouts: Sunda Islands, Sulawesi, Maluku, New Guinea, probably Solomon Islands and Vanuatu (CSV686; RMV5), Fiji and Cook Islands; species abundant in Indonesia but from New Guinea progressive ly replaced by *C. indicum*; edible seed.

References

Aburu (1982), Corner (1988), Evans (1991), Leenhouts (1955a, b, 1956, 1959), Malapa (1992), Smith (1985), Verheij & Coronel, eds (1992), Whitmore (1966).

Species
Canarium indicum Linnaeus

Family
Burseraceae

Common names (English and French)
Canarium nut
Pili nut
Java almond
La nangaille (nangailler)
Noix de Kanari (noyer de Kanari)

Name in Bislama
nangai

Consumption
Regular and abundant.

Part eaten
Kernels.

Toxicity
None.

Description

Tree of medium height (15-20 m) but able to reach 30 m; trunk straight, buttresses often massive; crown large and dense. Leaves composite with 4-8 pairs of lateral leaflets and a terminal leaflet; petiole 9 cm long; leaflets opposite, oblong (13.5-36 x 4.4-21 cm), base rounded and slightly asymmetrical, apex acuminate; stipules situated at the base of the petiole, large and toothed, persistent. Flowers set in axillary panicles (15-30 cm long), numerous; 3 cream petals; species naturally dioecious, but man over centuries has managed to select trees that bear both male flowers and hermaphrodite flowers, or both female flowers and hermaphrodite flowers. Fruits in groups of 6-12, green and then black at maturity, ovoid (4-8 x 3-4.5 cm); hard nut, ovoid and triangular or hexagonal in cross-section, containing 3 chambers of which 2 are generally sterile, and the third contains a white kernel (3.5 x 2 cm) covered with a thick brown skin or membrane.

Morphological variability

Canarium indicum is a species that shows great morphological variability, from one tree to another and even within the same tree. Man has cultivated it for centuries, selecting and preserving forms with large fruits but also those with fruits of particular characteristics. Nowadays one can mainly distinguish

Canarium indicum: present from northern Sulawesi to Vanuatu. Possibly an early aboriginal introduction from the Solomon Islands. Introduced later and cultivated in other islands of the Pacific such as Fiji, Samoa, Cook Islands, Hawaii, the Philippines and Guam.

forms with round fruits, which are very much predominant in Vanuatu, and others with elongate fruits. The situation is the opposite in Solomon Islands where the majority of fruits are of elongate form (Evans, 1991). It is noteworthy that a significant number of fruits cannot be classified. Measures of length, width, thickness, weight and density made on more than 1,000 nuts obtained from different trees in Vanuatu did not reveal the existence of any clearly defined variety (de Biran, personal communication). The variability includes, as we have seen, the shape of the fruits but also the number of kernels in a shell (1 or 2), the colour of the kernels (white or yellow), the rhythm of flowering (some cultivars with continuous flowering), the productivity and the ease of cracking of the nuts.

Canarium indicum

Ecology and exploitation

In Vanuatu the tree is found in secondary forest up to 400 m altitude. Frequent in the north of the archipelago, it becomes rare from Erromango and is absent from Tanna. The tree, protected in forests, is cultivated around domestic areas (villages and gardens). People transplant spontaneously germinated seedlings or plant in shallow holes fruits that have reached full ripeness or have the endocarp slightly dried. The cultivated trees are pruned to make the fruits easier to pick. In Vanuatu the fruits generally ripen between October and March. Flowering occurs immediately afterwards, followed by a long period

of maturation of the fruits which finally become black. The period of availability of the fruits varies slightly from one year to the next, and also from one tree to the next, since human selection has produced some trees that continue to fruit a little out of season. Generally the cultivated trees are very productive. Trees carrying female flowers are more productive than those with male and hermaphrodite flowers. Forest trees are less productive, and are mainly used for their timber. In Papua New Guinea the species grows from 0 to 700 (930) m altitude (Bourke, personal communication). In New Britain fruiting occurs twice per year, between the months of August and November and then again from April to May. The species is cultivated throughout its area of distribution, but particularly from Papua New Guinea eastwards. In Solomon Islands *C. indicum* is cultivated and often pruned. Young trees survive cyclone strength winds with little damage (Evans, 1991).

Alimentary uses

This is an important food plant in New Guinea and in Vanuatu. In Vanuatu the *nangai* are eaten fresh, as soon as they are picked. They are collected by knocking them down a little before maturity, just as they begin to become black. At this stage they are less oily and are easier to digest.

The hard shell of the nut is cracked between two stones that hold the nut vertically. It is also advisable to remove the thin brown skin that surrounds the white kernel, because this gives a slightly bitter taste to these nuts of exquisite taste and delicate texture. They may be boiled, roasted or crushed and sprinkled on the *lap-lap*. In certain regions, in particular in the Banks Islands, the nuts are preserved by smoking, after the fleshy mesocarp has been removed. They are placed on racks over the hearth or inside little huts constructed for this purpose and under which a small fire is kept permanently burning. They dry slowly, and are then placed in special baskets with a narrow aperture in which they will keep for several months or even several years. In Solomon Islands the nuts are preserved as in Vanuatu on bamboo racks over the hearth. The seeds are also extracted from their shells and cooked in an oven with hot stones until they are dry, then kept in closed containers for several months (Henderson & Hancock, 1989). The nutritional importance of these nuts and their potential for commercialisation has led Solomon Islands and Vanuatu to undertake some research on their taxonomy and agronomy. Indeed, both countries have started some local commercialisation successfully.

Other uses
In Vanuatu the timber is used for making canoes and paddles or for constructing timber frameworks. The buttresses are used for wood sculptures. The bark is used in traditional medicine for treatment of vomiting, and the young leaves for treatment of scabies and ciguatera poisoning. In New Guinea and in Solomon Islands the wood is also used for making canoes and bowls.

Other edible species
See *C. harveyi* (p. 129).

References
Aburu (1982), Brown (1954), Corner (1988), Evans (1991), Henderson & Hancock (1989), Leenhouts (1955a, b, 1956, 1959), Malapa (1992), Peekel (1984), Smith (1985), Whitmore (1966).

Species
Castanopsis acuminatissima Blanco

Family
Fagaceae

Common name (English)
Castanopsis chestnut

Consumption
Occasional.

Part eaten
Seeds.

Toxicity
Tannins present but eliminated by cooking.

Description

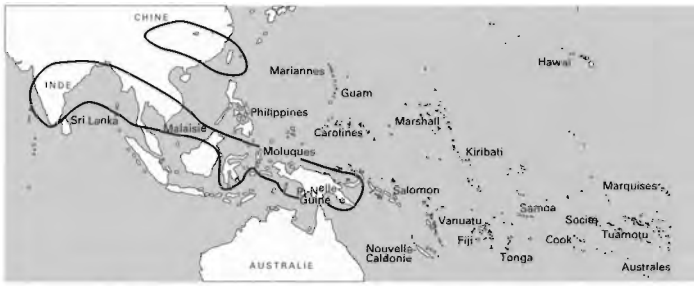
Tall tree (10-36 m) with large trunk. Leaves simple, alternate, dark shiny green above and silvery brown beneath, oval, lanceolate or even elliptical, 5-15 cm long. Flowers grouped in a male inflorescence (narrow spikes, beige in colour) or a female inflorescence (10 cm long rachis, greenish in colour), both present together on the same tree. Fruits formed from a single seed, held at its base in a woody cupule, brown, ovoid or conical (1.2 x 0.8 cm), downy, longitudinally veined; seed containing a kernel formed of two large cotyledons.

Ecology and exploitation

Castanopsis acuminatissima is a common tree in secondary forest in Papua New Guinea from 600-2,400 m altitude (Bourke, personal communication). This forest tree is widespread in the highlands and produces, when mature, numerous new shoots. It is a vigorous tree that produces large quantities of nuts each year. In the region of the Ankave, the tree flowers in April to May and bears ripe fruits in August.

Alimentary uses

The seed, although edible, is only eaten in some parts of New Guinea. The fruits are, however, easy to collect and the nuts can be broken without difficulty. They are eaten raw or cooked in bamboo containers by the populations of Okapa (Eastern Highlands), boiled by those of Pomio (New Britain), raw or grilled by the Karam (Madang), the outer envelope first having been removed. The Enga of the Western Highlands also eat them. In season the Ankave pick the seeds of *C. acuminatissima* during their walks in the forest. Brought back to the village, the women peel them by means of a bone of a fruit bat, then cook them and



Castanopsis acuminatissima: India (east Bengal), Burma, China (Guizhou and Yunnan), Taiwan, Thailand, Vietnam, Laos, the Indo-Malayan Region (north Sumatra, Java, north Borneo, Sulawesi, Maluku, New Guinea). Also in the islands of Japen, Misima, Fergusson, Goodenough and New Britain (it is the only species of the family Fagaceae in the Bismarck Archipelago).

serve them with specific edible leaves. Cockatoos, cassowaries and wild pigs eat the fruits when they have fallen to the ground. The seeds of *Castanopsis* would have been an important food for earlier hunter-gatherers. The mortars and pestles of New Guinea seem to have been mainly for the pounding of nuts, among which those of *Castanopsis* featured. Nowadays the seeds are no longer pounded.

Other uses

The timber of this species is hard and the Ankave use it for construction, as do other highland communities of Papua New Guinea.

Other edible species

The genus *Castanopsis* comprises 120 species of which several are edible. With caution, however, because some may be toxic (Corner, 1988).

C. costata (Blume) A.D.C.: Thailand, Malaysia and Borneo;

C. inermis (Lindley ex. Wallich) Benth.: Sumatra and Malaysia;

C. lucida (Nees) Soepadmo: Thailand, Malaysia and Borneo;

C. malaccensis Gamble: Thailand, Malaysia and Sumatra; seeds eaten in small quantities;

C. megacarpa Gamble: Malaysia, Borneo; information on this species is contradictory, sometimes saying that the seeds are edible and sometimes that they are toxic;

C. philippinensis (Blanco) Vidal: Philippines;

C. wallichii King ex. Hook. F.: Malaysia.

References

Brown (1951), Corner (1988), Millar & Dodd (undated), Soepadmo (1972), Verheij & Coronel, eds (1992).

Species
Castanospermum australe Cunn. & Frazer ex. Hook.

Family
Papilionaceae

Common name (English)
Moreton Bay chestnut

Consumption
Only in exceptional circumstances.

Part eaten
Seeds.

Toxicity
Yes.

Description

Tall tree (15-40 m); straight trunk, dense crown. Compound leaves with 5-19 leaflets, sub-opposed, dark green and glossy, oval to lanceolate (6-16 x 2-5 cm); petiolule 0.5 cm long. Flowers on erect racemes up to 20 cm long; calyx yellow and tubular, terminating in 5 lobes; 5 separate petals, yellow-orange or red (3 x 2 cm); 10 orange stamens protruding beyond the corolla and curved upwards. Fruits composed of a large, dark brown, hard husk (18-22 x 5-6 cm), containing 3-5 dark brown, rounded seeds (3-4 cm in diameter), slightly flattened, enveloped in white spongy material.

Geographical distribution

Originally from north eastern Australia, this species has been introduced to Indonesia, Malaysia, Solomon Islands, and probably New Guinea and Vanuatu.

Alimentary uses

The seeds are toxic but may be made edible by cooking. In Vanuatu they are apparently only eaten by a single family in the north of Efate, who prepare them as follows. The seeds, picked up from the ground, are grilled for a long time, then scraped to get rid of burnt parts. They are then eaten hot. Insufficient cooking leads to diarrhoea. Australian aboriginals eat these seeds after macerating them in water for a long time and then roasting them.

Other edible species

This is the only species in the genus.

References

Backer & Bakhuizen van den Brincke (1963), Brand Miller *et al.* (1993), Cooper & Cooper (1994), Corner (1988), Wheatley (1992).

Species
Citrus macroptera Montrouzier

Family
Rutaceae

Common name (English)
Ghost-lime

Consumption
Occasional.

Part eaten
Juice.

Toxicity
None.

Description

Small tree or shrub (3-6 m); crown not very dense. Leaves oval or lanceolate (6-13 x 3.2-5.5 cm); margins slightly dentate; fine, parallel secondary and tertiary veins; spines present on the axils of the leaves; petiole with wings that are almost as large as the leaves. Fruits yellow, rounded (6-7 cm in diameter), with a thick skin and pulp that is acid and not very juicy.

Geographical distribution

Species native to Thailand, Malaysia, Indonesia, the Philippines, New Guinea and the Bismarck Archipelago. Early aboriginal introduction to Solomon Islands, Vanuatu, New Caledonia and Polynesia. In Guam the species is either native or an aboriginal introduction.

Ecology and exploitation

In Vanuatu the species grows from sea level to 300 m altitude. It is found in almost all the islands of the archipelago, but it is particularly abundant in Erromango. It generally grows in small populations. It is not cultivated but is at least protected. The species is naturalised and abundant in Fiji. Several authors (Smith, 1985; Verheij & Coronel, eds, 1992) have indicated that this species hybridises with other species of *Citrus*.

Alimentary uses

In Vanuatu this wild orange is not really eaten, but it is regularly used for its juice.

Other uses

In Guam, Samoa and Fiji, the pulp of the fruit or the macerated leaves were used in earlier times for the washing of hair. The pulp was also used in Guam for washing linen. In Samoa the timber serves for making axe handles and canes.

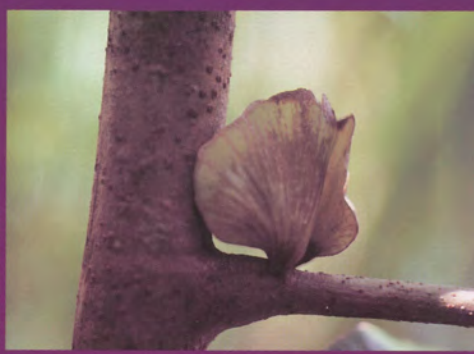
Other edible species

Many species of *Citrus* are edible, but in the Pacific *C. macroptera* seems to be the only local species. We note also: *C. hystrix* D.C., a species that is often confused with *C. macroptera*, which is localised to the Indo-Malayan Region. Its exact centre of origin is unknown.

References

Christophersen (1971), Safford (1905), Smith (1985), Verheij & Coronel, eds. (1992).

From New Guinea to Vanuatu, Canarium is an important food plant.



(Photo: J.M. Bompard)

Above: Stipule of Canarium harveyi: ear-shaped, it is situated near the base of the petiole.
Below: Fruits of Canarium harveyi.

(Photo: J.M. Bompard)

(Photo: J.M. Bompard)

Above: Nuts of Canarium harveyi smoked and kept in special baskets (Gaua: Vanuatu).
Below: Fruit of Canarium harveyi in transverse section.

(Photo: J.M. Bompard)

Canarium species have nuts of exquisite taste and delicate texture.

Above: Canarium indicum of ovoid shape with two kernels.
Middle: Canarium indicum with a yellow epidermis, found on Emae (Vanuatu).
Below: stipule of Canarium indicum situated at the junction of the petiole and the branch.

(Photo: G. Bourdy)

Above: Citrus macroptera.
Below: Sea trumpet (Cordia subcordata).

(Photo: J.M. Bompard)

(Photo: J.M. Bompard)

Above: Bundles of dragon plums (Dracontomelon vitiense) for sale in the market of Luganville (Vanuatu).
Below left: Bunches of dragon plums.
Below right: Dragon plums cut across to show the nut.

Above: Wild figs of Vanuatu (Ficus granatum).
Below: Wild figs (Ficus aspera).

(Photo: J.M. Bompard)

Above: Elaeocarpus sp., the flesh of which is eaten (Santo, Vanuatu).
Below: Wild figs of Oceania (Ficus scabra).

Foods of secondary importance or regularly eaten, figs are fruits that are sought after for their taste.

Above: Ficus virgata.
Below: wild figs of Melanesia (Ficus wassa).

Species
Cordia subcordata Lamarck

Family
Boraginaceae

Common names (English and French)
Sea trumpet
Gommier
Sébestier en coeur

Name in Bislama
bourao blong soltwata

Consumption
Nibbled frequently by children; food in times of shortage.

Part eaten
Kernels.

Toxicity
None.

Description

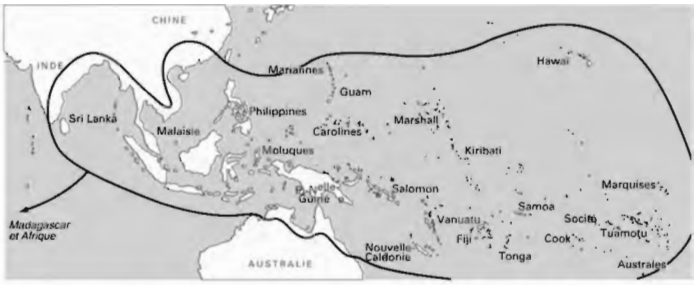
Squat tree, low in height (less than 15 m); bark greyish and fissured, peeling off in rectangular pieces. Leaves simple, alternate, light green, oval (6-8 x 9-16 cm); margins slightly undulate; 4-6 pairs of veins; petiole thin and 4-8 cm long. Flowers grouped in terminal or axillary bunches, not very many; calyx green and tubular (1-1.5 cm), lobed at the apex (3-6 lobes), persistent; 5-7 orange petals fused at their bases (2-4 cm long). Fruits green, becoming yellowish and then dark brown as they dry, hard, round (2-3.5 cm in diameter); containing a nut with 4 chambers; each chamber containing 1-2 kernels the size of a grain of rice, difficult to extract.

Morphological variability

Peekel (1984) indicated two types of *Cordia subcordata* occurring in the Bismarck Archipelago. The commoner type has orange flowers while the other, much rarer, has yellow flowers. Everywhere else, only the orange-flowered form is found.

Ecology and exploitation

The tree grows close to the sea in all Oceanian islands. In Vanuatu it is less frequent in the south of the archipelago, and it disappears at altitude. It is a wild tree, never cultivated and little protected. It is not very abundant in Vanuatu, but some fine specimens may be found, preserved as shade trees, in coastal



Cordia subcordata: from tropical Asia to Hawaii and from southern China to northern Australia, via all the islands between. Probably an aboriginal introduction to the Marquesas. Introduced to Madagascar and then the coasts of tropical Africa. Its floating fruits are dispersed by ocean currents. In certain islands of the Pacific, such as Hawaii, it could have been introduced by the Polynesians.

villages. Flowering and fruiting occurs throughout the year. The species is not very common in Guam and Samoa, but it is abundant in the Caroline Islands, Fiji and Hawaii. It is likewise common in Solomon Islands. The species is rarely cultivated.

Alimentary uses

In Vanuatu, children break the fruits open and eat the seeds, but this is quite a business because the seeds are very small. Adults do collect them, however, in times of food shortage. The seeds are also eaten in Queensland and in Fiji.

Other uses

Little used nowadays, *C. subcordata* was probably an important plant for Pacific peoples in olden times. Nowadays the species mainly furnishes a high quality timber for working. In Vanuatu it is not really abundant enough to be used in this way. However, particularly in Solomon Islands, but also in Fiji, Wallis and Tonga, it is still used for making supporting posts for houses, roofing, drums, oars for canoes, and carved objects. This major usage has led to the progressive disappearance of the species from certain regions. Henderson & Hancock (1989) noted that the timber is also an excellent fuelwood, and that it was used in earlier times for making fire by rubbing small twigs together. The flowers are used to make necklaces. The leaves, fruits and bark have medicinal properties. In Vanuatu, for example, an extract of leaves diluted with water soothes distension of the abdomen and aerophagia. In earlier times the bark provided good quality ropes. In Tonga and in Wallis, the leaves mixed with those of certain *Ficus* provide a red pigment used for colouring *tapa* cloths. The frequency with which this species is mentioned in the mythology of Hawaii, Tonga and the Tuamotu Islands (Neal, 1929) emphasises its importance in traditional culture; Thaman (1990) also showed that this plant occupied a central place in

the myths of Kiribati, and it is the emblem of the Karongoa tribe.

Other edible species

The genus comprises from 200 to 400 species according to author, the majority of which are found in tropical America. The seeds of *C. sebestena* and the flesh of the fruits of *C. dichotoma* are eaten in the Pacific:

C. sebestena L.: American species cultivated in tropical regions, including in Fiji, Hawaii and Guam;

C. dichotoma Forster f. (syn. *C. myxa* L.): species present from India, southern China and Taiwan to Fiji, via the Indo-Malayan Region and tropical Australia. The flesh of the fruits is eaten in the Bismarck Archipelago, in Fiji and by Australian aboriginals, but not in Vanuatu where the juice of the fruits is used as glue.

References

Brand Miller *et al.* (1993), Christophersen (1971), Cooper & Cooper (1994), Corner (1988), Dupuy & Guiot (1992), Heine (1976), Henderson & Hancock (1989), Neal (1929), Parham (1972), Peekel (1984), Smith (1991), St John (1951, 1953, 1960, 1974), Stone (1970), Thaman (1990), Wichman & St John (1990), Wilder (1934), Yuncker (1971).

Species
Corynocarpus similis Hemsley

Family
Corynocarpaceae

Consumption
Occasional; a food in times of scarcity.

Part eaten
Pulpy flesh.

Toxicity
The alkaloid karakine is present in the seeds.

Description

ALeaves simple, dark green on the upper surface, light green underneath, oboval (8-20 x 4.5-10 cm); 6-10 pairs of veins; petiole 2-3.5 cm long. Flowers grouped in a terminal panicle (10 cm long), white and small in size; calyx with 5 sepals; 5 petals; 5 stamens. Fruits green, white or pale red, spherical or slightly ovoid (3-5 x 1.6-3 cm), flesh more or less juicy.

Corynocarpus similis

Morphological variability

A form with red fruits and a form with white fruits are known. These two forms are not present in all islands. Of the two edible forms, the red which is less common is the more sought after.

Ecology and exploitation

In Vanuatu the species is not very common. It is found in all the islands, but becomes rarer towards the south. It is a tree that likes humidity and shade. It is found wild under forest canopies, near gardens and along footpaths in areas of secondary vegetation. It grows up to 1,300 m altitude (Wheatley, 1992). Its fruiting period is little known; Wheatley puts it between September and February.

Alimentary uses

The fruit is edible, but is little eaten except in times of food shortage. Only the communities of Tanna and the Torres Islands use it regularly as food. In Torres

Corynocarpus similis: endemic to Vanuatu.

this species was formerly abundant, cultivated and regularly eaten. The fruit was eaten cooked, slightly before it was fully ripe, or raw when it was completely ripe. In Malo only males ate the fruit, because ingestion by females led to swelling of the external genital organs. In Maewo, the fruit must never be picked with the aid of a stick. Anyone who forgets this prohibition will find himself struck in turn by the other fruits which will come to torment him in the night. In this island the fruits are anyway not eaten but are used in traditional medicine. The seed is very toxic and contains karakine, identical to that of *Corynocarpus laevigata* which is found in New Zealand and Hawaii.

Other uses

The leaves have medicinal properties. The timber is used for making implement handles or digging sticks for planting taro and yams.

Other edible species

C. laevigata Forster & Forster f.: endemic to New Zealand. Maoris eat the toxic seed, after long preparation, and the flesh. This species, called *karaka* in New Zealand, was introduced to Hawaii where it is now naturalised;

C. cribbianus (F.M. Bail.) L. S. Sm.: present in Solomon Islands where itis called *ibo* (*Kwara'ae*) and also in New Guinea and Australia. The tree, from which fruits with edible flesh were gathered in earlier times, has become rare in Solomon Islands. It is not eaten in Australia.

The fourth *Corynocarpus*, *C. australusica* C.T. White, found in Australia (north Queensland), in New Guinea and in the Aru Islands, is not edible.

References

Cabalion & Poisson (1987), Cooper & Cooper (1994), Henderson & Hancock (1989), van Steenis (1951), Wheatley (1992).

Genus

Diospyros spp.

This pantropical genus includes over 400 species, of still uncertain taxonomic status, that produce edible fruits (e.g. for New Guinea see Gorecki and Gillieson, 1989). By way of example we list two species, native to the Pacific and present in Tonga or Samoa. To our knowledge, no species of *Diospyros* with edible fruits is present in Vanuatu.

Species

Diospyros elliptica (Forster) Green

Family
Ebenaceae

Consumption
Occasional.

Part eaten
Pulpy flesh.

Toxicity
None.

Description

Small tree (10 m on average). Leaves more or less elongate, small in size (2-16 x 1.5-9 cm), petiole short. Flowers in groups of 3-15 in male or female inflorescences, pale yellow or rose according to variety; calyx with 3 lobes (2-4 mm long). Fruits yellow or red when ripe, ovoid (1-3 x 0.6-1.6 cm).

Morphological variability

Smith (1981) distinguished seven varieties of this species, of which five are found in Fiji.

Geographical distribution

Fiji, Samoa, Tonga, Niue. Aboriginal introduction to Tonga (Smith, 1981).

Uses

In Tonga children nibble the fruits, which are small in size. In times of food shortage the whole population uses them as food. An infusion or a decoction of the bark is used to treat stomach problems, abdominal pains and constipation; an infusion of bark (only) to treat internal haemorrhage or pains following childbirth.

Species
Diospyros major (Forster) Bakh.

Family
Ebenaceae

Consumption
Occasional.

Part eaten
Pulpy flesh.

Toxicity
None.

Description

Small tree (10 m on average). Leaves alternate, grey green, elliptical or oval (10-15 x 7-9 cm), apex rounded; petiole 1 cm long. Flowers small in size, grouped in axillary bunches. Fruits elliptical, 4 cm long, furnished with small hairs.

Geographical distribution

Present in Fiji. Aboriginal introduction to Tonga. Introduced and found in the cultivated state in Samoa. Likewise present in Wallis.

Uses

In Tonga these fragrant fruits are consumed, but they are mainly used for making necklaces. An infusion of leaves is administered in cases of mouth and stomach ailments, and also in cases of sterility and constipation. In Wallis the immature seeds are eaten, and the fruits, cut into quarters, for plaiting into necklaces.

References

Dupuy & Guiot (1992), Parham (1972), Smith (1981), Yuncker (1971).

Species
Dracontomelon vitiense Engler

Family
Anacardiaceae

Common names (English and French)
Dragon plum
Le tambol (tambolier)
Prune dragon (prunier dragon)

Name in Bislama
nakatambol

Consumption
Regular.

Part eaten
Pulpy flesh.

Toxicity
None.

Description

Tall tree (10-30 m); trunk large (20-97 cm in diameter), furnished with thick buttresses; crown large and dense. Leaves compound, with 4-9 pairs of alternate leaflets plus one terminal one; petiole 4-10 cm long; leaflets glossy green, oblong or lanceolate (8-15 x 3-5 cm), base asymmetrical; petiolule 0.4-1 cm long. Flowers grouped in panicles, white, small in size. Fruits yellow or orange, round and flattened (1-3.5 cm in diameter), embellished with 5 small depressions; a single stone, flattened and circular, with 5 oval marks of variable size on its dorsal surface; margin of stone irregular; 5 minute seeds.

Morphological variability

The people of Vanuatu distinguish and name two types of this tree, according to the size of the fruit. One is the large-fruited type and one the small-fruited type. This species, essentially wild but protected by humans, does not show much variability, but there is a slight and continuous selection pressure towards trees with fruits that are larger, fleshier and sweeter.

Ecology and exploitation

In Vanuatu the species grows up to 200-300 m altitude, in stands of primary forest. It is also found near villages and gardens, and in forests altered by human activity.