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GUARANÁ (*PAULLINIA CUPANA* VAR. *SORBILIS*): ECOLOGICAL AND SOCIAL PERSPECTIVES ON AN ECONOMIC PLANT OF THE CENTRAL AMAZON BASIN*

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Summary

Guaraná is considered an ideal crop for supplementing the incomes of small peasant farmers in the Amazon basin. A fast-growing perennial, guaraná can be planted in the midst of manioc crops, allowing the formation of extensive orchards in the place of regenerating scrub once the manioc has been harvested. Traditional forms of guaraná agriculture practised by the Saterê-Mawé Indians compare favourably with the plantation system favoured by government agronomists.

Indigenous techniques of hand-processing guaraná are also shown to produce better quality in the finished product than those practices adopted by industrial concerns. A detailed comparison of two systems of production show the Indians' implicit concern to avoid oxidization of the phenolic compounds in the seed, since this leads to the guaraná becoming dark in colour, bitter in taste, and irritating to the gastrointestinal tract. The short-term medicinal effects of guaraná are commonly thought to result from a high content of caffeine and associated alkaloids, as well as from considerable amounts of tannin. Future research may well show that various saponins also play an important part in the drug's pharmacology, particularly with regard to its long-term influence as a general tonic and prophylactic.

Introduction

Much time and effort has gone into efforts by scientists to propose viable alternatives for human occupation in the Amazon, and many research bodies and even international funding agencies — though not, as yet, the Brazilian government — are taking an increasingly hard line on the tragic devastation being inflicted on the world's largest rain forest. Lamentably

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enough, may of the present agricultural strategies in the area are either inefficient (in the case of most annual cash crops), short-sighted (in that of homogeneous forests), or positively suicidal (in the doomed attempts to convert the forest to cattle pastures). The fact of a mounting human population, however, will continue to remain a constant, and — even should political pressure finally bring an end to the age of the monstrous million-hectare "development" project — the pressing necessity of feeding this population is not a problem that will ever simply go away.

We can, therefore, expect an uninterrupted expansion of small-scale forest clearance for swidden agriculture in all areas of human occupation and particularly in those where local Indians and peasants are forced to be largely self-sufficient in terms of their food supplies. Virtually all these farmers, however, are also dependent in some form or other on trade for industrial goods, and traditionally have found commodities of their own to serve as mediums of exchange, including the staple manioc flour, whose laborious production presupposes a very low level of compensation for labour in order to remain competitive. The more rewarding items of trade can mainly be reduced to the well-known extractive products — rubber Brazil nuts, tonka beans, copaiba oil, jaborandi leaves, *etc*. — whose supply tends to dwindle inexorably along with the very area of primary forest itself, and whose production can rarely be increased sufficiently to provide for the needs of an expanding sedentary population.

A new source of income is therefore in many areas a pressing social necessity, and the proposals contained in this paper are dedicated to the economic potential contained in a shrubby perennial, *guaraná*, which in one small region — centred on the town of Maués, 250 km east of Manaus — is today the major cash crop, providing a trading commodity of very high value per unit weight, a considerable advantage when dealing with the spiralling transportation costs produced as the result of poor communications and the sheer geographical extension of the Amazon basin. Most commonly, guaraná is raised from seedlings in conjunction with the main food staples, attaining maturity well after these have been harvested, and growing to form extensive orchards which replace the ever widening swathes of secondary scrub that form around human habitation. Requiring little technical assistance and no new forest clearances — other than those undertaken as a matter of course for the growing of food crops — guaraná both can and should be produced on a far larger scale. With present market demand already way in excess of production, the time is ripe for a concerted attempt to convince local governments and peasant farmers of the social, ecological and, not least, economic good sense of growing more guaraná.

What is Guaraná ?

The commercial guaraná of the central Amazon is produced from seed kernels of *Paullinia cupana* H.B.K. var. *sorbilis* (Mart.) Ducke, a woody vine

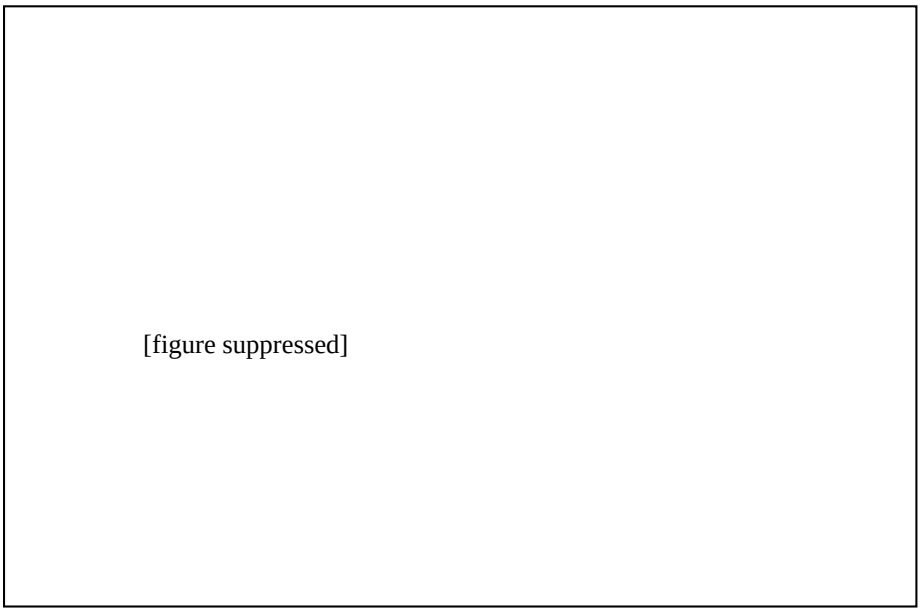

Fig. 1. Guaraná: *Paullinia cupana* H.B.K. var. *sorbilis* (Mart.) Ducke. (Drawing by Chien. Photo: Anthony Henman.)

of the Sapindaceae, which adopts a sub-erect, shrubby habit when cultivated in the open. A number of characteristics distinguish it from the relatively rare typical variety of *Paullinia cupana* collected by Humboldt on the upper Orinoco — notably the rather different outline of its divided compound leaves, the presence of supporting tendrils (generally at the base of leaves or inflorescences), and the size, shape and colour of its fruits.[1] A typical 25-cm panicle of flowers may, under ideal conditions, yield up to 50 fruiting bodies, giving the visual impression of a rather robust bunch of grapes. The fruits themselves are generally obovate and deeply segmented fleshy capsules 2 to

[1] Ducke 1937 describes the characters distinguishing the two varieties of *Paullinia cupana*. Other good botanical descriptions of the plant are in Corrêa (1952: 545 - 555) and Cavalcante (1976: 135 - 141).

2.5 cm in diameter, of an orange-red colour when ripe, and containing from one to three seeds, partially enclosed in a farinaceous white aril, and with glossy dark-brown tegument or testa which makes them not dissimilar to a rather small horse-chestnut (*Aesculus hippocastaneanum*).

It is these seeds, once roasted, which form the common article of corn merce, for they contain an exceptionally high yield of caffeine, reaching from a low of 2.7% (dried weight) to a high of 5.8%. In native practice the kernels are separated from the testa, then pounded, kneaded and dried by smoking over wood fires, being finally ground for use in the form of powders mixed with water. In this century, however, the principal use of guaraná has been in the form of syrups, extracts and distillates employed mainly as flavouring agents and as a source of caffeine by the soft-drinks industry. One purpose of this paper will be to attempt to reverse this trend, for — as we shall see — there are excellent technical, medical and indeed, commercial reasons for renewing the traditional emphasis on the use of the whole seed of guaraná: both as a stimulant and prophylactic, and as a specific treatment for certain common complaints.

It is not my intention, however, simply to sing the praises of guaraná though many years of personal use has shown it to be a most efficient stimulant, as well as an excellent tonic of the digestive system. Early accounts of the use of the drug provide abundant evidence of the high esteem in which it was held by both the native Indians of the Maués area and the early white colonists of the Amazon basin. The dietary restrictions which these Indians have always practised for magical reasons — during pregnancy, after a death in the family — usually limit food intake to manioc flour and a few minor insects such as flying ants. There is, however, no limit to the amount of guaraná that a person may imbibe under such circumstances, and no doubt its regular use has served to mitigate considerably the effects of prolonged fasting.

The very first written description of guaraná dates from 1669, when the Jesuit missionary João Felipe Betendorf penetrated this part of the Amazon, noting the Indians' fondness for drinking guaraná as an everyday beverage, as well as its diuretic properties, and the widespread reports of its efficaciousness against headaches, fevers and cramps.[2] By the middle of the eighteenth century, local dignitaries such as the Bishop Queirós had become converted to the use of guaraná, claiming that it provided relief from diarrhoea and the great heat and oppressiveness of the climate.[3]

A widespread faith in the ability of a daily dose — taken in the morning on an empty stomach — both to act as an aphrodisiac and to protect the regular user from malaria and even amoebic dysentery, caused it to be adopted enthusiastically by gold prospectors and other white adventurers in

[2]Betendorf (1909:36-37).

[3]Queiros (1847: 88). Other eighteenth century sources on guaraná include Sampaio (1825: 5 - 6), Perreira (1885: 75), and Noronha (1862: 27).

Amazonia[4] By the time of the visit to Maués of the botanist von Martius - who in 1819 collected the type specimen of what he denominated *Paullinia sorbilis*, later also dubbing it ironically *panacea peregrinatum* — there already existed a flourishing trade in guaraná between this settlement and areas as far away as Mato Grosso and Bolivia, providing what was probably the major impulse to the opening of the Madeira and Tapajós rivers to commerce.[6]

Scientific investigation of the properties of guaraná began with material which the botanist von Martius sent back to his brother Theodor, who in 1826 isolated a crystalline substance which he called guaranine — later shown to be a tetramethylxanthine, with a structure virtually identical to caffeine, and present in conjunction with surprisingly large quantities of theophylline and theobromine as well.[7] A school of thought has developed which sees the medicinal qualities of guaraná to reside solely in these various xanthine derivatives and in the plant's tannin content, the latter being a relatively high 5-6%, which would explain its astringent action in the digestive tract.[8]

In recent years, however, claims have been made for guaraná's suitability as a tea and coffee substitute, particularly for those suffering from cardiovascular afflictions, and this could be related to the counterbalance given to the stimulant alkaloids in the drug by the saponins which are so well represented in the plant family which includes guaraná (the Sapindaceae). Trace amounts of one saponin known as timbonine — similar to the compounds reported in the various *timbó* fish poisons used by Amazonian Indians - were reported by the German chemist Peckholt in the last century, but otherwise little interest has been shown in examining the non-alkaloidal properties of guaraná. This would seem to be a grave oversight, particularly in the light of recent research into the therapeutic properties of ginseng and other Old World stimulants, which have demonstrated clearly that the pharmacological activity of such plants is due mainly to their saponin contents. Both guaraná's popular reputation and my own subjective perception of its effects wouldSupport the proposal of a special category for this

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[4]References to the use of guaraná in popular medicine can be found in Wallace (1979: 271), Agassiz (1975: 189), Smith (1879: 255), Mata (1913: 126), Grieve (l931: 381), Souza(1873: 121 -123), Machado (1946), Cruls (1959: 49 - 60), Monteiro (1965: 21-29), Cruz (1965: 511 - 515), Cid (1978-: 81), and Corrêa *et al*. (1979).

[5]Martius (1943: 59), (1867: 401), Spix and Martius (1981: III, 134), Machado (1946.)

[6]Spruce (1908: I, 62), Hoehne (1939: 185 - 186), Souza (1873: 121 - 123), Cruls (1959: 55), Leacock (1964: 8), Patiño (1967: 258) also provides evidence of the plant being introduced to Java and Singapore at the turn of the century.

[7]Indian "sticks" yield between 4.2 and 5.8% caffeine, the kernels between 2.7 and 4.4% (the drop being due to the excessive parching which occurs industrial drying systems), and the testa between 2.2 and 3% caffeine. See Correa (1952:549 - 551). Carneiro (1931), Arens (1956); also Maravalhas (1965: 17 - 23) on theophylline and theobromine.

[8]Carneiro (1931), Corrêa (1952: 550 - 551).

plant, with its effects being perceived to lie somewhere between those of the classic caffeinated beverages and those of the Oriental "somatensics" described by Stephen Fulder in his incisive book on ginseng.[9]

On the other hand, guaraná's relatively mild effect – considering its high caffeine content – could well be due less to the internal chemistry of the plant than to the very pharmacology of its ingestion. Guaraná seeds have a high contents of fats, oils and resins which together prevent the whole drug from ever dissolving very successfully in water, and it never attains the simple aqueous solutions which can be produced with tea and coffee.[10] Particles of guaraná, plainly visible to the naked eye, are present in the prepared drink in the form of a milky suspension, and a certain sediment always forms on the bottom of the receptacle. It seems likely, therefore, that the stimulant properties are absorbed very slowly through the intestinal tract, with the effect of a single dose often being noticeable for a full six hours, or twice as long as that of an average cup of tea or coffee.[11] Indeed, it is probably the nutritive value of these fatty compounds, and the relative slowness which they afford to the absorbtion of the stimulant alkaloids, which together have given guaraná its reputation as a "healthy" pick-me-up and a sustaining food substitute during periods of voluntary or enforced fasting.

The cultivation of Guaraná

The observed contrasts between the use of the whole seed of guaraná and that of the crude extracts employed by the soft-drinks industry is itself eloquent testimony of the need to reconsider the traditional cultural context of the plant. This need becomes doubly imperious when we turn to consider the differences between the systems of cultivation put into effect by peasant farmers and the large agroindustrial concerns. An almost complete divide exists between a well-financed plantation system and the family-based guaraná orchards of the Saterê-Mawé Indians, and both sides view each other's techniques with the utmost scorn and derision. In fact, a far more subtle conflict of opinion exists than would appear at first sight, especially were one to heed only the agronomists' attempts to dismiss the whole argument as a simple matter of expertise confronting ignorance.[12] Even leaving to one side the social and ecological problems engendered by large-

[9] 0.06% of timbonine was reported by Peckholt, in Corrêa (1952:549). See Shibata (1977) and Fulder (1980) for recent discussions of the pharmacological activity of saponins in Old World plants. On fish poisons of the Sapindaceae see Rizzini and Mors (1976:97).

[10] For a summary of the different estimates of fats, oils and resins in guaraná see Corrêa (1952:550-551); also Arens (1956) on guaraná's insolubility in water.

[11] Cruls (1959:56) on guaraná's insolubility and slow absorption. The six-hour estimate is a rough figure I have arrived at from observing my own use.

[12] For examples of this, see Castro (1972) and Souza and Almeida (1972).

scale plantation agriculture,it is still by no means clear that capital-intensive forms of exploiting guaraná are even technically sound, for they are based on the use of a homogeneous stock of plants which — given the many imponderables which affect guaraná production — seldom perform in the manner intended, and almost never live up to their projected yields.

At the outset, it would be useful to consider the natural history of the guaraná plant. In recent years, considerable criticism has been focussed on the status traditionally accorded to guaraná — that of a cultivated plant or true domesticate.[13] Genuinely spontaneous plants have been found in dense primary forest hundreds of miles from the area in which the plant is cultivated, and — though large birds such as the toucan and the *jacú* are known to swallow the seeds and disseminate them in their droppings[14] — it seems unlikely that such a casual form of dispersion could account for the species' present wide distribution, unless of course, the plant were already adapted to surviving in the wild.

Furthermore, the Saterê-Mawé Indians — whose system of agriculture must surely approximate that of their own ancestors, the first men to cultivate guaraná — have never adopted the white man's practice of raising guaraná from seed, and continue to plant their orchards with young seedlings collected in the bush. Significantly, these seedlings are not only sought in the secondary scrub regenerating in abandoned manioc patches - where indeed one might suppose most plants to be "escapes" borne by birds from nearby areas of cultivation — but also in the virgin rain forest itself, where mature guaraná plants in the canopy drop numerous seeds to germinate in the nutrient-rich and well-shaded litter of the forest floor.

The Indian system of planting out seedlings collected in the wild has come in for some severe criticism from local agronomists, who have pointed out that there is no way of knowing what sort of yield such plants will eventually produce. They single out the fact that Indian orchards often contain numerous non-productive plants, and suggest instead their own system of selecting high-yielding cultivars and raising them from seed, or, better still, from cuttings induced to root by the application of hormones.[15] Cuttings taken from green or only semi-woody material root much more easily than those taken from woody stems; their advantage over sexually

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[13]Especially Cavalcante (1967), questioning the assumptions of Ducke (1937).

[14]Gonçalves(1971).

[15]On raising guaraná from seed, see Castro (1972), Souza and Almeida (1972), EMRATER/EMBRAPA (1976), Vasconcelos *et al*. (1976). Corrêa *et al*. (1980) have pointed out that the guaraná seed is normally immature on being harvested, which would account for its slow rate of germination and its infertility if allowed to dry out before being planted. Commercial guaraná seed must be transported over long distances in boxes of wet sand. Schmidt (1941:15) describes an early, rather inefficient form of propagation by cuttings. The use of hormones to improve the rooting of guaraná cuttings has been pioneered by the UEPAE station in Manaus (see Corrêa and Stolberg, 1981) and adopted commercially by Dr. Victor Nogueira of Maués, as I was able to observe on a visit to the SAMASA plantation on December 22, 1978.

propagated seedlings resides in a more rapid growth and in the faithful reproduction of the genetic traits of their immediate parent stock.

There are, however, a number of criticisms which can fairly be made of the system championed by the government agronomists. In the first place, Indians point to the considerable effort required to set up shaded beds for seedlings and rooted cuttings, to fill innumerable plastic bags with carefully prepared soil mixutres, and to subject the young plants to doses of expensive hormones, fertilizers, pesticides and fungicides. In the second place, the time lag involved in raising plants from seed means that one whole year will be lost in the seedling bed, and at least another four once the shrub has been planted out, before anything like economic yields begin to be achieved. In contrast, the Indian seedlings, collected in the wild when they are already at least one, and often as much as three or four, years old will usually be productive in the second or third year of planting out, just as the surrounding manioc crop is reaching the end of its useful life. The recent concentration on propagation by means of cuttings at the EMBRAPA research station in Manaus shows that the more perceptive agronomists are coming to recognize the advantages afforded by traditional practices, for cuttings – like the "wild" seedlings used by the Indians- produce economic yields much more quickly than plants raised directly from seed. It seems likely that the use of such cuttings will soon take the place of the slower growing seedlings allowing the rapid expansion of the area planted to guaraná, and recreating a pattern of propagation very similar to the original Indian system.

These relative rates of growth not only have implications vi-à-vis the speed at which economic harvests are achieved, but also with regard to the amount of labour that has to be expended on the clearing of intrusive weeds

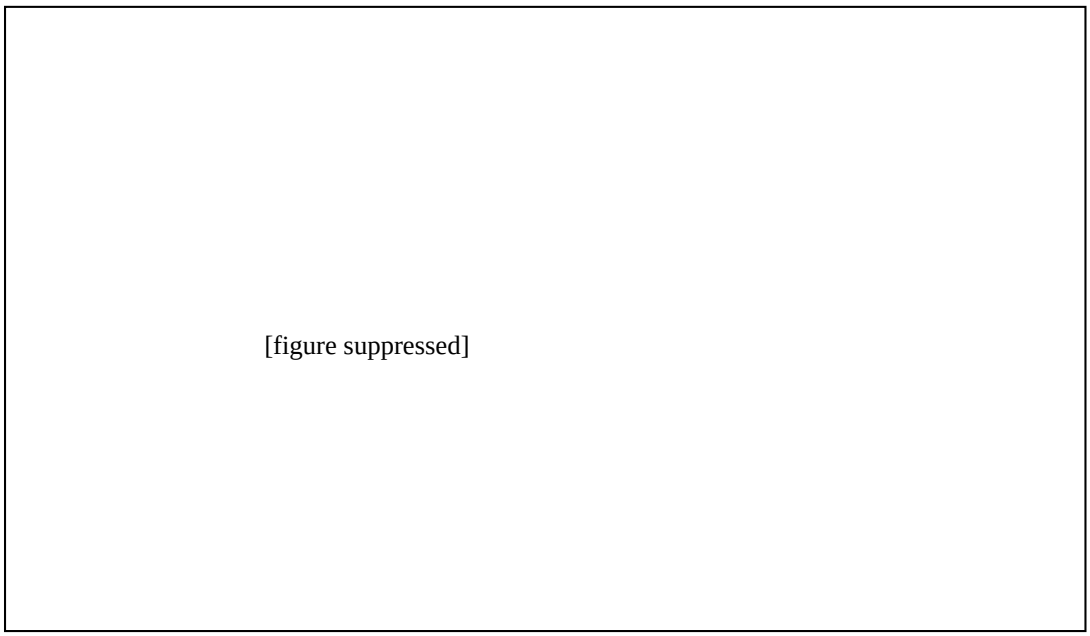

Fig. 2 View of river Maués showing the terraces of lateritic clay on which guaraná is cultivated. The plant in the foreground bears half-ripe fruiting clusters. (Photo: Anthony Henman.)

In the new orchard. Once the plant is fully grown - after five years by the Indian system, and often more like eight years when grown from seed - it forms a dense thicket which needs little help in holding its own, particularly since it forms a deep bed of fallen leaves which eliminate most competing species. Spaces between plants, however, inevitably suffer the intrusion of numerous weedy plants which must be cleared bi-annually by hand, a very laborious task. Clearly a cutting or an escaped plant which grows larger in a shorter period of time is at a distinct advantage over the slower growing seedling, since it saves the farmer a great deal of back-breaking work.

Large commercial plantations attempted in the past to overcome this problem by spacing their plants wide enough to allow the mechanical tilling of the intervening soil, but this system was eventually abandoned when it was realized that such spacing resulted in huge tractor bills and very low productivity over extensive areas. After several decades recommending spacing at 5 × 5 metres or even 7 × 7 metres, research agronomists have gently returned to the traditional Indian system of close (3 × 3 metres) spacing, both on account of its greater productivity per unit of area, and as a result of the facility it affords for controlling weeds.[16]

The mechanization of guaraná agriculture has, therefore, lost its principal usefulness, for the picking of the crop is a chore that has always had to be done by hand. The other function of mechanization, that of spreading lime and fertilizer, could again be seen to respond to a quite artificial need, when seen from the Indians' viewpoint. Mechanized clearing of the forest, and subsequent weeding by tractor, normally results in the removal of valuable ashes and decomposing vegetation to the sides of the field where it is of no use to the fledgling guaraná plants. The native system of allowing half-charred, fallen trees to remain on the ground after the initial burning off of the vegetation cover, prevents excessive leaching and erosion of the soil, and sets in motion a process of natural composting which is renewed_with fresh material at each of the bi-annual weedings by hand. The resulting jumble of rotting logs and decomposing weeds is extremely untidy from the

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[16] Corrêa *et al.*'s (1978) statistics for their own experimental fields are telling in this respect:

Spacing	Yield in kg dried seed per hectare
3 × 3 m	932
4 × 4 m	394
5 × 5 m	174

The overall average for Amazonas state varies between about 67 kg/hectare in a regular year (1976) and 120 kg/hectare in a good year (1977); see SUDAM (January, 1978). Corrêa *et al.* (1978) have also come round to recognizing the good sense of another important feature of traditional guaraná agriculture, that of planting out new seedlings in the midst of manioc, which not only provides a quick economic return for the effort of clearing the forest but also gives an all-important shading to the young guaraná plants. Government agronomists (eg. EMBRATER/EMBRAPA, 1976) have usually recommended the laborious business of building an individual shelter (*arapuca*) made of wood or palm leaves to shade each plant during early growth, a system only used by the Indians with very young and tender plants.

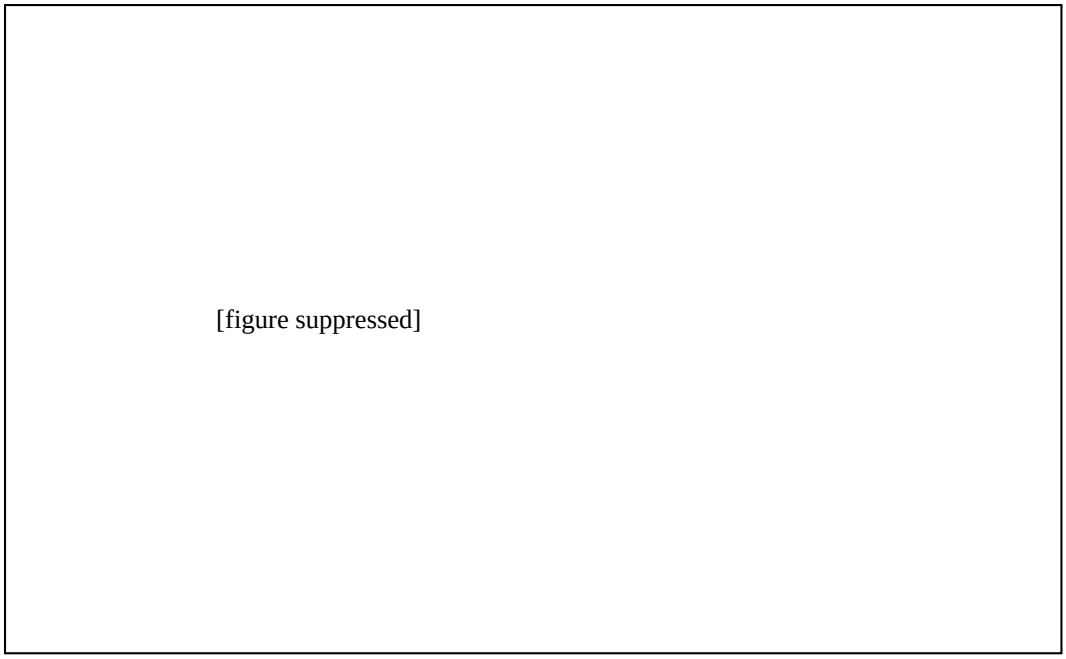

Fig. 3. Adult guaraná plantation interspersed with fruit trees, and surrounding a palm-thatched house of the Saterê-Mawé Indians. (Photo: Anthony Henman)

visual point of view, but it is far better adapted to the conditions of the tropical rain forest than the regular rows of guaraná plants and intervening areas of exposed soil favoured by large-scale concerns, many of whom seem to imagine fondly that the plant will respond in much the same fashion as that other classic perennial vine, the grape.

The advantages of modern techniques as applied to the cultivation of guaraná seem, therefore, to have been singularly over-estimated, and only in very few cases do production statistics bear out the claims made in the literature for the supposed benefits that would accrue from mechanization and the subjection of the soil to a bombardment of chemical products. Even the much vaunted genetic advances made in the selection of high-yielding cultivars have proved of dubious long-term benefit, as such strains may degenerate rapidly and are often tellingly susceptible to the numerous fungi and insects which commonly attack the guaraná plant. One fungus in particular - *Colletotrichum guaranicola* Albuquerque, known locally as *a queima* or "the burn" – has wreaked havoc in many areas around Maués since it was first reported in 1946, often producing as much as a 90% drop in production and causing many plantations simply tobe abandoned to the encroaching forest.[17]

The fungus is also present in Indian areas though here the very genetic variability of the guaraná population - drawn as it is from numerous wild,

[17] Alburquerque (1961). The fungus has also spread to the new areas of guaraná cultivation in Bahia; see *Suplemento Agrícola*, *Estado de São Paulo*, July 21, 1974. Escobar and Corrêa (1981) have alerted to the dangers of genetic deterioration which can occur through self-polhnation of the guaraná plant, a danger obviously exacerbated in areas where plantations are established with a very homogeneous stock of cultivars

hybrid and escaped plants, each with differing degrees of resistance — provides a barrier to the type of fungus infestation witnessed in many areas of large-scale production. It is this very variety which has protected Indian orchards again and again from genetic losses and cyclical plagues, and provided their owners with an almost unconscious gene pool from which to draw the "prize bushes" that they readily point out to visitors — those with remarkable yields or vigorous habits, or unusual resistance to disease. To the Indian farmers it does not seem unreasonable that for every prize bush of this kind they should also have to plant three or four dismal failures; such is the cost of genetic trial and error, such is the nature of the diversity which they witness daily all around them in the forest, and which they attempt to internalize ultimately in their very culture and cosmology itself.

All this is not to say that there is no room for innovation in the horticulture of guaraná. A greater concentration on pruning, in particular, has great contributions to make in getting the best out of a guaraná plant, since it is known that flowering and fruiting extremities are only produced from the year's new growth.[18] Such growth sould be encouraged by a vigorous pruning back of old branches, particularly those trailing on the ground, a custom which is hardly envisaged by most guaraná cultivators, whether they be large agroindustrial concerns or small peasant farmers. Even those who do prune the growing tips of young transplants to prevent top-heavy growth, rarely extend such cares to mature bushes as well, thus encouraging a considerable loss of fruit from inflorescences carried at ground level. Pruning is also useful in fighting the fungus *Colletotrichum guaranicola*, whose incidence can be reduced considerably by removing the affected parts of the plant and burning them. Practices of this kind are little known to most guaraná cultivators, who simply cut back the diseased branches and leave them on the ground, allowing the fungus to spread back to unaffected parts of the plant.

Another area of horticultural innovation that could legitimately be pursued concerns the use of supportive frames, which again assist in raising the guaraná plant from the ground, and thus increase the rate of successful maturation. The Indian custom of building small wooden or bamboo frames to support the plant in the early years of its life should be encouraged further, right into full maturity, a practice which at present is limited to areas close to human habitation, where there is a health and safety interest in keeping the ground surface clear. Attention should also be given to the occasional native custom of planting two bushes with their stems joining in a cross, to provide mutual support in the early stages of growth.[19]

Finally, to give credit where credit is due, the genetic research of government agronomists has not all been in vain, as it has identified some interesting new guidelines for future selection, guidelines which inevitably call into question the previous reliance on the sheer size of seed and fruiting

[18]Schultz and Valois (1974:51) and Gonçalves (1971).

[19]Gonçalves (1971) and Monteiro (1965:13).

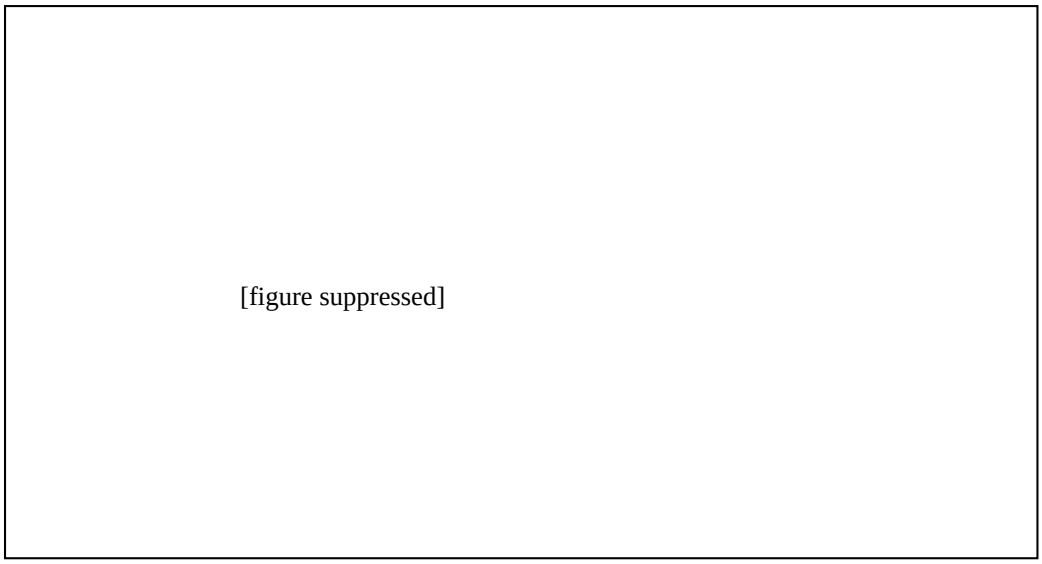

Fig. 4. Guaraná plant supported on a bamboo frame, to allow the clearing of the ground surface near the human dwellings. (Photo: Anthony Henman.)

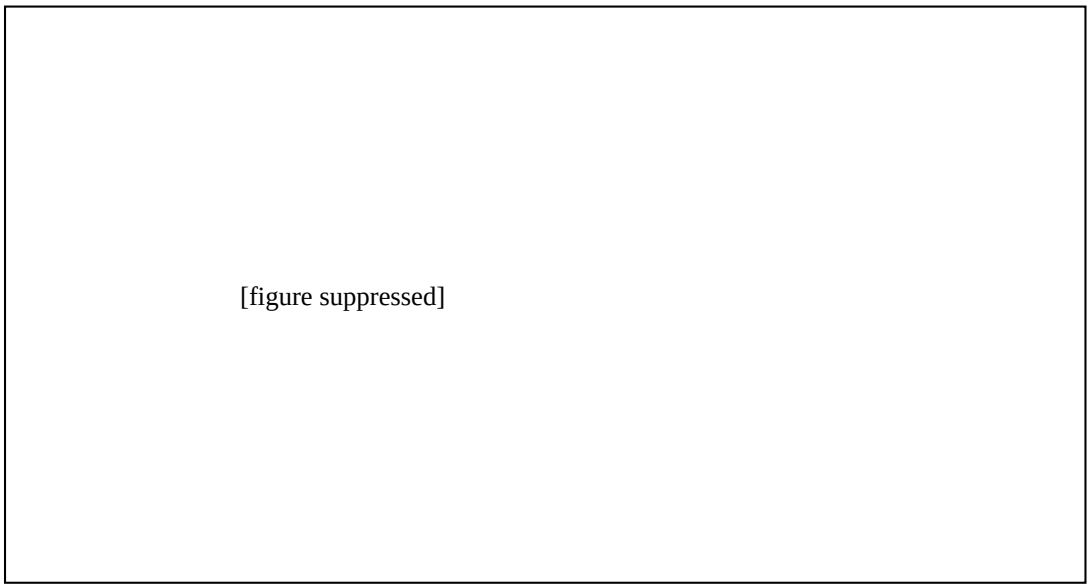

Fig. 5. Typical habitat of a guaraná plant cultivated in the open. (Photo: Anthony Henman.)

Cluster as the major criterion on which to base their work. Significantly, Statistical research into the heritability of various characters of the guaraná Plant has shown that the only element amenable to significant improvement by means of sexual propagation is not the total size of inflorescence, nor the number of flower buds in the inflorescence, nor even the total yield of fruits produced by each inflorescence, but rather –a much less obvious factor- the number of seeds per fruit.[20] Given that the pollination of guaraná, and

[20] Valois and Corrêa (1976).

with it the total yield of dried seed material, are both notoriously dependent on climatic conditions, strains with a marked incidence of fruits bearing two or three seeds (rather than the more usual one) always show significantly better overall yields, both in years of abundant harvests and in those of relative failure.

Inevitably, this leads one to consider the wider issues of local meteorology the complex monoecious flowering pattern of guaraná is affected above all by these factors, and principally, by the occurrence of a relatively dry two- or three-month period in Maués between August and November. Guaraná's dependence on the vagaries of the climate would seem to result from a combination of hydroperiodism –whereby flowering is brought on by increased temperatures and decreased rainfall and atmospheric humidity -and the life-cycle of the main agents responsible for the cross-pollination of guaraná, two species of bee whose levels of activity increases significantly during the dry season.[21] Other than the use of colonies of imported bees, something which has not yet been attempted in research, it would seem that human intervention is powerless to improve or manipulate guaraná's response to the climate. It is this which explains the importance of selecting for varieties with more than one seed per fruit – for in years of wet "summers", when only little fruit is set, there is at least a possibility of recouping some of the losses by this means.

Other forms of selective intervention in guaraná horticulture concern the plant's actual flowering evidence a pronounced dimorphism, with atrophied female organs on male flowers and atrophied male organs on the females. In addition, there exists a pronounced tendency towards the occurence of a greater percentage of male flowers on each inflorescence, with the incidence of female flowers varying from a low of 0% to a high of 60%, but with a mean of no more than 15.29%. Obviously, productivity of the guaraná plant could be greatly increased through the selection of those relatively rare strains which show a high ratio of female flowers (over 45% of the inflorescence) since it is these which ultimately bear the fruit.[22]

Furthermore, the guaraná plant is very strictly monoecious, with Separate male and female flowering periods –and intervening periods of Dormancy two to four days long- not only on the same inflorescence, but even on the same branch. The fact of the flowering unit being the branch rather than the whole plant means, however, that seed may be set as much by self-pollination of a single plant as by cross-pollination between two separate plants. The flowering period of the female flowers varies from one to five days with a mean of 2.24, while male flowering can be spread over a period ranging from a single day to a full month, with a mean of 10.99 days. The occurrence of this relatively short femal flowering period obviously yields a bunch of fruit with roughly uniform maturity at the time of harvest-

[21]Schultz and Valois (1974: 38-39, 47-48).
[22]Schultz and Valois (1974: 42-44, 50).

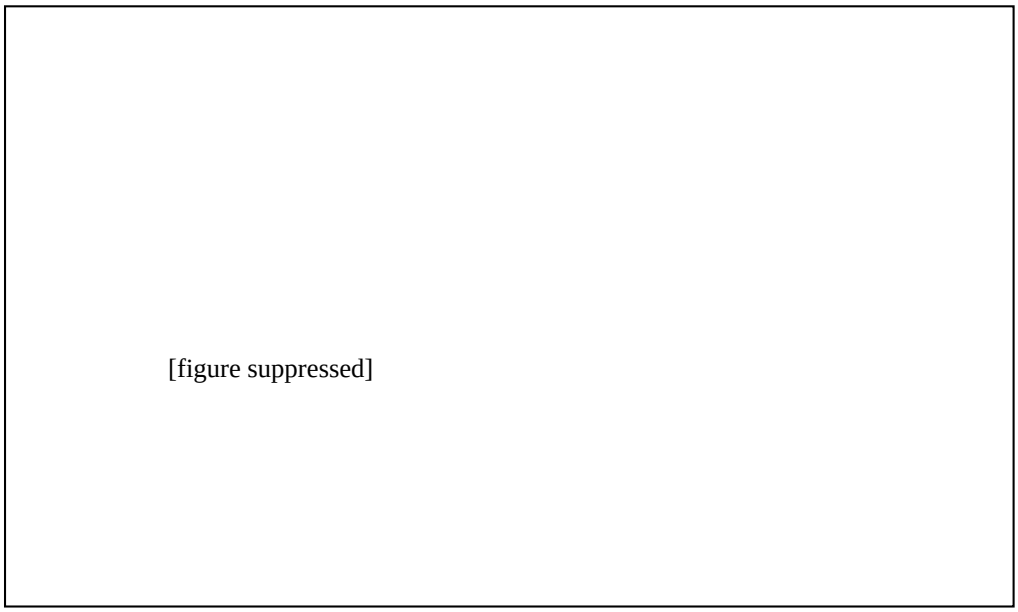

Fig. 6. Guaraná in flower. (Photo: Anthony Henman.)

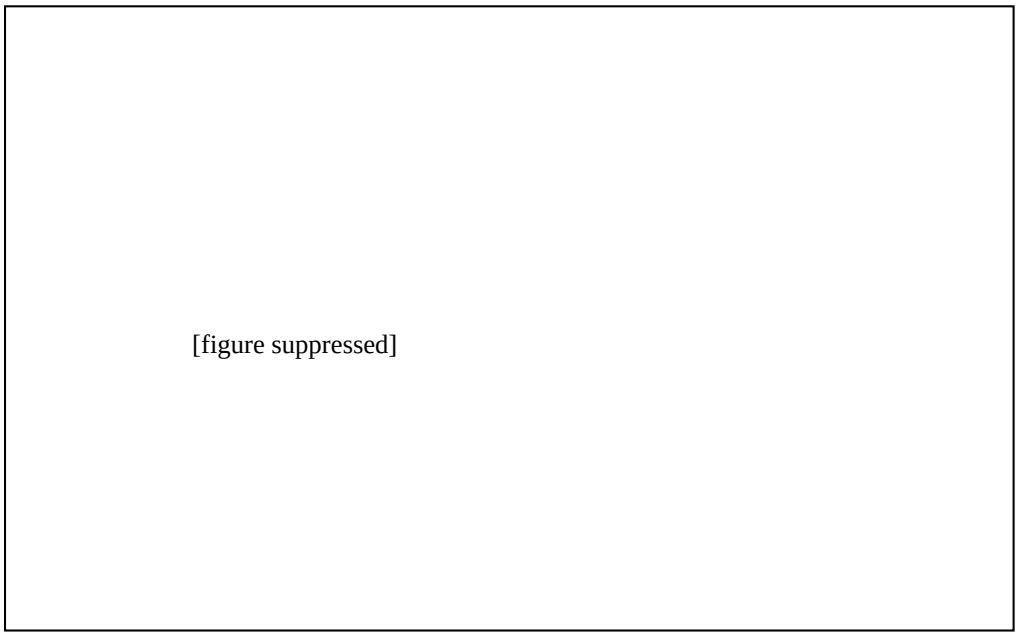

Fig. 7. Guaraná fruits approaching maturity. (Photo: Anthony Henman.)

ing, one of the great advantages of guaraná from the picker's point of view, but unfortunately this benefit is offset by no less than a 27% incidence of two periods of female flowering on a single inflorescence.[23] This has the result of producing a bunch of fruit at two distinct stages of growth, and is clearly a trait that selective breeding would attempt to eliminate from the stock of useful cultivars.

The processing of Guaraná

In view of the many imponderables associated with large-scale guaraná agriculture, it is perhaps not surprising that the same sort of emphasis on the small producer, as against the bigger agroindustrial concern, must also result from any considered assessment of the forms in which guaraná is processed for eventual consumption. Of the present total production - which varies between 250 and 650 tons per annum[24] - rather more than three-quarters is absorbed by the soft drinks industry, who simply grind up the dried seeds with their husks and subject the resultant powder to boiling at high pressure in large vats of alcohol. This alcoholic extract remains stable until the

[23]Schultz and Valois (1974: 47).

[24]The earliest statistics on guaraná date from the 1850s, when production was estimated at a maximum of 400 *arrôbas* or approximately six tons (Monteiro, 1965:39). This figure remained reasonably constant until demand began to increase in the 1920s, 30s and 40s, with Germany, Great Britain and the United States buying large amounts for use in the extraction of caffeine. Production in these years rose from 75 tons in 1930 to 226 tons in 1951, with occasional bad harvests such as that of 1948, which only netted 25 tons. Exports increased from 9 tons in 1919 to almost 100 tons in 1939, when large quantities were acquired by Nazi Germany, presumably to stockpile caffeine for the war. Trade slumped somewhat thereafter, with exports falling back to 16 tons in 1946 and only 3 tons in 1951 (Almeida, 1953). Due to this loss of foreign markets - it no longer being economical to extract caffeine from guaraná -little interest was shown in the crop in the 1950s and 60s, and the lion's share was absorbed by the Brazilian soft-drinks industry, now obliged by law to include a certain amount of the original material in the sodas calling themselves guaraná. Production remained sluggish – the maximum figure in the 60s was 200 tons (1965), the minimum 77 tons (1966) - showing little or no improvement over the previous period. By the late 60s, however, foreign buyers again became interested in guaraná, principally for inclusion in pharmaceutical products aimed at the geriatric and "health food" markets. One Japanese firm put in an order for 800 tons and were sorely disappointed (Vasconcelos *et al.*, 1976:70), and another source estimated a potential U.S. consumption of 3000 tons per annum (*Suplemento Agrícola, Estado de São Paulo*, July 21, 1974). Production in the state of Amazonas responded slowly to this demand: average years such as 1973 and 1976 produced 250 and 265 tons, respectively, though a best-ever crop was recorded with 400 tons in 1977 (Rizzini and Mors, 1976:4; SUDAM, January, 1978). New plantations in Pará and Bahia were supposed to boost this figure to 1000 tons in 1980 and 2000 tons in 1985 (*Latin America Economic Report*, March 18,1977), but recent statistics provided by EMBRAPA officials show a less ambitious increase - to 650 tons in 1980 and back to 450 tons in 1981. Harvests are dated in the year they are marketed, and thus each year's figure refers to quantities mainly produced in Amazonas in the last three months of the preceding year. (The ton referred to here is the metric *tonne* of 1000 kg.)

essence of guaraná is separated at the soft-drinks factory, and added in infinitesimal quantities to the well-known brands of "Guaraná Champagne", which together account for a major share of the market for non-alcoholic bottled beverages in Brazil. Something of a standing joke exists with regard to the actual existence of the elusive substance in those bottles of soda known as guaraná. By the 1940s, it was discovered that many so-called "guaranás" contained not the slightest trace of the drug, and a decree was passed in 1944 stipulating that all soft-drinks should contain at least 0.6% of the fruit referred to on the label, whether this be guaraná, orange, cola, or any other natural flavoring.[25] Given the impossibility of meeting such requirements, the minimum content was subsequently reduced to 0.3%, but to this day it is most unlikely that even this figure is being met. A calculation made on the basis of the current turnover of sodas calling themselves guaraná would suppose the existence of a crop of over 2000 tons of seed, that is, fully five times the average annual harvest attained in the 1970s.[26]

With the expansion of the market for fizzy guaranás beyond Brazil's own frontiers –principally in Latin America and the United States, though also in Japan, in Africa and in Europe[27] –there has obviously been a strong incentive to establish large guaraná plantations owned directly by the soft-drinks industry itself. Many of these are now beginning the enter production, and most have been located well away from the traditional guaraná lands of the central Amazon, in more easily accessible areas such as Pará, Bahia and the Ribeira valley of São Paulo. The fruiting season of guaraná in the cocoa zone of Bahia between Salvador and Ilheus –which is where the major competition to Amazonas state is currently being established –occurs rather later than in the plant's native habitat, with the harvest reaching a

[25] The original *Decreto-lei* is No. 6.425 of April 14, 1944. Article 2, which states the minimum percentage of natural flavouring to be included in soft drinks, was changed by *Decreto-lei* No. 7.669 of June22, 1945 (Almeida, 1953). The new *Lei dos sucos* ("Law of Fruit Juices") is part of the *Código Nacional de Bebidas* ("National Drinks Code") which came into effect in 1979. It maintains the 0.3% stipulation on guaraná (300 grams of guaraná seeds to every 100 litres of the soft drink.) It is clear, however, that the inclusion of other fruit-based flavourings –principally pineapple, guava and apple, which have always been used since guaraná itself is virtually tasteless –constitutes a widely disseminated practice (Toccini, 1977:47). Guaraná's contribution, therefore, lies mainly in the colouring and caffeine it gives to the soft drink.

[26] *Visão* magazine (May 27, 1974) and Schultz and Valois (1974:36).

[27] One of the major Brazilian soft drinks manufacturers, Brahma have recently expanded into the Bolivian market, traditionally receptive to guaraná in all its forms. The company benefited from earlier attempts to introduce the crop to Bahia (see Vasconcelos *et al.*, 1976) and now have 100 000 bushes on the Fazenda Cultrosa near Camamu (*Jornal do Brasil*, July 3, 1978). Antartica, through their subsidiary SAMASA, have planted 124 500 bushes on a large plantation near Maués, and have recently launched their own brand of guaraná in France (*Estado de São Paulo,* April 20, 1979). Ariosto da Riva, a São Paulo entrepreneur with large holdings at Alta Floresta in the north of Mato Grosso, has also planted 100 000 guaraná bushes on his "model" colonization project in that area (*Estado de São Paulo*, July 30, 1978). In the Ribeira Valley, in south-eastern São Paulo, guaraná has been introduced experimentally at the CEDEVAL agricultural research station at Pariquera-Açú (*Estado de São Paulo*, June 27, 1979).

peak in the months of April and May. Processing here has adopted a number of simple but innovative techniques which are clearly geared to the production of an indifferent quality of guaraná suitable for the manufacture of soft drinks. The bunches of fruit are harvested and allowed to ferment for ten days before being screened to remove the stems. They are then passed through rollers to break up the outer rind of the fruit and layed out on concrete under tunnels of sheet plastic to dry out in the sun. Finally, they are put through a threshing machine - an adaptation of the technology used for processing black pepper - which separates the seeds from the rest of the fruit, and require no further toasting before being ground to produce an alcoholic extract.

In Maués itself, the home of guaraná, only the mouldy or inferior qualitites are sold to the soft-drinks industry, for a better price is paid by a number of small manufacturing concerns which continue to produce various preparations of the whole guaraná seed for the booming market in organic medicinal drugs. These preparations include syrups, pills – such as those recently marketed in California under the trade-name "Zoom"[28] - and various grades of powders, which are mainly sold through chemists and health-food shops in Brazil, having the reputation of prophylactics, aphrodisiacs, and salubrious alternatives to the heavily sugared coffee which is the nation's traditional vice. In recent years, a soluble guaraná powder has been developed by the Centro de Pesquisas Agropecuárias do Trópico Umido (CPATU) in Belem, prepared from an alcoholic extract which is re-solidified through the use of spray-drying or freeze-drying technology. This has not been marketed due to the inventors' reticence at launching a product that could easily be assimilated to the category of a "dangerous drug" - some soluble guaraná has been shown to contain no less than 10% caffeine!

It would, perhaps, be cynical of me to poke fun at supposedly "organic" products such as the powders made from whole guaraná seeds, but the fact remains that the methods whereby they are produced leave a great deal to be desired. Above all, the use of metal grinders to powder the seeds causes oxidation of their phenolic compounds, catalyzed by contact with the ferrous moving parts. This significantly alters the flavour and effects of the final preparation, so that it becomes rather bitter and slightly irritating in the gastrointestinal tract. Furthermore, the high temperatures produced in the course of such grinding causes some of the fatty compounds in the seed to fuse precipitating a thin film of protein on the exterior of each particle, and thus making the ultimate product actually less soluble, as well as leading to a marked drop in overall caffeine content.[29]

Doubly unfortunate is the fact that mechanical grinding of this kind not only occurs in the industrial plants producing guaraná powder, but also has found many adepts among the small, family-based enterprises which

[28]The "Zoom" boom was reported in *San Francisco Chronicle* and *Los Angeles Times* (September 10, 1979) and *Daily Telegraph*, London (September 11, 1979).

[29]Arens (1956), Maravalhas (1965: 7).

account for the production of guaraná in its traditional form — that is pounded, kneaded, rolled and smoked over open fires so that it forms hard "sticks" which are subsequently grated by the user as need requires. Indeed I would like to distinguish between the two qualities of "stick" guaraná quoted on the market at Maués: the hand-made *guaraná das terras* or *guaraná do Marau* which is the finest and most highly valued kind, being produced almost exclusively by the Saterê-Mawé Indians; and the semi-industrialized *guaraná de Luzeia* which is manufactured by white colonists, usually on quite a small scale, though in fact the most successful firm claims to handle upwards of fifty tons per annum.[30]

I hope a brief run though the details of their respective systems of production will serve to highlight the marked qualitative difference between the Marau and Luzeia types of "stick" guaraná. A constant preoccupation will be to show how quality is adversely affected not only by the introduction of metal grinders, but also by the failure to prevent deterioration of the colour and taste of guaraná by natural processes of decomposition. The principal agent responsible for these changes is an enzyme which — like the grinding with ferrous metals, though at a considerably slower rate — allows oxygen in the atmosphere to act upon the phenolic compounds in the seed.[31]

This concern manifests itself from the very moment of picking the fruits. By the Marau system, a bunch of guaraná is deemed ripe when the first of its fruits bursts its outer skin, bringing forth a glimpse of the seed and its surrounding aril which looks uncannily like a human eye. This "eye" finds a place in Saterê-Mawé mythology, for the guaraná plant is said by the Indians to have originated from the planting of the eyes of a boy who had been killed by a snake-bite, a manifestation of the aggressive forest spirit *Jurupará*. In another version, the boy was killed by his maternal uncles, since he was considered to have been conceived of an illicit union between his mother and the snake/*Jurupará*. Whatever the ultimate reason for this tragedy, the Indians do not like to be reminded of the "boy's eyes" and therefore pick any bunch where an eye appears immediately. By this means are included several seeds which are still only partially ripe, being characterized by a higher yield of the milky sap which serves to give a better bind (*liga*) to the final mix. By the Luzeia system, on the other hand, bunches of guaraná are only considered ripe once at least half of the fruits have burst their shells in this way, which results in the inclusion of several over-ripe and semi-desiccated seeds.

The second difference resides in the speed at which the fleshy outer rind and aril are removed from around the guaraná seeds. Though these peels

[30]This is the Tibiriça Company, which sells all its guaraná through an outlet in Cuiabá, Mato Grosso. Industrias Magnani, who pioneered the mechanical mortars used in making industrialized "sticks" of guaraná, also claim to handle about thirty tons a year. Both companies' estimates are probably quite inflated.

[31]Maravalhas (1965: 6 - 7).

contain an acid which stains and puckers the skin on the workers' hands, this does not prevent the Indians from undertaking the laborious task of removing them immediately after picking. The remaining parts of the fruit are soaked overnight in baskets at the river's edge, and by the next morning the arils can be removed with ease by further rubbing between the hands. In the Luzeia system such precautions are seen as altogether too much work. Instead, the fruits are piled up in large heaps where they are allowed to rot for as much as a week or ten days, by which time peels and arils have decomposed into a stinking black mush which can be trampled underfoot for a quick and easy extraction of the seeds. Since the enzymes present in guaraná allow a much faster staining of the inner kernels while the seeds are still unroasted, this latter technique inevitably leads to a deterioration of the guaraná, and may even allow the formation of dangerous microtoxins as well.

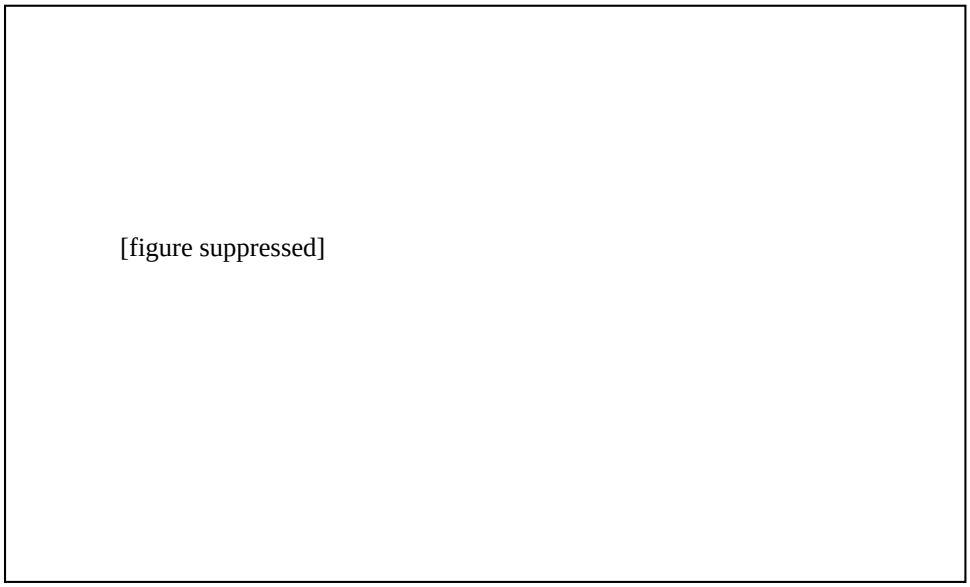

Fig. 8. Guaraná processing: removal of external rind prior to soaking and removal of the white aril surrounding the seeds. (Photo: Anthony Henman.)

The differences continue into the next stage, that of roasting the seeds. By the Marau method, this is accomplished on a one- or two-metre diameter griddle made of clay at least an inch thick, and tempered with the ashes of the bark *caraipé*, taken from a tree of the genus *Licania*. A fire is lit under the griddle and burns furiously for about 40 minutes, the guaraná being turned constantly with a wooden paddle until the first seeds begin to burst their shells. At periodic intervals over the next 20 minutes, small amounts of water are added to the guaraná and stirred, to prevent excessive parching and desiccation of the oils. Finally, when the seeds are deemed roasted, the fire is allowed to die down, the guaraná being left to cool off slowly over a period of at least five or six hours.

The Luzeia drying process, in contrast, uses common metal griddles and submerges the seeds from the outset in an excess of water, so that they end

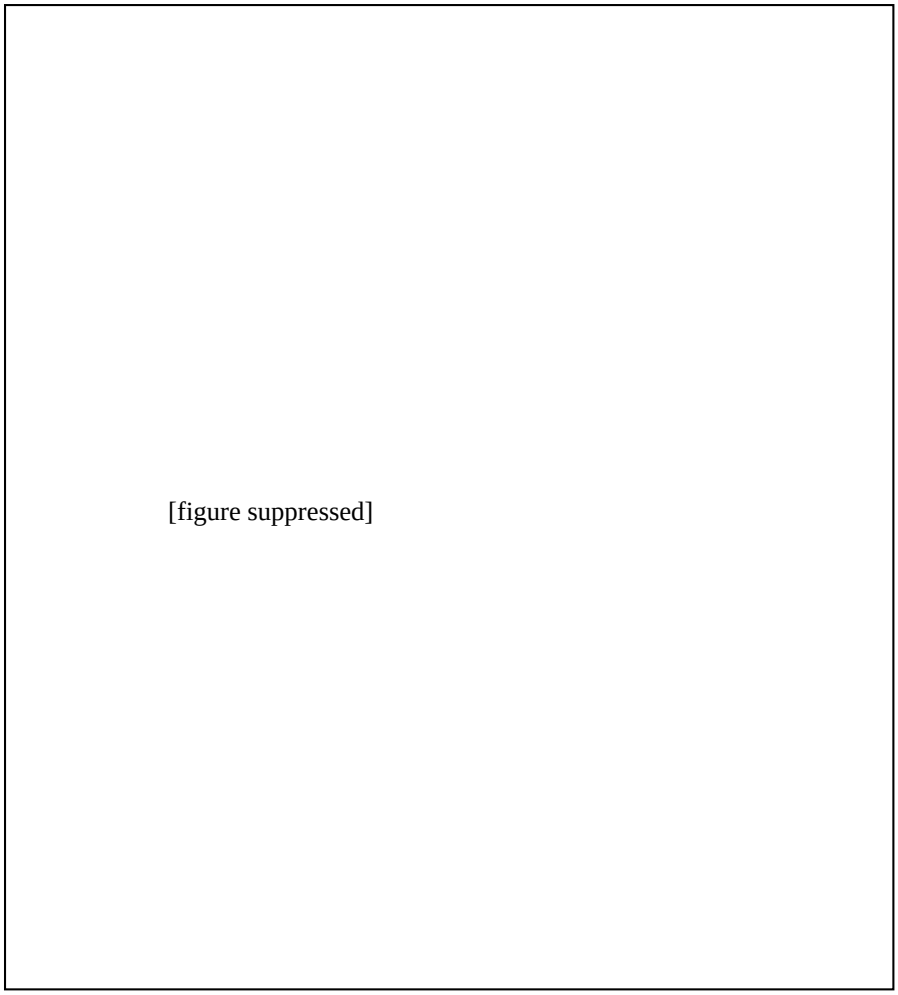

Fig. 9. Guaraná processing:
Top left: picking the fruits.
Top right: toasting guaraná on an earthenware griddle. After the right point of desiccation has been reached, the fire is allowed to go out and the guaraná cools off gradually.
Middle left: hardwood mortar and pestle, and screens separating best-quality guaraná. After beating the whole seeds in a sack with a wooden club, two basketwork sieves are employed to separate the best-quality (the whole kernels, at top) from the smaller fragments and the dark outer husks.
Middle right: kneading guaraná dough. After adding a small amount of water, the seeds are pounded in a deep and narrow hardwood mortar. The dough is then firmly kneaded to expel any remaining air bubbles, which could later cause the guaraná to crack.
Below left: washing and smoothing the external surface of 125-g sticks of guaraná
Below right: wet-grating a section of stick guaraná on the bone of the tongue of the Pirarucú fish, and (inset) on a slab of basalt. (Drawings by Chien. Photos: Anthony Henman.)

up almost being boiled. This shorter form of processing seems to lack any clear perception of the need to roast guaraná to precisely the right point. Consequently, it leads either to excessive parching and a "dark roast" or, at the opposite extreme, to insufficient drying of the seeds, which allows internal fermentation and oxidization to continue taking place. Indeed, some of the guaraná sold to unwary buyers in seed form (*em rama*) is still so damp that it can form external moulds and spoil in a matter of days.

The removal of the inner seed-husk or testa of guaraná is also accomplished in a much more haphazard fashion by the Luzeia process, allowing numerous small particles of this husk to enter the final product, which lends the guaraná a bitter, chocolate-like taste and makes it rather irritating to the intestines. The Indians, on the other hand, beat the seeds in a sack to loosen the husks then pass them through two sieves to separate out all the fragments, selecting only the best quality kernels to make their sticks of guaraná, and selling the rest to traders as a loose, second-rate product which goes mainly to the soft-drinks factories. The good kernels are placed, about half a kilo at a time, into long narrow mortars set in the ground, and pounded by hand with heavy hard-wood pestles for about twenty mintues. A little water is added at regular intervals - between ten and twenty soup-spoonfuls altogether per half-kilo of seeds - the liquid so used being often prepared beforehand from decoctions of other medicinal barks such as *muiratã* (a member of the Moraceae, whose reputed qualities recommend it to those who share the local obsession for aphrodisiacs).

The resultant mass - with a consistency approaching that of a rather dense bread dough, and containing a fair percentage of whole or only semi-triturated seeds - is then carefully kneaded by a specialist known as a "bread-maker" (*padeiro*), who must make sure that the dough contains no bubbles of air, since these could expand at a later stage and cause the stick or "bread" of guaraná to burst and crack, allowing smoke to penetrate the interior and producing a loss of half its market value. Once kneaded, the mass is rolled into cylinders with rounded points, washed in water to give the exterior a smooth and well-sealed surface, then placed on racks above some slow-burning aromatic wood such as *murici* (*Byrsonima* spp.). Here it is slowly dried, smoked and hardened, being regularly turned throughout the month or two during which it remains in the smoke-house, or - in the case of smaller producers - above the family hearth. The expertise involved in making a stick of guaraná is only surpassed by the art of those rare individuals, usually shamans, who still maintain the ability to shape the dough in its original, virtually prehistoric form - that of round balls approximately 15 cm in diameter, originally described by the Jesuit father Betendorf and later by von Martius.

Returning to the semi-industrial (Luzeia) system, we have seen that it is at this stage that most manufacturers commit the grave mistake of grinding up the seed prior to placing it in their machine-driven mortars. The pounding stage of the process is still necessary despite all the previous grinding, for it is by this means that water may be added to the mixture and a malleable

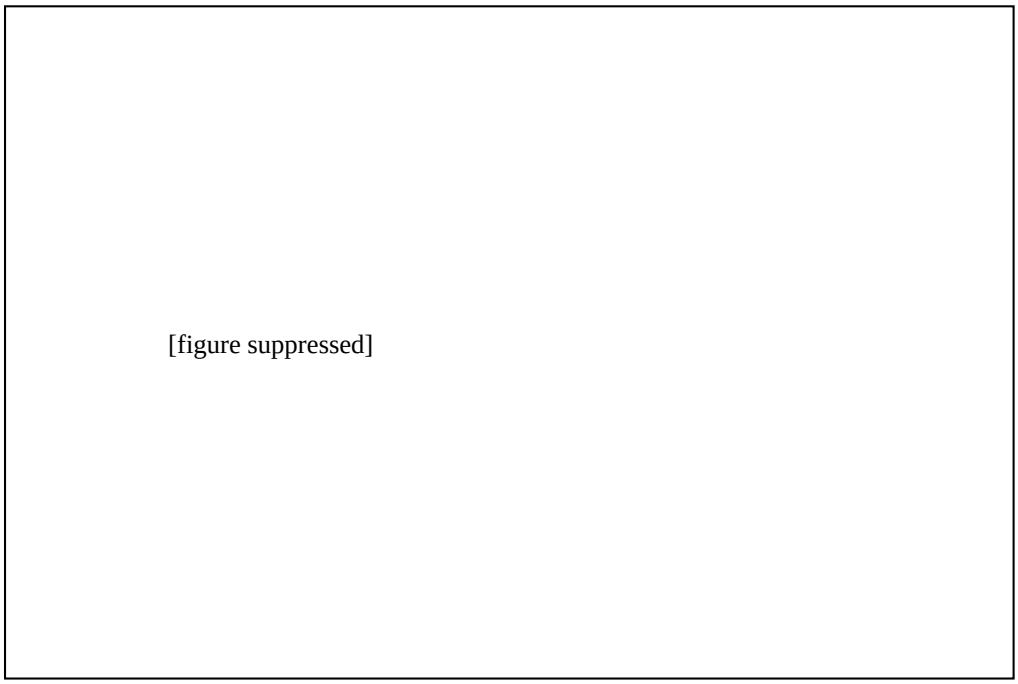

Fig. 10. A Saterê-Mawé shaman preparing the traditional "ball"-shaped guaraná, which requires greater expertise in the kneading than the more common "stick" form. (Photo-Anthony Henman.)
Fig. 11. 500g sticks of guaraná being dried and smoked on a slatted platform over the family hearth. (Photo: Anthony Henman.)

dough formed. This dough, however, is really rather lifeless, and much more homogeneous in texture than the Marau type. It requires only a cursory kneading before being moulded into flat-ended cylinders, and rolled between two planks set in a tray to give the stick a standard size and shape. Sticks of Luzeia guaraná are given twenty-four hours over an open fire — a preliminary "baking" which helps them hold their shape in the absence of sufficient oils — then smoked in the normal way for two or three weeks, until hard.

Connoisseurs of guaraná point to the fact that the sticks of the Marau type normally weigh half a kilo, whereas those produced in the Luzeia system rarely exceed one hundred grams, and it seems likely that the Luzeia standard of guaraná would seldom survive rolling into larger sticks without being considerably damaged by bursting or cracking while in the smoke room. The final products are equally hard in both cases, but Luzeia guaraná is brittle and may shatter into many fragments, whereas the Marau type is resilient and normally breaks with a clean fracture. Most telling of all, when the outer crust of smoke is washed away, good Marau guaraná will be of a light tan colour, and taste sweet and rather neutral, while the Luzeia kind will be a dark chocolate brown and taste much more bitter and astringent.

These differences in size and texture become highly significant when we turn to consider the way in which guaraná is actually consumed.

The Luzeia type is normally grated dry, either in small plants which market it to the consumer in an already powdered state, or else by the user himself, who uses a steel file or - should he be acquainted with guaraná's aversion to ferrous metals -with the abrasive rasp provided by the bone inside the tongue of a large fresh-water fish, the *pirarucú* (*Arapaima gigas*). The Marau type, however, at least in Indian usage, is always grated wet, being repeatedly dipped in the water contained in a large open gourd and rubbed on the same *pirarucú* tongue or on a fine-grained slab of basalt. Since guaraná hardly dissolves at all in water, it can readily be appreciated that such wet-grating produces a much finer suspension of its particles, which results in a more palatable and more easily digestible drink.

Given the many laborious stages involved in the production of the traditional types of guaraná, my readers may well be asking themselves what is the point of such a complicated and time-consuming process. Why not settle simply for the soft drink, or the syrup, or the powders produced simply by grinding the roasted seeds? In the native context, there can be no doubt that the traditional technology has evolved as a response to the limitations of a specific environment - for hard, dry, well-smoked sticks of guaraná can be stored for use between the annual harvests, something, which is not possible with the whole seeds or even the powders, which deteriorate and go mouldy remarkably quickly in the heat and humidity of the Amazon basin. This advantage, however, pales in comparison to the qualitative difference which is immediately apparent to any consumer who has the opportunity to compare all the various guaraná preparations. Discounting syrups and soft drinks - which hardly deserve the name guaraná at all - there is an obvious quality spectrum which reaches from the powdered seed, with its unpalatable muddy consistency when mixed with water to the still bitter and somewhat burnt taste of *guaraná de Luzeia*, and finally to the clean, light, soothing and nutty flavour of *guaraná do Marau*.

The Guaraná Project: a modest proposal

I think that I have already stressed sufficiently the undesirability of guaraná's future being dominated by the needs of the soft-dnnks industry - not only because this industry lacks any real respect for what I could call the very "spirit of the plant", but also on account of their growing reliance on a large-scale plantation system as a means of supplying their requirements. Such a system is economically inefficient, agriculturally unsound, ecologi-cally disruptive, and - perhaps most important of all - socially disastrous. The net result of the present blight of monstrous agroindustnal development in the interior of Brazil will be the emergence of a mass of landless peasants and an inevitable increase in political strife, matched only by the thoughtless impoverishment of the physical environment by people with no real ties to

the land. On this matter let us be quite clear — at the present historical juncture, there can be no future for a science which would turn its back on the social issues and submit itself to those who would rape the Amazon basin without heed to future generations.

This is not, of course, to say that there is anything morally repugnant in the simple fact of using a natural product to flavour a rather over-rated fizzy drink. Indeed, recent research has shown that the seed husks of guaraná precisely those parts that should be discarded in the production of the genuine article, are almost as good a source of caffeine as the kernels themselves. Furthermore, they have better colour and a stronger flavour (surely a useful trait for any substance used in concentrations below 0.1%) and since they lack the waxy compounds of the kernels, possess none of the cloudiness which complicates the lives of industrial chemists forced to work with extracts of the whole seeds.[32] The entire plant of guaraná is an excellent source of caffeine, theophyiline and theobromine; just the leaves, which are never used for any purpose at all, yield a minimum 1.2% of alkaloid, and the Indians themselves prepare a beverage from the burnt inflorescences when supplies of the prepared sticks run short.[33] There are, in addition, numerous other species of *Paullinia* awaiting investigation as sources of botanical drugs One of these, *Paullinia yoco* Schultes & Killip, is employed by Indians of the Colombian Putumayo as a source of a stimulant drink rather different to guaraná, prepared simply from lengths of scraped bark which are squeezed in cold water to express the sap.[34]

In other words, there exist a number of subsidiary derivatives of guaraná and related *Paullinia* species which could usefully be developed to supply the demand for pure caffeine, or the kind of caffeine-based syrups used as flavouring agents by the soft-drinks industry. With demand for real guaraná expanding rapidly on both the Brazilian and international markets — and with, as a result of this, increasingly competitive prices being paid even for unprocessed seeds — it seems ridiculous that such a large share of the present production should be handed over for uses which could easily be supplied from other, less expensive sources. In recognition of this, my proposal is founded on the premise that rising demand and better prices for genuine guaraná will inevitably lead to a revival of interest in the traditional product and, ultimately, to a long overdue reassessment of the technology applied to the processing of the final article.

Research into the complex phenomena surrounding guaraná should, therefore, concentrate on three principal areas of activity. In the first place, genetic research into more resistant and productive strains should concentrate less on the rather crude parameters investigated by most agronomists in the past, and redirect attention to the more stable long-term prospects

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[32]Maravalhas (1965: 6).

[33]Carneiro (1931), Corrêa (1952: 551), Maravalhas (1965: 17 - 22).

[34]Schultes (1942). Two other wild species closely related to guaraná were also listed by von Martius in his *Florae Brasiliensis*. These are *Paullinia elegans* and *P. rubiginosa* which both have rather smaller fruits, with a noticeable downy exterior (Almeida, 1953).

afforded by the considerable diversity of the species, both in the wild and in areas of traditional Indian husbandry. Hybridization with the typical variety of *Paullinia cupana* —now all but abandoned as an economic crop in the Orinoco, despite its generally larger fruits and seeds[35] -should be attempted, and detailed studies of the plant's pollination patterns undertaken in conjunction with zoological research into the insect populations which make this pollination possible. Finally, the botanical aspects of any program regarding guaraná should extend to the considerable innovations which could be introduced as the result of creative thinking along horticultural lines, such as were outlined earlier in this paper.

The second aspect of developing guaraná as an economic crop clearly involves an investigation of the pharmacology of its use and the claims made for it as a medicinal plant. Studies of its chemistry, particularly where this relates to the changes brought about by different forms of processing, would help to devise a new technology reproducing the quality of the original Indian product, only with far less expenditure of sheer muscular energy. This would enable good guaraná to become far better known at large, and ultimately supplant the inferior preparations which at present dominate the market. Such action, in turn, is intimately related to the third aspect of a guaraná project, the need to knit together all the various stages of production into a harmonious social whole.

The point is an important one, for simply to rifle the genetic data bank of the Saterê-Mawé Indians, to industrialize their system of production and thus undercut their own attempts to reach a wider market, would be a base and cowardly form of action, totally lacking in any sense of historical responsibility. Clearly a technical "fix" would be quite meaningless were it to be turned over to the large agroindustrial concerns, and allowed to become a new mechanism for oppression and exploitation. Drawing on previous experience, it seems self-evident that the only way to integrate research into an equitable distribution of resources is to allow for a participa-

[35]See Ferreira (1885: 75), Schmidt (1941: 9), and Ducke (1937) on *P. cupana* in the upper Rio Negro in Brazil, which from being common in the eighteenth century, became relatively rare in the nineteenth, and all but disappeared in the twentieth. Ferreira stated that the product of the Rio Negro fell from grace among traders in Belem on account of its poor processing, which allowed the seeds to turn mouldy before they reached their final destination. Marcus Colchester (personal communication, May 16, 1978) reports that the Piaroa Indians of the lower Ventauri are familiar with the plant from the past, but no longer use it or cultivate it today. In Venezuelan territory, he can vouch for the present occurrence of *P. cupana* as a cultigen -and in the form of two distinct cultivars - only among the Macu of the lower Ventuari who, interestingly enough, call the plant *yucu* (though it is not the *P. yoco* of the Colombian Putumayo). The Macu preparation of *cupana* does not involve toasting the seeds. Instead, these are ground into a fine mush and directly mixed with cold water, apparently dispensing with the underwater fermentation and sun-drying of the mush originally described on the Orinoco by Humboldt (1822: VII, 342) Colchester adds: "The resulting cold infusion has a very bitter pee-like taste and is taken as a preliminary to more exotic drugs such as *Banisteriopsis caapi* and *Adenanthera peregrina*... For all its mildness our informants were unanimous in classifying *Paullinia* along with the better known and more psychedelic plants..."

tion of those who are so often seen simply as "objects" of social engineering - the people themselves. Only by this means will it be possible to reorganize trade in genuinely cooperative structures, eliminating the paternalism and profiteering of present-day middlemen, establishing the size of production units which would remain economically viable in the future, and identifying the type of requirements which are necessary to carry the infrastructure forward.

Having done this much in the area where guaraná originated, it would be a relatively simple process to introduce it as a new economic crop in other areas. As pointed out in the introduction, the plant can be grown in areas cleared as a matter of course for the production of food staples, and thus does not require any major leap of faith, nor indeed any crippling new investment on the part of those who come to the crop for the first time. The type of climate which characterizes Maués, and even the soils on which guaraná is grown –yellow or reddish lateritic clays dating from the late Tertiary and early Quaternary[36] –are widely distributed throughout Amazonia, and provide no impediment to the spread of the plant through ever increasing areas. Even the introduction of new technology for processing the plant, and the formation of new economic units, are not tasks that would be completely impossible –given a modicum of support, initiative, and official goodwill.

These conditions, however, lead me to end on a rather sober note, for it could well be that prospects such as those that I have just outlined would be seen as highly "subversive" by the Brazilian military regime and its international backers – those forces who together are organizing the current pillage of the Amazon, and its prostration at the feet of corporate agribusiness. I have no easy answers to this problem, other than to say that such factors again stress the need for a coherent analysis of the social and historical choices involved in the development of any economic or medicinal plant. I hope to have contributed with a proposition that might provide a stable and long-term option for human occupation in the Amazon basin.

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[36]Corrêa (1952:547), Schmidt (1941:14), Gonçalves (1971), Vasconcelos *et al.* (1976:65).

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