THE USE OF MEDICINAL PLANTS BY THE YANOMAMI INDIANS OF BRAZIL[1]

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The results of the first detailed study of the use of medicinal plants by a group of Yanomami Indians are presented. Contrary to previous assumptions, they are shown to possess a substantial pharmacopoeia, including at least 113 species of plants and fungi. The changes in their use and knowledge of plant medicine are discussed in the context of the past and present influences on the Yanomami by the outside world.

Uso de plantas medicinais pelos Índios Yanomami do Brasil. *O presente trabalho apresenta os resultados obtidos através do primeiro estudo detalhado a respeito do uso de plantas medicinais por um grupo de índios Yanomami. Ao contrário do que se acreditava anteriormente, estes índios possuem uma farmacopéia considerável, na qual incluem-se, pelo menos, 113 espécies de plantas e fungos. As mudanças ocorridas no uso e no conhecimento das plantas medicinais são discutidas no contexto das influências que os Yanomami vêm sofrendo através do contato com o mundo exterior, tanto no passado como no presente.*

Key Words: Yanomami; medicinal plants; Amazônia; phytotherapy; intellectual property rights.

Although this paper is primarily a discussion of the medicinal plants used by a group of Yanomami Indians, and those plants have been collected and identified using rigorous ethnobotanical procedures, only those medicinal species whose properties are widely used and which are already well documented have been mentioned by name. This is a deliberate attempt to combine protection of the intellectual property rights of those people with scientific reporting. It is hoped that it will help to emphasize the urgent need for a satisfactory and equitable solution to an issue which ethnobiologists ought not to be able to ignore.

THE YANOMAMI

The data discussed in this paper were collected during two visits by the authors to the Yanomami village of Watoriki-t^{h}eri in July–August 1993 and July–August 1994. The principal aim of the visits was to gather information for inclusion in a bilingual health manual, for use by medical personnel working within the Yanomami territory. The long-term objective was to provide a base of information for future use by health workers in the re-establishment of traditional health practices (where appropriate), and in the control of the dependence on introduced allopathic medicine which has become established amongst the majority of the tribe.

The Yanomami Indians have, since 1950, been the subject of a great deal of (primarily anthropological) research. Their use of plants has been discussed, occasionally in some detail, in the general anthropological literature (e.g., Fuentes 1980; Lizot 1984: Ch. IV), but also by specific ethnobotanical studies (e.g., Anderson 1978; Prance 1972, 1984). Discussion of Yanomami curing techniques has, rightly, been focussed mainly upon their shamanic practices, and their associated use of hallucinogenic plants (*Virola* spp. [Myristicaceae] and *Anadenanthera peregrina* (L.) Speg. [Leguminosae] etc.) has been documented in detail (e.g., Biocca 1979a; Brewer-Carias and Steyermark 1976; Chagnon, Le Quesne, and Cook 1970, 1971; Prance 1970; Schultes and Holmstedt 1968; Seitz 1967). This is indisputably the most evident and the most

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important aspect of their traditional healing practices, perhaps as a result of which the Yanomami have almost invariably been reported as using virtually no medicinal plants in the conventional sense of the term (e.g., Chagnon 1968: 52). A short paper by Biocca (1979b) appears to be the only published work dealing specifically with Yanomami plant medicine, and although he mentioned the occasional use of a few medicinal plants, he nonetheless concluded that the 'unacculturated' Yanomami are almost completely ignorant of the vast natural pharmacy which inevitably exists in their surrounding forests.

Data collected during anthropological/linguistic fieldwork at Watorikɨtʰeri by B.A. and the ethnolinguist Gale Goodwin Gomez in 1991 demonstrated that, contrary to the earlier assumptions of most other researchers, at least some of the Yanomami possess a significant body of knowledge of medicinal plants. The names and uses of 58 medicinal plants, most of which had not been collected or identified, were recorded during the 1991 fieldwork and these data formed the basis for the present study.

The Village

The village of Watorikɨtʰeri consists of a single, round, open-centred palm-thatched structure housing a population of 89 at the time of the 1993 study, of whom 46% were children under the age of ten. It lies at the southern edge of the upland massif which forms the watershed between the Amazon and the Orinoco basins, and which constitutes the bulk of the traditional Yanomami territory. The village is situated close to Km 211 on the abandoned Perimetral Norte (BR210) highway, which runs eastwards to Boa Vista and peters out some 24 km to the west. Approximately 3 km from the village, on a strip of the abandoned highway, there is an airstrip (62°49′22″W, 1°30′48″N, alt. 154 m a.s.l.) and an indigenous post (PIN Demini) run by the Brazilian Indian Foundation FUNAI (Fig. 1). This post incorporates a medical facility which at the time of study was manned by a nurse employed by the Comissão Pró–Yanomami (CCPY), who were responsible for the medical support for the Yanomami in that sector of their territory.

The people of Watorikɨtʰeri moved down from their upland territories on the upper Lobo d'Almada affluent of the Rio Catrimani in the early 1970s, and were decimated by a disastrous epidemic of measles in 1973. As a belated measure to cushion the effects of the Perimetral Norte construction programme, a FUNAI sub-post was then built on the Rio Mapulaú, with which the Indians established contact. The Mapulaú sub-post was then closed and a new post was established at Demini (1976–1977), towards which the Watorikɨtʰeri (led by their headman Lourival) began to approximate themselves. By 1982–1983 they were established in its vicinity, and in regular contact with the white (FUNAI) people living there.

This migration was the last move of the Watorikɨtʰeri in the context of the general expansion of the Yanomami of the highlands of the Serra Parima into the lowlands of the Rio Branco tributaries, which probably began during the latter part of the 19th century. This expansion was underpinned by a demographical increase thought to have been due to the acquisition of metal tools and new cultigens, and the availability of land caused by disappearance of neighbouring peoples (see Albert 1985: Ch. I and II).

Methods

The ethnobotanical data collected during this study were supported by herbarium voucher specimens. These have been lodged at the herbaria of the Instituto Nacional de Pesquisas da Amazônia at Manaus (INPA), Kew (K), Boa Vista (MIRR) and New York (NY), and a full set including sterile voucher specimens is maintained at Kew. Collection of specimens and preliminary data was carried out in the forest with Yanomami informants (principally Justino and Antonio), and subsequently plant identifications and usage data were checked by consensus back in the village. Identification of plant species was only recorded when a consensus agreement was reached.

Discussions of the properties of the plants were conducted in the Yanomami language. The number of people with whom the data were initially checked varied from two to several, depending upon availability. Subsequently, systematic discussions of the entire data set were held with all the adult men in the village (using only the plant names as prompts), both in 1993 and in 1994. In certain cases, medicinal use data were recorded without corroboration, on the grounds that the precarious state of the knowledge of medicinal plants (see Results) has in-

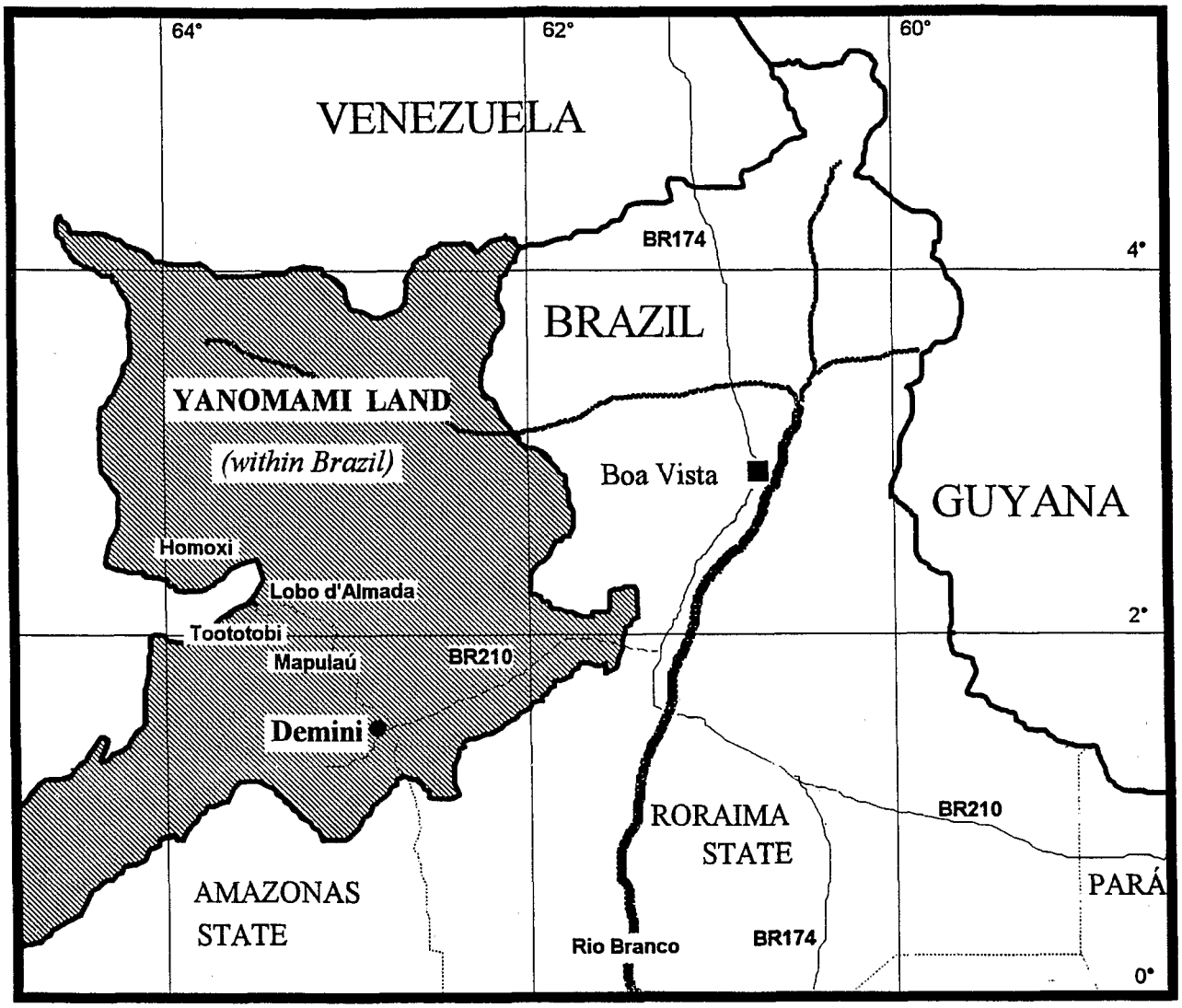

Fig. 1. Approximate location of the study area (Demini Indigenous Post).

evitably resulted in much of that information becoming 'uncommon knowledge' but nonetheless valid. On the rare occasions that uncorroborated data were specifically denied by others, they were rejected. In some cases, plants were brought in independently by other villagers, and these were subjected to the same checking process. Subsequent efforts were then made to observe these species growing in the forest.

Results

The total number of species of medicinal plants (including fungi) collected during the study was 113, representing 92 genera and 51 families (Table 1). Of these, 11 were cultivated plants, 6 of which were apparently grown specifically for their medicinal (and often magical) properties. Some of these, such as the numerous cultivated varieties of *Cyperus articulatus* L. (Cyperaceae), had been obtained by trade with other villages, sometimes considerable distances away, and their owners could recall with clarity from whom they had acquired them and for what they had exchanged them. One of the cultivated medicinal plants, *Zingiber officinale* Roscoe (Zingiberaceae), was not being grown at Watorikɨtʰeri, and had to be collected from the village of Tootobi approximately 100 km to the west.

Of the wild medicinal plants, six species did not occur in the vicinity of Watorikɨtʰeri but were collected in the upland territories (at Homoxi) during a short visit there by a group of men from Watorikɨtʰeri following the 1993 massacre at Haximu (see Albert 1994). The seeds of one of these, *Phytolacca rivinoides* Kunth & Bouché

(Phytolaccaceae) were then planted close to the village and were flourishing there in 1994. Two further species were identified as possessing medicinal properties by a visitor from Toototobi, one of which was apparently unknown to the people of Watorikɨtʰeri and the other of which was known to them by name but was not recognized in the forest.

The medicinal plants collected appeared to represent the great majority of those whose properties were still known by the inhabitants of the village. All of the medicinal plants whose names could be remembered at the time (101 species), were collected in 1993. Furthermore, although during the early part of the 1993 study the sighting of certain medicinal plants in the forest stimulated the Yanomami to remember their medicinal properties (although they had been unable to remember their names when asked previously to list medicinal species known to them), this occurred increasingly rarely towards the end of the study. It is therefore reasonable to assume that the bulk of the medicinal plant information extant in the village was collected.

During the return visit in 1994, a further 12 species were added to the list. In some cases these were plants which had been encountered in 1993 but whose medicinal properties the Yanomami had omitted to mention, and in others they were plants which were encountered for the first time in 1994 and whose properties were immediately remembered. The medicinal use of one species, *Ceiba pentandra* (L.) Gaertn. (Bombacaceae), had been learned from another group of Yanomami Indians during a visit earlier in the year.

The majority of the plant medicines demonstrated by the Yanomami at Watorikɨtʰeri did not appear to be in current use. This was almost certainly largely due to the increasing availability of Western allopathic medicines since the mid-1970s (through the presence of health organizations), in which they had probably established their faith as a result of their obvious effectiveness against otherwise incurable introduced epidemic diseases (see Discussion). Another of the consequences of these epidemics, however, was that most of the elders of the group died during that period of early contact. The initial epidemic of 1973 killed the majority, and another in 1976–1977 seriously affected a part of the group

TABLE 1. MEDICINAL PLANT AND FUNGUS FAMILIES RECORDED AT WATORIKɨTᴴERI.

	Family	No. species
Angiospermae	Acanthaceae	2
	Anacardiaceae	2
	Annonaceae	4
	Apocynaceae	4
	Araceae	6
	Aristolochiaceae	1
	Bignoniaceae	3
	Bombacaceae	1
	Burseraceae	2
	Costaceae	2
	Cucurbitaceae	1
	Cyperaceae	1
	Dioscoreaceae	1
	Euphorbiaceae	1
	Flacourtiaceae	1
	Gesneriaceae	2
	Gramineae	1
	Guttiferae	4
	Heliconiaceae	1
	Hernandiaceae	1
	Iridaceae	1
	Leguminosae	9
	Malpighiaceae	1
	Malvaceae	1
	Marantaceae	1
	Menispermaceae	2
	Monimiaceae	3
	Moraceae	6
	Musaceae	2
	Myristicaceae	1
	Palmae	3
	Passifloraceae	1
	Phytolaccaceae	1
	Piperaceae	8
	Polygonaceae	3
	Rubiaceae	6
	Rutaceae	2
	Scrophulariaceae	1
	Simaroubaceae	1
	Solanaceae	2
	Sterculiaceae	1
	Theophrastaceae	1
	Urticaceae	2
	Violaceae	2
	Zingiberaceae	3
Pteridophyta	Dryopteridaceae	1
	Polypodiaceae	2
Fungi	Meruliaceae	1
	Phallaceae	2
	Tricholomataceae	1
	Xylariaceae	1
Total	51	113

Fig. 2. Direct application of the aromatic crushed stem of *Renealmia* (Zingiberaceae) to treat headache.

Fig. 3. Use of the young leaves of a leguminous tree to treat eye infection. The leaves are heated in the flames of the fire and held close to the open eye as a poultice.

which had stayed on the upper Lobo d'Almada in the 1970s and who rejoined the people of Watorikɨtʰeri in 1984. Two of the eldest surviving shamans (Noé and Valdo) died at the end of the 1980s, leaving only the current leader Lourival surviving. This had resulted in a very unbalanced age distribution within the group, of whom only 35% were adults over 20, nine were above the age of 40 and one over 50.

It was said that the knowledge of traditional plant medicine had originally been kept and practised largely by the older women. In many cases, particularly for treatment of fevers etc., this phytotherapy would have taken the role of a follow-up treatment after a shamanic healing session had been performed by men. There were, however, no survivors of the generation of women who had a wide knowledge of these traditional medicines remaining in the village. The last of them (the mother of Antonio, one of the men who provided much of the information gathered here) had died in 1984. Most of the knowledge of medicinal plants remaining within the group (i.e., that collected during this study) was that which a few of the older men had picked up from their mothers and grandmothers while they were still living in the Rio Catrimani uplands before their migration in the early 1970s (although the five remaining women over the age of 40 in the village also knew of some of the medicinal plants collected). It is therefore likely that this information represents only a part of what was originally known.

The medicinal plants and fungi collected represent a broad spectrum of plant families. The majority are represented by only one or two species (50% and 24% respectively), and the most important in terms of numbers of species used (>4) are the Piperaceae, Leguminosae, Araceae, Rubiaceae, Moraceae, Annonaceae, Apocynaceae and Guttiferae. These are also well represented in the literature on Amazonian medicinal plants, all of them featuring amongst the 13 most represented families (by number of species used) in a broad survey of the pharmacopoeia of French Guiana (Grenand, Moretti, and Jacquemin 1987).

The plants were attributed a broad range of medicinal properties, which are listed in Table 2 along with their modes of administration. A few of the medical problems which the plants are used to treat are attributed to sorcery by the Yanomami, but this does not alter the fact that they are genuine clinical disorders which modern medicine may attribute to other causes. As the table demonstrates, a high proportion of the treatments involve external application of the plant preparation, even for internal disorders. The most prominent example of these is fever, for which the great majority of applicable plants (e.g., *Piper* and *Peperomia* spp., Piperaceae) are prepared as an infusion (generally aromatic) which is poured over the head and body. As has already been mentioned, these fever medicines are primarily for use following sessions of shamanic treatment.

For some other medicinal applications, e.g., headache and stomach ache, the bark or stems of the plants used are softened by beating (which also releases the juices) and then tied around the affected region, as in Fig. 2 where *Renealmia alpinia* (Aubl.) Maas (Zingiberaceae) is being

TABLE 2. APPLICATION AND ADMINISTRATION OF YANOMAMI MEDICINAL PLANTS.

Application	Spp.	Administration technique: Ingested	Externally applied: solid/ liquid	Externally applied: vapour/ smoke	Plant families employed
Fever/Weakness	20	4	16	0	Ana/Ara/Cyp/Dry/Ges/Leg/Mal/Mon/Pal/Pas/Pip/ Rub/Zin
Stomach ache/Diarrhoea	11	7	4	0	Ana/Ara/Ari/Big/Leg/Men/Mor/Myr/Rub/Zin
Eye infection	10	0	4	6	Aca/Cuc/Gut/Leg/Mus/Rub/Vio
Malaria	10	7	3	0	Ann/Apo/Ara/Leg/Men/Pha/Rub
Toothache	9	0	9	0	Ara/Bom/Cyp/Fla/Mar/Mor/Polyg/Rut/Zin
Itching (skin disorders)	7	0	7	0	Aca/Ann/Big/Ges/Scr
Congestion/colds	7	2	1	4	Ann/Bur/Eup/Leg/Polyp/Rub/The
Infantile thrush (oral)	5	0	5	0	Big/Iri/Leg/Pal/Ste
Cough	5	4	1	0	Pip/Rub/Sim/The/Zin
Parasites	5	3	2	0	Apo/Eup/Leg
Fungal skin infection	4	0	4	0	Gut/Mor
Dizziness	4	0	0	4	Mon/Polyg/Sol
Nausea	4	3	0	1	Cos/Pas/Rut
Abscess	3	0	3	0	Leg/Tri/Xyl
Ant sting	3	0	3	0	Vio/Mer/Hel
Localized body pain	3	0	3	0	Gra/Urt/Zin
Snake bite	3	0	3	0	Big/Gut/Zin
Headache	3	0	3	0	Urt/Zin
Lumbar pains	3	0	2	1	Ara/Urt
Cramps/leg pains	3	0	3	0	Mus/Urt
Burns	2	0	2	0	Mor
Chiggers	2	0	2	0	Gut/Phy
Convulsions	2	1	1	0	Mal/Polyg
Sore throat	2	2	0	0	Leg/Sim
Bruising	1	0	1	0	Her
Crying (baby)	1	0	0	1	Leg
Hernia	1	0	1	0	Dio
Imminent blindness	1	0	1	0	Sol
Infected wounds	1	0	1	0	Apo
Lesions (leishmaniasis?)	1	0	1	0	Gut
Scorpion sting	1	0	1	0	Ara
Wounds (arrow)	1	0	1	0	Sim
Totals		33	88	17	

used to treat headache. Some of the medicinal plants used in this fashion, such as *Uncaria guianensis* (Aubl.) Gmel. (Rubiaceae) and *Aristolochia* sp. (Aristolochiaceae) may also be taken internally (as an infusion) for the same ailment, which suggests that the active constituents may equally be absorbed through the skin as through the stomach lining. It was particularly interesting that some plants and fungi were said to be used in this manner to treat malaria, by direct action on the spleen. Swelling of the spleen is a common symptom of the disease and this is evidently well known to the Yanomami. Their word *hura* means both 'malaria' and 'spleen', and *huramu* (to have malaria) literally means 'to be spleening.' The direct application of the plants to the swollen spleen has also been observed amongst the Wayãpi Indians of French Guiana (Grenand, Moretti, and Jacquemin 1987).

The sniffing or inhalation of crushed aromatic leaves or resins such as *Siparuna guianensis* Aubl. (Monimiaceae) and *Protium* spp. (Burseraceae) is used for a number of ailments including congestion, colds, dizziness and nausea. Likewise the young leaves of several plant species, including a cultivated banana variety, are used in an interesting fashion for the treatment of eye infections. The leaves are heated in the

TABLE 3A. SOME MEDICINAL PLANTS USED BY THE YANOMAMI INDIANS, AND A COMPARISON WITH MEDICINAL PLANTS USED BY OTHER PEOPLES. VOUCHER NUMBERS REPRESENT COLLECTIONS IN THE WILLIAM MILLIKEN SERIES, KEPT AT KEW (K) AND OTHER HERBARIA (SEE METHODS).

Medicinal plants used by the Yanomami Indians				
Species (Yanomami name)	Family	Application	Method	Voucher
Aristolochia disticha Mast. vel sp. aff. (*xuu t^{h}ot^{h}o*)	Aristolochiaceae	Diarrhoea & stomach ache	Stem infusion drunk, or crushed stem wrapped round waist	WM1713
Aspidosperma nitidum Benth. (*hura sihi*)	Apocynaceae	Malaria	Bark decoction drunk	WM1734
Bauhinia guianensis Aubl. (*tũwakaramë t^{h}ot^{h}o*)	Leguminosae	Diarrhoea & stomach ache	Stem infusion drunk, or beaten stem wrapped round waist	WM1736
Clusia aff. *nemorosa* G. F. W. Meyer (*poripori t^{h}ot^{h}o*)	Guttiferae	Infected wounds	Resin from the fruit or aerial roots applied directly to wound	WM1982
Cyperus articulatus L. (*haro kɨkɨ*)	Cyperaceae	Fevers	Rhizome infusion drunk & poured over the head & body	WM1751
Geophila repens (L.) I. M. Johnst. (*mamo wayi kɨkɨ*)	Rubiaceae	Eye infections	Juice of crushed fruits dripped into eyes	WM1712
Inga acuminata Benth. (*rĩa moxiririma hi*)	Leguminosae	Infantile thrush (oral)	Powdered dried leaves put in baby's mouth	WM1865
Musa sp. (*paixima si*)	Musaceae	Eye infections	Young leaves heated & held close to open eyes	WM1907
Peperomia macrostachya (Vahl) A. Dietr. (*kona hanakɨ*)	Piperaceae	Fevers	Leaf infusion poured over head & body	WM1886
Peperomia rotundifolia (L.) Kunth (*oru kɨkɨ wĩte*)	Piperaceae	Coughs	Leaves chewed & swallowed	WM1720
Philodendron solimoesensis A. C. Smith (*puu t^{h}ot^{h}okɨ*)	Araceae	Scorpion stings	Exudate from aerial roots applied to sting	WM1790
Phlebodium decumanum Willd. (*tokosi hanakɨ*)	Polypodiaceae	Coughs & congestion	Leaf infusion poured over head & body	WM1890
Phytolacca rivinoides Kunth & Bouché (*krɨpɨari hi*)	Phytolaccaceae	Chiggers holes in feet	Juice of crushed fruits applied to holes after removal of chiggers	WM1928
Piper arborea Aubl. (*kahu mahi*)	Piperaceae	Fevers	Leaf infusion poured over head & body	WM1804

TABLE 3B.

Medicinal plants used by other peoples				
Species	Users	Application	Method	Source(s)
Aristolochia spp.	Bolivia (Chácobo Indians), Ecuador (Siona Indians), French Guiana (Wayãpi Indians)	Diarrhoea & stomach ache	Plant decoction drunk	Boom (1987), Vickers & Plowman (1984), Grenand et al. (1987)
Aspidosperma nitidum	Brazil	Malaria	Bark decoction drunk	Altschul (1973), Brandão et al. (1992)
Bauhinia guianensis & other *Bauhinia* spp.	Brazil (Waimiri Atroari Indians), French Guiana (Wayãpi)	Diarrhoea & dysentery	Stem infusion or decoction drunk	Milliken et al. (1992); Grenand et al. (1987)
Clusia spp.	Colombia (Makuna, Karijona & Makú Indians), Mexico, Costa Rica	Sores, wounds & leprosy	Resin applied directly to affected region	Schultes & Raffauf (1990), Morton (1981)
Cyperus articulatus & other *Cyperus* spp.	Ecuador (Secoya Indians), Brazil (Tiriyó Indians)	Fevers	Rhizome infusion drunk & poured over the head & body	Schultes & Raffauf (1990), Cavalcante & Frikel (1973)
Geophila repens	Ecuador (Ketchwa Indians), French Guiana (Palikur Indians)	Fungal infections	Crushed fruits applied to affected region	Schultes & Raffauf (1990), Grenand et al. (1987)
Inga spp.	French Guiana (Wayãpi Indians); Colombia (Tikuna Indians)	Buccal dermatitis of children, fungal skin infections	Bark decoction, leaf & root decoction	Grenand et al. (1987), Schultes & Raffauf (1990)
Musa paradisiaca L.	Indonesia	Eye infections	Leaves used; method unspecified	Dharma (1987)
Peperomia macrostachya	Colombia (Taiwano Indians), French Guiana (Wayãpi Indians)	Fevers	Leaf decoction applied as external bath	Schultes & Raffauf (1990), Grenand et al. (1987)
Peperomia rotundifolia	French Guiana (Wayãpi Indians)	Coughs	Leaves taken raw or in decoction	Grenand et al. (1987)
Philodendron spp. & other araceous epiphytes	Peru, Brazil (Waimiri Atroari Indians), Colombia	Insect stings/bites	Exudates applied to the sting	Duke & Vasquez (1994), Milliken et al. (1992), Schultes & Raffauf (1990)
Phlebodium decumanum	Colombia (Miraña Indians)	Pulmonary disorders	Infusion of the rhizome drunk	La Rotta (1988)
Phytolacca rivinoides	Colombia (Andoke Indians), Ecuador	Inflamed & infected wounds (disinfectant)	Infusion or poultice of the leaves applied externally	Schultes & Raffauf (1990)
Piper spp.	Venezuela, Brazil, Colombia	Fevers	Leaf decoction or infusion poured over body or drunk	Morton (1981), Branch & Silva (1983), Schultes & Raffauf (1990)

TABLE 3A. CONTINUED.

Medicinal plants used by the Yanomami Indians				
Species (Yanomami name)	Family	Application	Method	Voucher
Protium unifoliolatum Spruce ex Engl. (*warapë kohi*)	Burseraceae	Congestion & respiratory infections	Resin from trunk dissolved in water & drunk or poured over head; crushed fruits sniffed	WM2066
Renealmia alpinia (Aubl.) Maas (*mãokori sinakɨ*)	Zingiberaceae	Headache, stomach ache & general weakness	Crushed stem tied around forehead or midriff, or infusion poured over head & body	WM1971
Siparuna guianensis Aubl. (*mõe hanakɨ*)	Monimiaceae	Dizziness	Crushed leaves sniffed and rubbed on head & body	WM1702
Spondias mombin L. (*pirimë ahɨ̃ tʰotʰo*)	Anacardiaceae	Fevers	Leaf infusion poured over head & body	WM1733
Tabernaemontana angulata Mart. ex M. Arg. (*akiã hi*)	Apocynaceae	Intestinal worms (roundworms)	Bark infusion drunk	WM1820
Tanaecium nocturnum (Barb. Rodr.) Bur. ex K. Schum. (*puu tʰotʰo mokɨ*)	Bignoniaceae	Itching	Leaves cooked & their juices rubbed onto the skin	WM1719
Uncaria guianensis (Aubl.) Gmel. (*ëramë tʰotʰo*)	Rubiaceae	Diarrhoea & stomach ache	Stem infusion drunk, or crushed stem wrapped round waist	WM1738
Urera baccifera (L.) Gaud. (*ɨ̃ra nakɨ*)	Urticaceae	Aches & body pains (including headaches)	Stinging leaves pressed onto affected region	WM1968
Vismia angusta Miq. (*yoasi hi*)	Guttiferae	Fungal skin infections	Resin from the bark applied to the affected region	WM1865
Zanthoxylum pentandrum (Aubl.) R. Howard (*naharã hi*)	Rutaceae	Toothache	Bark grated & kept as a wad in the lip	WM1747
Zingiber officinale Roscoe (*amatʰa kɨkɨ*)	Zingiberaceae	Toothache	Rhizome chewed	WM2058

flames of the fire and held up close to the eyes (Fig. 3), which are kept open and are presumably affected by the vapours emanating from the hot leaves.

The preparation of ingested medicines, many of which are made from the inner bark of trees and vines, varies considerably and may depend upon the circumstances when required. Thus a bark which is carefully prepared as a hot water infusion in the village may, if required urgently in the forest, be simply crushed and squeezed out into an impromptu leaf-cup of cold water and drunk. Medicinal barks are generally collected by scraping off the outer bark from the trunk, and then scraping off fine shavings of the inner bark which are caught in a leaf. In a num-

TABLE 3B. CONTINUED.

Medicinal plants used by other peoples				
Species	Users	Application	Method	Source(s)
Protium unifoliolatum & other *Protium* spp.	Colombia (Tikuna Indians), Brazil (Ka-'apor Indians)	Colds & congestion	Resin put into nostrils	Schultes & Raffauf (1990), Balée (1994)
Renealmia spp.	French Guiana (Créoles), Colombia (Andoke Indians)	Tonic & fortifier	Infusion of plant used as bath, or leaves rubbed on the body	Grenand et al. (1987), Schultes & Raffauf (1990)
Siparuna guianensis & other *Siparuna* spp.	Brazil, Colombia (Tikuna Indians), Ecuador (Quechua and Waorani Indians)	Headaches, nausea, fever; calmative	Leaf infusion or decoction used externally as bath	Branch & Silva (1983), Freise (1933), Schultes & Raffauf (1990), Lescure et al. (nd.)
Spondias mombin	Mexico, Brazil	Fevers	Decoction of bark or leaves taken or used externally	Morton (1981), Brandão et al. (1992)
Tabernaemontana undulata Vahl	Colombia (Taiwano Indians)	Intestinal worms	Decoction of the leaves drunk	Schultes & Raffauf (1990)
Tanaecium nocturnum	French Guiana (Wayãpi Indians)	Cutaneous eruptions	Stem decoction applied to skin	Grenand et al. (1987)
Uncaria guianensis	Bolivia (Chácobo Indians); Colombia	Diarrhoea & stomach ache	Stem decoction drunk	Boom (1987), Schultes & Raffauf (1990)
Urera baccifera	Ecuador (Siona Indians), Colombia, Brazil	Muscular pains & paralysis	Stinging leaves pressed onto affected region	Vickers & Plowman (1984), Schultes & Raffauf (1990), Freise (1933)
Vismia angusta & other *Vismia* spp.	Colombia (Tikuna Indians), French Guiana (Wayãpi Indians), Brazil	Fungal infections	Latex applied to affected region	Schultes & Raffauf (1990), Grenand et al. (1987), Branch & Silva (1983)
Zanthoxylum spp.	French Guiana, North America, Honduras, W. Indies	Toothache	Bark chewed	Grenand et al. (1987), Heckel (1897), Schultes & Raffauf (1990), Morton (1981)
Zingiber officinale	Colombia	Toothache	Rhizome chewed	Schultes & Raffauf (1990)

ber of cases these must then be wrapped in a tight package made from a marantaceous leaf (Fig. 4) and cooked in the embers of the fire. When ready, they are removed from the fire and the juice is squeezed from them and drunk.

A few plants and fungi are burned and their ashes are used medicinally, particularly for the treatment of oral thrush (yeast infections) in babies. For this purpose the ashes are glued to the nipple of the nursing mother with a little saliva or with the sticky sap from the skin of a green plantain, and when the baby is suckled they are effectively dispersed around its mouth and presumably into its digestive tract. The dried tannin-rich leaves of *Inga acuminata* Benth. (Leguminosae), powdered but not burned, are used in the same manner. It was said that three of the plants indicated for this purpose could be used

Fig. 4. Preparation of a medicinal bark. The bark scrapings are being wrapped in a marantaceous leaf and will be cooked in the fire before the juice can be extracted and drunk.

jointly. In general, however, the use of mixtures of plant species appears to be relatively rare in Yanomami medical practice; the great majority of the plants being used on their own. Most of the medicines are prepared from the leaves or the bark of the plants concerned (Fig. 5).

In addition to the information collected on the use of medicinal plants by the Yanomami, observations were made on their use of insects for medicinal purposes. The majority of these were Hymenoptera, which in most cases were employed either for the therapeutic properties of their stings (in the case of ants) or of the propolis and pollen from their nests (in the case of bees). These will be documented in detail elsewhere.

Discussion and Conclusions

The results of this study demonstrate that the Yanomami Indians, at least in the area visited, possessed at the time a rich knowledge of medicinal plant properties, although the transmission of this knowledge was threatened by the consequences of the population losses of the 1970s/1980s and by their increasing access to introduced (manufactured) medicines. Clearly it would not be possible adequately to assess the efficacy of their plant medicines without lengthy and detailed pharmacological screening. However, an initial (limited) search of

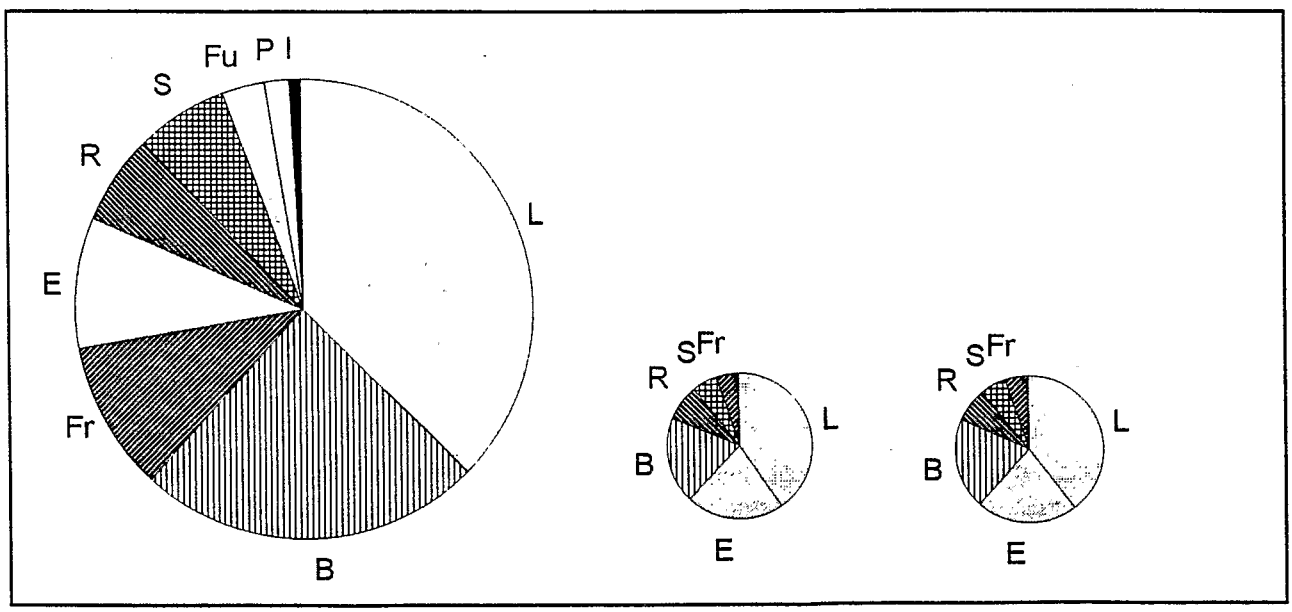

Fig. 5. Relative use of plant and fungal parts in Yanomami medicine (left) and use of medicinal plant parts by the Chácobo (centre) and Tiriyó Indians of Bolivia and Brazil (right) (Boom 1987; Cavalcante and Frikel 1973). B = bark & wood—including liana stems; E = Exudate; Fr = Fruit/seed; Fu = Fungal fruiting body; I = Inflorescence; L = Leaf; P = Pith/palm heart; S = Stem [herbaceous]; R = Root/rhizome.

some of the relevant ethnobotanical literature (principal sources are cited in Table 3) has revealed a substantial degree of overlap with the properties attributed those species (or genera) by other peoples elsewhere, strongly suggesting that these species are indeed clinically effective.

For example, the use of bitter bark of *Aspidosperma nitidum* Benth. (Apocynaceae) for treating malaria and associated liver disorders is very widespread in Amazonia, although its effectiveness has yet to be proven. Amongst the indigenous groups of Roraima State it was the only species *consistently* cited as effective for this disease during a survey of the anti-malarial plants of the region (W.M., unpublished data). Similarly the use of the woody vines *Bauhinia guianensis* Aubl. (Leguminosae) and *Uncaria guianensis* (Aubl.) Gmel. (Rubiaceae) to treat diarrhoea and stomach ache are widespread, both in Roraima and beyond. For some of these species, the chemicals which are almost certainly responsible for their effects (e.g., the tannins in *Bauhinia guianensis*) have already been identified, and many of the genera represented have been shown to be rich in alkaloids and/or other bioactive compounds (Grenand, Moretti, and Jacquemin 1987). A selection of the Yanomami medicinal plants whose use data are corroborated by published information is given in Table 3. Overall, it was found that for at least 105 (93%) of the medicinal plants, the same genera are used elsewhere for medicinal purposes, and for 55 (49%) of them those genera are employed elsewhere for the same medicinal purposes as by the Yanomami. More significantly, at the species level at least 58 (51%) of the plants are used medicinally elsewhere, with 24 (21%) being used for the same purpose. These figures are of course to some degree subjective, depending upon the measure of 'sameness' used. In this case, applications are considered to be the same if they are for essentially the same disorders (rather than the same clinical effects), although the methods of preparation and administration may differ.

A comparison of the way in which the Yanomami employ their medicinal plants with the ways in which other south American indigenous groups use theirs, highlights considerable similarities. The proportions of the various plant parts used by the Chácobo of Bolivia and the Tiriyó of Brazil, for example, are almost identical (see Fig. 5) with a strong predominance of leaves employed. Data for the Yanomami are similar, again with leaves being the most used plant parts, the differences being a slightly greater use of fruits and barks and a lesser use of exudates. However, amongst the Wayãpi medicinal plants collected by Grenand, Moretti, and Jacquemin (1987) in French Guiana, bark and stems were employed in many more cases than leaves. These figures will inevitably be influenced by the types of vegetation amongst which the group is living and the proportions of plant growth habits represented amongst them: Grenand and co–workers concluded that in most cases the choice of plant part probably depended upon the ease and speed of its collection.

If one compares the applications to which the Yanomami put their medicinal plants with those of other groups, one again encounters considerable similarities (see Table 4). Clearly it is not possible to make a direct quantitative comparison between them, since the differences in the ways in which these groups (and to some extent the ethnobotanists who worked with them) perceive disease affects the way that the medicines are classified, but nevertheless there is a clear preponderance of certain problems such as fevers, stomach and intestinal disorders, bacterial and fungal infections of skin, wounds and eyes, respiratory disorders, toothache, etc.

The Waorani Indians of Ecuador, shortly after their contact with the outside world, were recorded as being affected by external parasites, fungal infections, poor dentition and undefined fevers as well as a high rate of snakebite, but to suffer minimally from epidemic diseases, internal parasites or bacterial infections (Larrick et al. 1979). Of the 35 medicinal plants recorded amongst them by Davis and Yost (1983), the majority (30) were used to treat only fungal infections, snake-bite, dental problems, fevers, botfly larvae and stings. The degree to which remedies for diseases *not* native to the New World (see Newman 1976) are represented in a pharmacopoeia will of course depend to some extent upon the history of contact of the group concerned, although diseases have often reached indigenous peoples through intertribal contacts long before they can be said to have been 'contacted.' Cook (1946), in a comparison of the remedies prescribed in a 17th

TABLE 4. THE PRINCIPAL USES OF MEDICINAL PLANTS AMONG FOUR TRIBES OF SOUTH AMERICAN INDIANS (RANKED BY NUMBERS OF SPECIES EMPLOYED). DATA FROM BOOM (1987), LA ROTTA (1988), CAVALCANTE AND FRIKEL (1973) AND THE PRESENT STUDY.

Chácobo	Spp.	Miraña	Spp.	Tiriyó	Spp.	Yanomami	Spp.
Stomach ache	32	Skin disorders	23	Fevers	53	Fever/Weakness	20
Skin infections	26	Fevers	19	Wounds/ulcers	21	Stomach ache/Diarrhoea	11
Diarrhoea	25	Gastro-intestinal	19	Rheumatism	9	Eye infections	10
Rheumatism	25	Rheumatism	8	Headache	8	Malaria	10
Toothache	10	Infections (bacteria)	10	Anaemia/weakness	7	Toothache	9
Hepatitis	10	Inflammation	8	Stomach ache	6	Itching (skin disorders)	7
Fevers	9	Pain (analgaesic)	8	Toothache	6	Congestion/colds	7
Vomiting	9	Wounds	8	Dizziness/vision	6	Infantile thrush (oral)	5
Appendicitis	6	Bronchial disorder	5	Coughs	6	Coughs	5
Headache	5	Snakebite	6	Convulsions	5	Parasites	5
Eye infections	4	Eye infections	3	Eye infections	4	Fungal skin infections	4
Head colds	3	Liver	3	Hepatitis	4	Dizziness	4

century English herbal with those from two accounts of Mexican herbal remedies, found that in Mexico there were significantly greater proportions of remedies for infectious diseases, particularly respiratory disorders, diarrhoea/dysentery and fevers (in that order of importance). He took this to indicate that these were, at that time, more prevalent there than in Europe.

The fact that the majority of the plant medicines used by the Yanomami are applied externally (see Table 2), even for internal disorders in many cases, is not unusual among South American tribes. Of the 209 applications recorded among the Tiriyó of Brazil, for instance, 41 were used internally and 168 externally (Cavalcante and Frikel 1973). Among the second category, the majority (119) were used as baths and washes, as is also the case for the Wayãpi Indians (Grenand, Moretti, and Jacquemin 1987). The Wayãpi, like the Yanomami, use most of their medicinal plants singly (266 versus 16 applications), rather than in combinations. Both the Wayãpi and the Tiriyó use similar methods of preparation/administration to the Yanomami, including the softening of leaves in the fire to release their juices, the burning of leaves to ashes for ingestion or external application, defumation of the afflicted part of the body with heated or burning aromatic plants, rubbing of grated leaves or bark into the skin, application of poultices, etc.

That the existence and breadth of the knowledge of medicinal plants amongst the Yanomami has only recently come to light merits attention. One possibility is that the knowledge is to some extent a regional phenomenon, and that other detailed studies amongst other groups of Yanomami would not reveal the same quantity of data. It is hoped that this will become clear in future work. Another possibility is that the Yanomami groups visited previously by ethnobotanists had already reached the stage of having lost the majority of their traditional medicinal knowledge—a position in which the Watorikɨtʰeri Yanomami may well find themselves in the near future. It may also be that the intense interest demonstrated during previous studies on shamanic medicine and its associated hallucinogens diverted attention from the use of medicinal plants. The fact that plant medicine was traditionally practised primarily by women (although this was no longer the case at Watorikɨtʰeri), but that most ethnobotanists who visited the area were men, may also be of some significance.

The discovery of a number of plants which are used against malaria was interesting. Since the invasion of their lands by gold prospectors in the late 1980s, malaria has been a very serious health problem amongst the Yanomami, reaching epidemic proportions and causing numerous deaths. Although this was largely under control at the time of study thanks to the efforts of various health organizations, it remains a significant threat. The initial malaria epidemic was particularly savage in the highlands of the Serra

Parima, where the people had not, on account of their isolation, been previously exposed to the disease. However, the population bloc to which the Watorikɨtʰeri belong had maintained regular contact with the Catrimani/Toototobi Yanomami who entered the neighbouring lowlands in the first decades of the 20th century, and who probably encountered malaria at some time between the 1920s and the 1940s. These Catrimani Yanomami were in contact with *balateiros* (latex collectors) in the 1920s, and the Border Commission (CBDL) and the Indian Protection Service (SPI) entered the Catrimani/Toototobi area at the beginning of the 1940s.

Thus it seems probable that the anti-malarial plants collected at Watorikɨtʰeri (which are currently being investigated for their pharmaceutical properties at the University of Brasília) were discovered by these groups within the last 70 years. Although there are references to certain of these species or their congeners being used elsewhere to treat fevers etc., only one (*Aspidosperma nitidum*) appears widely to be used to treat malaria. It is unlikely that the properties of these plants would have been learned by these south-western Yanomami from other tribal groups, since their immediate neighbours had been extinct as independent peoples since the end of the 19th century, although a few remnants of the Pauxiana (Caribs) and the Bahuana (Arawaks) lived on the Catrimani and Demini rivers respectively until the first decades of the 20th century. Instead, at least some of them may have been discovered through experimentation, possibly using bitterness (*koaimi*) as an indicator of their likely activity. This association of bitterness with anti-malarial properties is very commonly encountered amongst the indigenous peoples of Roraima (W.M., pers. obs.).

The Yanomami have, however, been in extended contact with neighbouring tribes in the more distant past (see Albert, loc. cit.) and it is more than likely that they have adopted at least some of their plant medicines from them. A potential example of such a transfer of knowledge was observed during the 1993 study visit when Davi Kopenawa, who lives at Watorikɨtʰeri and has travelled widely both within and outside Brazil as a spokesman of the Yanomami people, was assisting with medicinal plant collection at Homoxi. He noticed a small herb which he had observed being used to treat itching by the Makuxi Indians, and brought the plant (*Scoparia dulcis* L. [Scrophulariaceae]—a species widely used in phytotherapy) back to Watorikɨtʰeri where it caused considerable interest amongst the other men, who had not formerly recognized it as a useful plant, nor indeed had a name for it.

It has already been mentioned that at Watorikɨtʰeri the knowledge of medicinal plants has largely been transferred, inadvertently, from the women to the few remaining older men within the last twenty years. However, there is no sign that the oral transfer of this information is being perpetuated within the male line as it used to be among the women. The young men of the village, who are periodically subjected to increasing external influences (including the presence of researchers in their village), are apparently showing little interest in acquiring this type of traditional knowledge, whose benefits are far from obvious in the light of the current availability of modern medicines. Amongst the older men, who provided the information but who rarely actually used the medicines, there was occasionally considerable discussion over the manner in which the plants were used (see Methods). Within the next decades these men will have died, and most of that information will almost certainly have been lost from the oral tradition. If nothing is done to prevent this from happening, then the potential value (direct or indirect) which that knowledge might have had for the Yanomami will have been lost, but more importantly the people of Watorikɨtʰeri will have lost part of their ability to support themselves independently on their own lands, and will have moved a step nearer towards a scarcely controllable dependence on the outside world.

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