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Medicinal Plant Selection Criteria among the Tzeltal Maya of Highland Chiapas, Mexico

by

John Allen Brett

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Medical Anthropology

in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA

San Francisco

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DEDICATION

This research is dedicated to my mother, Janet A. Brett (deceased), whose love and encouragement were so important to my sense of worth.

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ACKNOWLEDGMENTS

Many people and organizations aided in the execution of this research. Although I cannot name them all, I thank them all. I would especially like to thank the members of my committee, Dr. Fred Dunn, at UCSF, Dr. Brent Berlin and Dr. Tom Duncan at UCB for their encouragement and support through the various stages of the research process. While working in Mexico, the staff and resources of PROCOMITH made difficult work easier, and definitely more fun. Dr. Dennis Breedlove at the California Academy of Sciences was very generous with his time and expertise, making the task of plant identification an interesting and enjoyable task. Special thanks go to my wife, Susan Niermeyer, whose presence and medical expertise made fieldwork immensely more enjoyable and productive. To my family I owe much thanks for their constant support and encouragement which made the whole process bearable.

Finally, special thanks go to the people of San Juan Cancuc without whose warmth, openness and generosity, this research would have been neither possible nor as exciting as it was.

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ABSTRACT

Medicinal Plant Selection Criteria among the
Tzeltal Maya of Highland Chiapas, Mexico

John A. Brett

This research addresses questions concerning the criteria utilized by Tzeltal Maya of Chiapas, Mexico in their selection and use of medicinal plants. It has been demonstrated repeatedly that many medicinal plants have the potential of beneficial pharmacological activity when used according to indigenous practices. Likewise, it has been widely reported that people in traditional societies have a deep, empirically based knowledge of the natural environment. The primary focus of this research is a description and analysis of these empirical skills as related to the evaluation and choice of plants as medicines. Taste and smell characteristics figure large in the assessment of medicinal plants. This chemosensory information on the underlying biological and chemical properties of the plants is interpreted according to cultural expectations of medicinal activity and efficacy in the definitional process. Specific taste and odor qualities are consistently used to treat particular classes of illness. There is a very clear understanding of the proximate and ultimate outcome arising from use of the medicine. Different taste and odor qualities call into play different expectations of medicinal process and activity. This study addresses the interface between cultural beliefs about health and illness and the biologically based empirical skills people utilize to identify and prepare bioactive medicinal plants. As such it represents an important contribution to our understanding of the dynamics of medical systems and people's knowledge and utilization of their environmental resources.

The research was conducted using a methodology based on structured and semi-structured ethnographic interview techniques. Interviews were conducted in two settings: 1) On plants known and used as medicines by individual informants, and 2) on plants in a medicinal plant garden, chosen for their frequency and consistency of use based on previous collections in the community and their pharmacological potential from the chemical literature.

Frederick Dunn
14 March 1994

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Introduction

This research sought to discover, describe, and analyze the criteria utilized in the selection of medicinal plants by the Tzeltal Maya of Chiapas, Mexico. The major questions driving the research included: What are the properties noted by people when they decide that some plants are medicinal while others are not? Out of the vast number of plants available for use, why are relatively few used or considered as valuable medicinals while most others are not? What do Tzeltal Maya know about their medicinal plants that lead them to believe that they are indeed medicinal? What are the ethnomedical beliefs and practices that inform and condition the selection, use, and expectations of medicinal plants?

A study of how medicinal plants are selected by traditional peoples is viewed as an important and timely question that complements and extends our knowledge of the ways in which humans come to understand and utilize their environmental resources (Alcorn 1981b; Alcorn 1984; Messer 1978; Posey 1984a). The focus on medicinal plants is significant because these plant species are purposefully sought out for their perceived value in treating disease and ill-health. As such, medicinal plants represent a distinct category of the biological world, being at once part of the natural vegetation (the Tzeltal, for the most part, do not keep medicinal plant gardens), yet represent a culturally recognized category by virtue of their understood value. They are defined as plants with medicinal value because they meet cultural expectations of what a medicinal plant should be like and what it should do in the context of illness. The definitional process is a complex weaving of

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plant biology (as organoleptic properties), pharmacological potential (potentially toxic secondary compounds), understanding of illness processes, and the anticipated outcome from therapy that interact to identify a plant as medicinal. Ethnomedically a plant is explicitly defined as medicinal not necessarily because of anything inherent to the plant but largely because of what it does to or for the sick person.

The significance of this research is the description and understanding of how indigenous peoples recognize the phytochemical properties of plants, some of which likely have demonstrated pharmacological value. An understanding of the manner in which indigenous peoples perceive potential bioactivity is an important component of our efforts to comprehend how illness (disease) is understood and how therapy is directed toward symptom relief and healing.

Within the field of ethnobiology considerable effort has been devoted to the classificatory and nomenclatural aspects of peoples' knowledge of the biological world (Berlin 1972; Berlin 1976; Berlin 1992; Berlin, Boster, and O'Neill 1981; Berlin, Breedlove, and Raven 1973; Berlin, Breedlove, and Raven 1974; Boster 1984; Brown 1979; Brown 1986; Diamond 1966; Hays 1979; Hunn 1977; Hunn 1982; see Berlin 1992 for a recent, thorough review). It has been repeatedly demonstrated that there are recognizable patterns in the way any given society classifies and names the organisms in their environment (Berlin 1992). Very little attention has been focused on identification, the process by which one type of organism is distinguished from another. While the criteria employed in the

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identification of medicinal plants may be complex, it is argued that some, if not most, of them could be elicited from knowledgeable informants by the methods of medical ethnobotany and formal ethnography. An important assumption at the outset of this research was that people explicitly understand why they use the plants they do as medicines. Thus, when asked why some plant species is medicinal, it was hypothesized that informants could state: "This is a medicine because..." This hypothesis was borne out in the course of the research; the Tzeltal have a remarkable depth of knowledge on medicinal plants and many of them had no difficulty elaborating in considerable detail why individual plants were medicinal, and equally important, why many plants were not medicines.

Johns (1986) and Johns and Keen (1985, 1986) have indicated that taste and the detection of potentially toxic compounds in potatoes affect the "...ways by which humans select plants for chemical constituents..." (Johns 1986:266). In particular they consider the role of taste in selecting against possible toxic levels of glycoalkaloids in tuberous root crops, especially potatoes. An obvious extension of this focus is consideration of the role of taste and smell in the selection of medicinal plants for their chemical constituents. If, as Johns and Keen (ibid.) have demonstrated, humans can detect potentially toxic compounds (or co-occurring compounds), what role does this chemical detection ability play in the determination of a plant species as potentially medicinal? How does the ability to recognize, categorize and evaluate tastes and odors operate within cultural expectations of what makes a good medicine?

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Several authors have noted the apparent deliberate behavior of mammals, especially primates (most often chimpanzees), in seeking out and consuming plants which are not a usual component of their diet (Huffman and Seifu 1989; Janzen 1978; Phillips-Conroy 1986; Wrangham and Nishida 1983). As documented by Wrangham and Nishida (1983) chimpanzees deliberately harvest and eat leaves of *Aspilia* spp. (Asteraceae), often sampling with tongue and lips before picking, and then carefully rolling in the mouth and swallowing whole. Subsequent phytochemical analysis (Rodríquez et al. 1985) isolated chemicals of definite pharmacological potential. Huffman and Seifu (1989) strongly suggest a link between an ill chimpanzee and her having sought out and consumed *Vernonia amygdolina* (Asteraceae), a plant almost never consumed as part of the regular diet, and which was ignored by all other members of the band. They noted a marked improvement in her condition the following day.

In both cases the plants are clearly identified as distinct from regular food plants in the manner in which they are selected and consumed. Similarly, both plants are important medicinal species used by local peoples, primarily for gastrointestinal illnesses. If primates can identify and remember medicinal plants based on chemical perception it is reasonable to argue that humans have a similar skill.

The investigators of PROCOMITH (Programa de Colaboración sobre Medicina Indígina Tradicional y Herbolaria, a research team studying highland Maya medical ethnobiology in Chiapas [Berlin et al. 1986, 1989]) had identified 13 descriptive terms in Tzeltal and Tzotzil that describe the character of a plant's healing properties.

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These terms refer to sensory perception of plant characteristics (especially taste and smell). Preliminary research that I conducted in the summer of 1990 indicated that when questions of taxonomy or medicinal value arose, positive identification was usually made after a careful inspection of the specimen's morphology, odor and taste. Thus, biological and chemical components clearly serve as important criteria to identify and define plants as medicinal. These sensory terms are fundamental to an understanding of the identification, evaluation, and valuation of plants, although they represent only one half of the process.

It has been demonstrated that other factors may affect medicinal plant selection. The understandings of health, illness, and bodily function as derived from the ethnomedical system inform the expectations and therefore the choice of medicinal plants (Alcorn 1981a; Alcorn 1984; Bastien 1983; Browner 1985a; Browner 1985b; Browner and Ortiz de Montellano 1986; Etkin 1988a; Messer 1975; Messer 1978). While socio-cultural factors are of critical importance to a complete understanding of the role of the ethnopharmacopoeia in the folk medical system, inclusion of these variables was initially seen as beyond the scope of this research. The focus of the research was to be primarily on the biological and chemical factors that appear to be operating in the definition of plants as medicinal. Socio-cultural factors such as humoral quality and the doctrine of signatures were to be included only to the extent to which they could be demonstrated to have phytochemical correlates. As the research progressed it became apparant that it was not possible to divorce the biological from the cultural. To do so would have resulted in an

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inaccurate picture of the role of medicinal plants in the Tzeltal response to ill health. To have ignored the fundamental importance of cultural factors would ultimately have led to a failure of the study as originally proposed. Nevertheless, the integration of the biological and chemical criteria with other aspects of medical beliefs and practice still represents a major focus for future research.

Emphasis on ethnomedical work in the Chiapas Highlands has until recently been largely devoted to the more cosmological aspects of healing (Fabrega 1972; Fabrega and Silver 1973; Holland 1963; Metzger and Williams 1963; Nash 1967; Vogt 1976). A less well investigated aspect of Highland Maya ethnomedicine is the healing/curing response based on pragmatic therapies, especially medicinal plants. A major thrust of the PROCOMITH project has been to catalog all of the plants considered to be of medicinal value in 14 Tzeltal and Tzotzil municipalities, to identify and describe the folk syndromes in terms of their biomedical equivalents, when such exist, and to produce a multilingual medicinal ethnobotanical atlas on regional medicinal plant usage (Berlin et al. 1989). The large amount of ethnomedical and ethnobotanical data generated in this project permitted the asking of fine-grained questions such as those researched here.

The field of ethnopharmacology has been much concerned with finding medicinal plants with pharmacological value (Bastien 1982; Bruhn and Helmstedt 1981; Davidson and Ortiz de Montellano 1983; Farnsworth 1980; Lozoya 1978; Lozoya and Zolla 1982; Malone 1977; Schultes 1972; Schultes and Raffauf 1990; Waller 1993). A more recent effort has been the development of methods aimed at more

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efficiently identifying those plants within a pharmacopoeia that are most likely to exhibit pharmacological activity (Berlin et al. 1988; Heinrich et al. 1992b; Johns, Kokworo, and Kimanani 1990; Linares, Peñafiel, and Bye 1988; Malone 1983; Moerman 1979; Moerman 1989; Ortiz de Montellano 1986; Trotter, Logan, Rocha, and Boneta 1983; Trotter and Logan 1986). Parallel to this activity in ethnopharmacology has been a similar emphasis on the context of medicinal plant use in ethnobotanical studies (Bastien 1987; Browner 1985a; Browner, Ortiz de Montellano, and Rubel 1988; Elisabetsky 1986; Etkin and Ross 1982; Etkin 1979; Etkin 1986; Etkin 1988b). The emphasis in much of this work has been to identify the interdigitating nature of biological and cultural factors in the use and value of medicinal plants. The questions addressed in this research contribute to this literature by beginning to elucidate indigenous knowledge about the biochemical properties of plants with probable pharmacological or medicinal properties. An understanding of the manner in which sociocultural processes operate in the perception of potential bioactivity in medicinal plants is an important component of our efforts to comprehend medical systems.

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General outline of dissertion:

Chapter One is a brief ethnographic introduction to the Tzeltal community of Cancuc where this research was conducted. Although relatively little ethnographic work has been carried out in this particular municipality, general cultural patterns do not differ significantly from those of surrounding municipalities where much more extensive research has been conducted. However, recent social

and political changes have resulted in substantial structural changes, the consequences of which will be tremendous.

Chapter Two covers the methodology used in this study. A combination of structured, semi-structured and open-ended ethnographic interview techniques in combination with observation of, and to the degree possible, participation in the realm of health, illness and healing.

Chapter Three contains a discussion of the "medical system" as it is relevant to this research. It is not a complete description because that was not the focus of the research.

Chapter Four is a detailed discussion of the role of taste and odor in human affairs and the way in which chemosensation is used to identify potentially medicinal plants.

Chapter Five discusses the cultural context of chemosensation in the selection and evaluation of plants as medicines. All chemosensation is interpreted according to cultural expectations of those sensations and their possible role as medicine and the consequences of their use.

Chapter Six is a summary of the findings of this research, a discussion of some of the theoretical consequences, and where this type of research proceeds from here.

There are four appendices, A-D. Appendix A contains the data collection forms used in the structured and semi-structured interviews; Appendix B describes and, where possible, defines the ethnomedical illness terms collected in this study; Appendix C is the rated severity of illnesses as measured by the pile sort exercise, and

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Appendix D contains definitions and examples of each of the chemosensory quality terms collected during this research.

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Chapter 1

Ethnographic Description of Cancuc

Cancuc is a Tzeltal-speaking municipality (municipio)[1] of about 21,000 persons (1990 Census) located in the central highlands of Chiapas, Mexico, see map, figures one and two. It is bordered by the municipalities of Ocosingo to the north and east, Chenalhó and Pantelhó to the north, Tenejapa and Oxchuc to the northwest and west respectively. It shares many common features with other highland Mayan groups in economy, religious activity, history, society and politics. Very little has been written about Cancuc, per se, but much has been written the about neighboring Tzeltal and Tzotzil speaking municipalities. While there are unquestionably significant local differences, the broad characteristics described for these neighboring municipalities apply equally to Cancuc. Ethnographic descriptions have been written for Oxchuc (Siverts 1969; Villa Rojas 1990; Gomez Ramiriz 1988), Tenejapa (Medina 1991) San Pedro Chenalhó (Guiteras Holmes 1961; Arias 1990), Zinacantan (Vogt 1969), and Chamula (Pozas Arciniega 1959; Aguilar Penagos 1990); the Tzeltal and Tzotzil in general (Laughlin 1969; McQuown and Pitt-Rivers 1970; Villa Rojas 1969; Vogt 1966). Additionally, brief mention is made in a number of early surveys: (Blom and LaFarge 1927; Siverts 1965; Starr 1902; Starr 1908).

One feature unique to Cancuc relative to other highland communities is its newly achieved status as an independent municipality. This much heralded, and probably much overdue, event has occasioned many changes in the community, especially of

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an infrastructural and economic nature, but inevitably, social and cultural, as well. I will discuss these changes in more detail below.

The highlands of central Chiapas (Chiapas Plateau, *Mesa Central* or *Altaplanicie de Chiapas*) are characterized by steep, rugged, predominantly limestone, mountains with generally poor soils (Mulleried 1957), a marked dry season, and a variety of floristic associations (Breedlove 1981). The exact floristic formation varies according to altitude, rainfall patterns, slope aspect and soils (ibid.). Phytogeographically Cancuc was originally a mixture of Pine-Oak-Liquidamber Forest and Pine-Oak Forest, depending on altitude and slope aspect (Breedlove 1981:16-19). At present most of the territory is in various stages of permanent secondary successional communities (Breedlove 1981:24). Millennia of slash and burn type agriculture combined with recent substantial increases in population, and the intensification of cattle production (introduced shortly after Conquest) and the introduction of coffee (within the last 15 years) as cash crops have largely eliminated any mature stands of forest. There is one exception in large stands of pine *Pinus pseudostrobus* that are protected for their yield of *ocote* ('pitch pine') important for starting fires and use as torches. While these areas appear to have been pine-oak forests at one point, the oaks have been reduced by harvest (coppicing) for firewood to shrubby multistem trees seldom over 3 meters tall. Scattered throughout the community are large tracts of woodlands (parklands) used for pasturing the few local horses and raising of cattle.

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Language

Tzeltal is one of the 25 (Kaufman 1970) Mayan languages spoken in Southern Mexico and Central America and shares many affinites with Tzotzil, the other major language of the southern Mexican Highlands (Hopkins 1970). The Cancuc dialect is a member of the Northern Tzeltal group (Hopkins 1970) and is most similar to the neighboring dialect of Tenejapa. According to the 1990 census 35-45% of the population is bilingual, speaking both Spanish and Tzeltal. This number indicates those individuals who have some knowledge of Spanish although most men can conduct only the most basic conversation in Spanish, while very few women can speak more than rudimentary Spanish. Those who have finished grade school and/or who have worked extensively in the lowland coffee plantations will often have control over basic Spanish. Like many other features of life in Cancuc, this is changing rapidly as increasing numbers of children complete secondary school and opportunities to work outside the community for extended periods become more readily available and increasingly necessary as land shortages become more acute.

History

Historical linguistic reconstruction (Kaufman 1970; Kaufman 1977; Campbell and Kaufman 1985) and very limited regional archaeological work (Adams 1961; Lowe and Mason 1965) indicate that ancestral populations to modern Tzeltal and Tzotzil speakers probably moved into the highlands in the 7th century A.D., during the Mayan Early Classic Period, probably coming from the Peten (McQuown 1956) with Tzotzil diverging as a separate language between 1000 and 1500 A.D (Hopkins 1977; Kaufman 1977).

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Subsequent to the collapse of Classic Mayan society (A.D. 900) the highlands appear to have become more isolated and seem not to have been much affected by, or involved in, the various waves of Central Mexican expansion (Adams 1961:348).

The Spanish conquest in what is now Chiapas began in 1524 and was largely concluded by 1528 (Gosner 1984; Vogt 1969) Gosner suggests that because of the paucity of exploitable resources in the highlands the primary Spanish economic activity was the establishment of *encomiendas*, often to supply labor for lowland sugar plantations. These met with limited success in part because of restrictions placed on the encomienda system by the church and the crown, but more likely because of severe depopulation of the indigenous populations in the 16th century (Gosner 1984). With one notable exception, the colonial history of Cancuc is unremarkable and shares essential features with all of southern Mexico and certainly with the highlands. These central features included ongoing Spanish attempts at economic exploitation of the limited highland resources, the struggle between colonists wishing to maximize their economic gain and the Spanish Crown's need to realize a profit from their colonial investment; the Catholic church's conflicting interests between maintaining and/or enriching themselves and protecting their converts/charges from over-exploitation by secular colonists; repeated plagues of locusts and/or contagious European diseases, etc. Full discussions of these various issues may be found in Barnadas (1984); Chance and Taylor (1985); de Landa (1978); Gibson (1987); Gosner (1984); Leon-Portilla (1962); McNeill (1976); Rus and Wasserstrom (1980).

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In 1712, Cancuc was the point of origin of the only widespread Indian rebellion against Spanish colonial authority in Chiapas.[2] (A similar rebellion in Chamula in 1868 was more localized.) The rebellion is best characterized as a revitalization movement that succeeded in attracting support and converts from a large number, but not all, of the highland Indian towns, Tzeltal, Tzotzil, and Chol (Gosner, 1984:126). While the Indians were vastly superior numerically and were highly motivated, the effort was ultimately doomed to failure because of superior Spanish armaments and horses, the dependence of the movement on the continued belief in the Cult of the Virgin enshrined in Cancuc, internal conflicts, and poor management on the part of the Indian religious and military leaders (Bricker 1981; Gosner 1984; Klein 1966; Villa Rojas 1947; Wasserstrom 1980).

Although the rebellion has been much discussed, the subsequent history of Cancuc has not been much considered (Esponda Jimeno and Chapoy Licéaga 1990 [1984]). What is known is discussed in Esponda and Chapoy (1990 [1984]) and will be summarized briefly here. The community was destroyed in the process of putting down the rebellion, as were Oxchuc and Huixtán (Gosner 1984), and the town moved to what is now the hamlet (paraje) of Chak Te' near the river of the same name, about 7 km northeast of the present location and 1000 meters lower in elevation. No mention is made of when the original church and monastery in Cancuc center were destroyed or by whom. This impressive ruin is located in the area now generally referred to as Pokoj Na (old church) about 1 1/2 km east of the present church on the road to

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Oxchuc. (The area is used now principally as grazing for local horses, mules, and burros and, being one of the few flat, treeless spaces in the community, as the landing site for the helicopters ferrying dignitaries in and out.) Presumably the move to the lowland site facilitated administration and control by the Spanish (and later, Mexican) authorities at Ocosingo which, until 1989, had administrative control over Cancuc. The Cancuc community sought permission to return to the higher elevation site as early as 1730 citing the bad climate and illness at the lower site. (At about 600 meters, Chak Te' is very hot and humid and presently has a fairly high incidence of malaria.) When they were actually allowed to return to their mountain site is unclear. Documentary evidence locates the municipal seat (*asentamiento*) in Chak Te' as late as 1819, and a French explorer/ethnographer, Teobert Maler, refers to the "new" Cancuc when he passed through the highland site in 1877 (Esponda Jimeno and Chapoy Licéaga 1990 [1984]). A map dated 1868 (Guiteras Holmes 1990) clearly locates the center of Cancuc on the highland site. Standing in opposition to this is community lore which has the current church having been built approximately 250 years ago (~1740) along with the understanding that the church and community in Chak Te' were occupied for "only a few years". It is difficult to determine the age of the current church; I was unable to locate a dated cornerstone or any other indication of date of construction. The building is in a state of advanced decay and badly in need of (and reportedly scheduled for) major rehabilitation.

While the community was eventually allowed to return to the highland site, Cancuc remained within the administrative jurisdiction

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of Ocosingo. This has long been a point of contention because the people of Cancuc identify themselves as distinct from those of Ocosingo, and perhaps more importantly, state that economic resources budgeted for Cancuc never seemed to make it out of Ocosingo, contributing substantially to the continued isolation and poverty of Cancuc. Esponda and Chapoy (1990 [1984]) state that since 1979 a small group of Cancuc men had been seeking status as an independent municipality, though they don't cite a source for this date. In the community the struggle (*la lucha*) is said to have been going on for at least 18 years and some say as long as 30 years. I would be more inclined toward the more conservative of these two time periods since the man most credited with orchestrating the effort is the current municipal president (Lorenzo Domínguez Pérez), a man of about 40 years of age.

Independent municipal status was finally achieved officially in 1989. This was a sufficiently momentous occasion that the President of Mexico (Salinas de Gotari) and the Governor of Chiapas (González Blanco Garrido) made a special ceremonial visit to attend the inauguration. This served as the opportunity for the Mexican government to launch (or announce) a major development scheme that has had tremendous impact on the community. There had been scattered development efforts prior to this: The completion of the road from Tenejapa in 1979 (poorly maintained and often unpassable, but now being renovated) and another from Oxchuc (completed in 1986); the construction of the main health clinic by the Instituto Méxicano de Seguridad Social (IMSS) in 1979 (about 1 km below the town center in Barrio Yaxa' on the road to Tenejapa);

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various water projects, largely involving enclosing wells and piping water into the town center from a larger well to the north and the construction of clothes washing basins near permanent water sources; the construction of the community run CONASUPO store ('Consejo Nacional de Subsistencias Populares'), designed to provide basic commodities at subsidized prices; construction of warehouses for coffee and honey (both largely unused the year of the fieldwork referenced here); construction of a primary school and an *escuela telesecundaria*, 'television boradcast secondary school. I have my doubts about the value of this last project because there was no reliable source of electricity before March 1990.

The changes to the community since achieving status as an independent municipality are staggering and the cost of construction must have run into the millions of dollars. The town center (including the primary school and the old *cabildo* or town hall) was razed completely, leaving only the church, and was rebuilt in a grand style, including a much larger *cabildo* ('town hall'), *casa de cultura* ('house of culture'), *casa de mujeres* (women's center'), *casa de DIF* (*Desarollo Integral Familiar*, 'Integrated Family Development'), *tiendas de artisenales* ('artisans stalls'), and a large central plaza complete with bandstand. These are all in the Mexican architectural style, down to the planting of *Ficus benjamina* and oleander (*Nerium indicum*), both common plaza and park ornamental species in tropical Chiapas.

Electricity was promised to all households in the community and was first turned on in March of 1990 (indicating that plans and construction had begun long before the August 1989 dedication).

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This project required tremendous commitment of resources on the part of the community. Most of the other construction projects were carried out by outside laborers brought into the community, a point of some contention in the community. While engineers and technicians were involved throughout the process, the majority of the labor was locally supplied on a volunteer basis.

A brief example will indicate the difficulties involved. Trucks brought the major power transmission poles into the town center and unloaded; these poles then were carried to placement sites by local Tzeltal men. Each of the major poles is made from reinforced cast concrete and required a minimum of 52 men to carry it, more on very steep territory. There are dozens of these large poles throughout the municipality and hundreds of intermediate and small distribution poles made of welded steel. Each of the major poles required one to three days to carry to the placement site, plus an additional several days to get the hole dug and the pole erected. While the labor rotated among the men of the community, it was viewed as a major demand which took men away from their usual economic activities.

In those places where it was deemed impossible to bring in power lines, the houses and schools were supplied with photovoltaic cells, three 12 volt batteries and fluorescent light fixtures. Only during the foggiest, rainiest weather do these fail to produce at least a few hours of light.

A third major effort was the construction of new schools. The primary school had been in the town square next to the *cabildo* and was razed with the rest of the older buildings. The new, much larger

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school was built ~1/2 km below the plaza. A large, but immediately undersized, secondary school was built in Barrio La Gloria about 2 km northeast of the plaza. This is a nonresidential school serving the entire community. All instruction is in Spanish (vs. bilingual in the primary grades) and has a decidedly technical orientation with agronomy being one of the more important and popular topics. While technically free, students must purchase any extra books and all supplies. Students who don't live within walking distance or who don't have family living nearby must rent a room, placing considerable strain on household resources, if not preventing some students from attending.

One of the fundamental difficulties in highland Indian communities, and especially in Cancuc and Oxchuc, is limited potable water due in large part to rapid runoff through the porous limestone surface. While the government has been active over the last 10-15 years improving wells, primarily by enclosing them and consolidating smaller ones, the fundamental limitation has been that there simply is not enough water for the number of people who need it. During the dry season (late February to late May in Cancuc) many of the smaller wells dry up completely and larger wells slow to a trickle. It is not uncommon to find women waiting to get water at two a.m. when it takes only 30-45 minutes to fill up a 15 liter water jar. In the fall of 1992 a water distribution system was being built in the town center. While the expected arrival was still 9 months to a year away, water was being piped from the neighboring municipality of Tenejapa. Households could request that water be brought to their house site or elect to carry water from one of

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several community standpipes. Those who choose to have water on-site must pay a monthly users fee, as they do with electricity, ostensibly for maintenence.

Another major project begun in the fall of 1992 was a road from Cancuc to the municipality of Huaquitepec and Tenango in Ocosingo. This is part of the state's effort to provide vehicle access to all of the major population concentrations in the highlands.

Finally, the last major development project was the vastly increased amount of money made available for low interest loans, usually for the construction of houses or small stores. This was a very popular program and many people went happily into debt in order to have their new house. However, there was a dissenting opinion. Some individuals were unwilling to go so deeply in debt (up to U.S.$350) in an economy where there was no regular or guaranteed income for the majority. Prices for local produce (honey, pork, coffee, labor) are largely set by outsiders and can flucuate widely, making it difficult to anticipate expenses in light of uncertain income. While the required monthly payment was quite low (~U.S.$1.50), it must be paid to avoid a penalty. This represents a potential problem in that each of the major development schemes (housing, electricity, water) requires a monthly cash fee, but there has been little change in peoples' ability to generate cash.

Economy

While income earning opportunities have increased recently, the people of Cancuc are above all subsistence farmers on private and communal land. With the exception of very few individuals, if one doesn't plant *milpa* (agricultural fields of corn, usually with

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beans and squash interplanted), one does not eat. This fundamental fact of life drives their routine and largely defines their primary preoccupation. If coffee production is bad or the prices are absurdly low (as they have been the last several years), or if the honeybees die, then there will not be cash for consumer goods. But if the milpa is bad or untended then there will be hardship and hunger. Increasingly people worry about producing enough corn to last the year. Writing in 1944, Guiteras Holmes (1990 [1947]) indicates, somewhat ambigously, that most people have enough land and can produce adequate corn and beans for the year. This is still the case but people perceive it as increasingly difficult to insure adequate supplies and it is not uncommon for families to have to buy corn before the harvest. The five-fold increase in population, from an estimate of 4000 in 1944 to over 21,000 in 1990, and of equal importance, the pressure placed on land supply by the planting of coffee has made the enterprise of producing food difficult and tenuous. People complain of now having to use fertilizer routinely to ensure good yields, and often, especially for younger men, fields are 3-4 hour walk from where they live. Ideally, each family has access to land in both high, cold, country and low, hot, country. This distribution allows for a more secure production cycle because the low country fields can be planted 2-3 months earlier than cold country fields, reducing the potential shortfall of food at the end of the agricultural cycle, just before harvest. Weather patterns are also surprisingly different between the two regions, so it is best to have fields in both locales in the event of drought in the lowland fields or hailstorms in the highland fields. This pattern is shifting, largely

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because coffee must be planted in the middle and low zones, forcing a shift of corn production to the higher fields.

Cancuc specialized in the production of pigs, chilis, and to a lesser extent cotton, in years past (Guiteras Holmes 1990; Starr 1902). In recent years production effort has shifted away from these locally tradable commodities to products destined for the larger national and international markets, principally coffee and honey. Local enterprise still figures large, as more money comes into the community, both as a result of construction workers who spend locally, an increasing number of young people leaving the community temporarily to work, and as a result of people having cash from coffee sales, etc. there are increased opportunities to provide services within the community. The most popular activity is the *tiendita* (little store), which appears in increasing numbers in ever more remote locations. If they are within 5 km of a road these stores will most likely be selling soft drinks, carried in from the road. It is not uncommon on delivery days to see cartons of empty soft drink bottles stacked along the side of the road, often attended by a woman and children, waiting for the delivery truck to come by with a new supply. Additionally these stores may sell candles, rice, canned fish, matches, cookies and candy, school notebooks and pencils, flashlights, batteries and the like. Other cash producing activities include shoe repair, radio/tape player repair, basic electrical installation and repair, carpentry and house building. Each of these activities is secondary to the milpa: the stores will be closed, shoes remain unrepaired, and houses don't get built during periods of intensive agricultural activity.

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For the majority of the people of Cancuc, the primary cash producing activity appears to be coffee. Increasing numbers are also trying their hand at honey production. A few are attempting to begin cattle production but this is largely constrained by available pasture. Pigs and chili peppers are still raised by a few. Cotton is only occasionally raised and then only for household consumption.

Coffee growing is largely an individual/family enterprise, while the honey and cattle production tends to be undertaken by *cooperativas*, 'cooperatives'. The planting of coffee has set in motion a complex set of interacting factors that may have serious long-term consequences for the community. Cancuc, like all highland communities, has a mixture of private land holdings (usufruct) and communal lands that may be used by anyone. Although I have not studied this systematically, what appears to be happening is that as people plant coffee on their private land holdings, they are turning increasingly to communal lands for basic food production. Secondly, a small number of people, characterized by some as greedy, but also people without land of their own, are beginning to plant coffee on communal lands, effectively making them private land holdings for the 30 year duration of the coffee grove, and thus removing them from the pool of available food producing land. This set of factors, in combination with population increase, has changed fundamentally the land use patterns in Cancuc, and what was described in the recent past as an area largely covered with primary forest (Pitt-Rivers and McQuown 1964) is now largely devoid of primary forest of any significance. This is a process that has largely occurred or accelerated tremendously in the last 10 years. Areas a mere thirty

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minute walk from the center of town contained trees too large to put ones arms around when men now in their mid twenties were teenagers. Although the price of coffee has been abysmal for several years now, well below production costs, the drive to plant more and more coffee continues apace.

The cooperatives for honey and cattle operate somewhat differently, one from the other. Honey cooperatives act primarily as buying and selling groups, allowing members to get volume discounts, and to share expenses on equipment. At peak labor times, members work together, building new hives, removing the honey, taking it to market, etc. Because of the ability to bring a relatively large amount to market at once, the cooperatives can command higher prices for their honey. Of equal importance, they have greater leverage with the, all too often, less-than-honest Ladino buyers in San Cristóbal. A single producer cannot do much if the buyer fails to pay when they promise, but the cooperatives can take their business elsewhere, and they are often sponsored by INI (Instituto Nacional Indigenista) and file a grievance through the local office. Each member is largely responsible for their own hives, although members work cooperatively during the setup or moving of large groups of hives and during the extraction period. The cattle coops are buying organizations and work groups, sharing in the profits when the animals are sold as calves to the lowland ranches or are slaughtered as adults and the meat sold at one of the regional markets, or locally.

Chili peppers, peanut, and vegetable growing (cabbage and onions primarily), and pig, chicken and turkey raising are family

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enterprises. The small animal husbandry is usually the responsibility of women and children. Only those with land in the hot country can produce chilis and it is considered to be a great deal of work for a modest return.

A final, variable cash producing activity is to hire oneself out as wage labor, principally to the large coffee plantations or cattle ranches in the lowlands. This is viewed as a method by which to "get a little cash" since it must be fit in around the regular agricultural activity. Many men have spent at least some time working on the plantations and ranches, especially in their younger years. With the introduction of coffee production to Cancuc both the motivation and the time to go to the lowlands has changed. The coffee harvest in the lowland plantatations generally begins between the last weeding of the season in August and the harvest of the corn in December and January. This was traditionally the time when one might go to the lowlands to work. Coffee harvest in Cancuc generally begins in October and runs through December or January. Consequently, only those without coffee continue to opt for work in the lowlands, either on coffee plantations or cattle ranches. Another pattern, increasingly important, is for young men and occasionally women to leave the community to work for a period of time in the cities. Jobs are commonly menial and low level: "house boys", maids, janitorial, or if the young person did well in school and is highly motivated they may get a job in a store as a clerk or a restaurant as a cook or waiter. Those in the former category often move back to the community after several years, deciding that life in the mountains is no worse than that in the cities and at some level more predictable. For those

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with the motivation, there are opportunities (though difficult at best) to continue with schooling to become teachers, engineers and public employees of one sort or another.

Figure 1.1 is a map of the municipality showing most of the named settlements and the main trails within the community. Figure 1.2 is a map showing the relative position of the Cancuc in Chiapas and Mexico.

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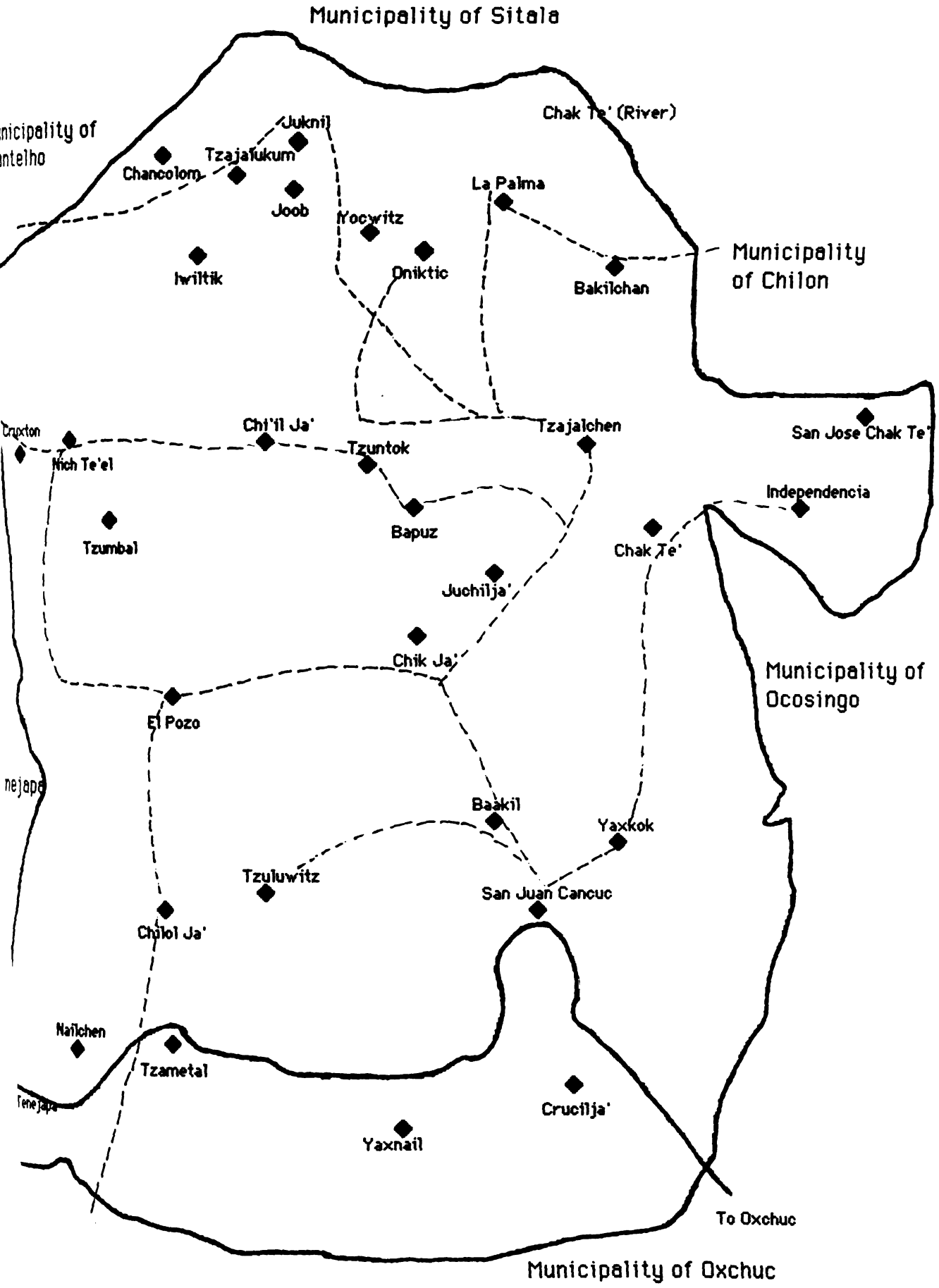

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e 1.1, Map of Cancuc and surrounding communities. Dashed lines indicate main trails through community.

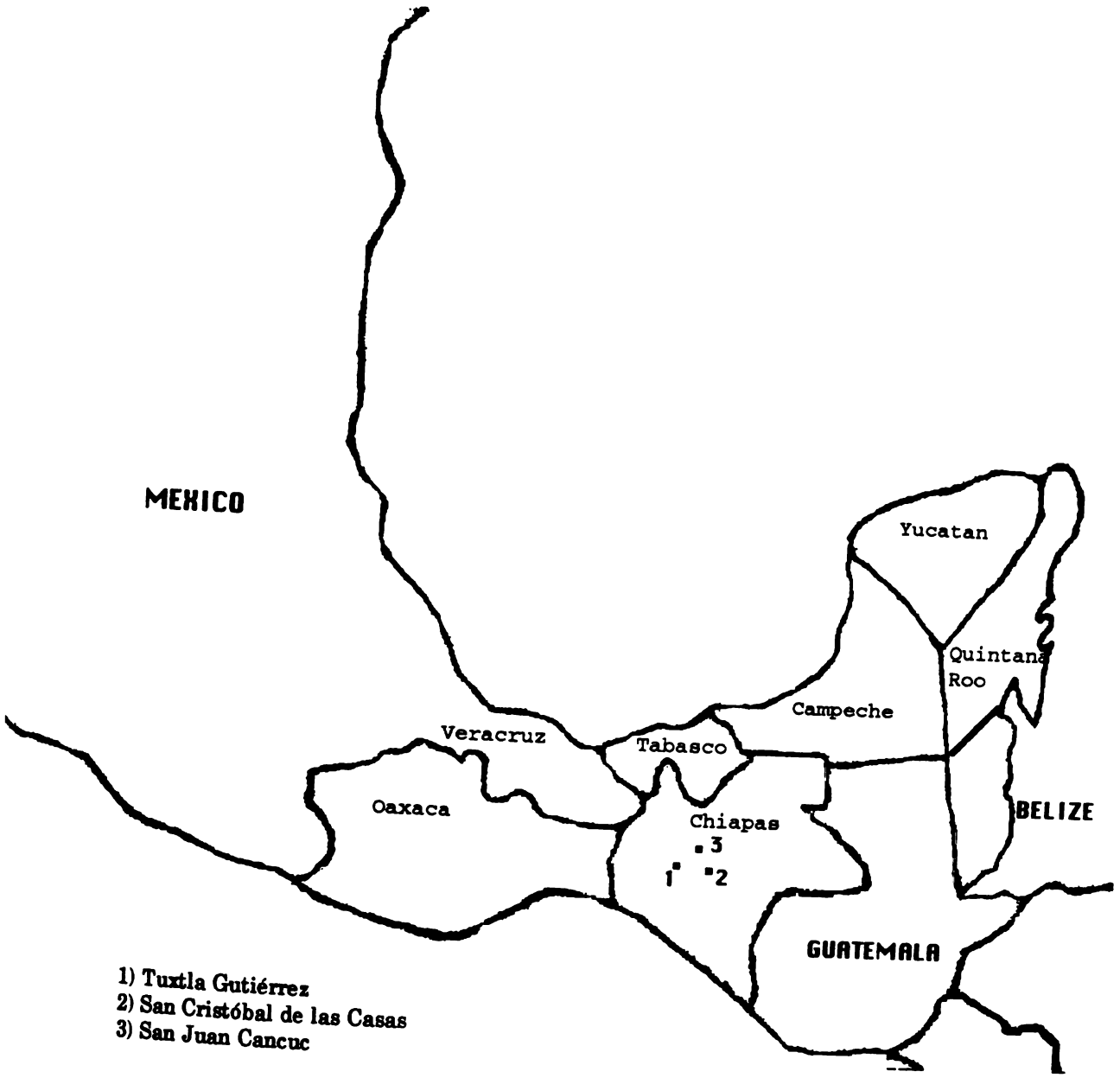

Figure 1.2, Map of Mexico showing state of Chiapas and the relative positions of the State Capital, Tuxtla Gutierrez, the highland city of San Cristobal de las Casas and the Municipality of San Juan Cancuc.

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Chapter 2

Methodology

The research methodology used to collect the data reported on in this study was a combination of structured, semi-structured, and informal interviews, as well as sytematic botanical collection of medicinal plants and the establishment of a semi-experimental medicinal plant garden. The types of structured and semi-structured interviews used derive philosophically from the ethnoscientific tradition in anthropology. These methods permit collection of very detailed, in-depth data on a particular domain of human activity, in this case the evaluation of medicinal plants. The informal ethnographic interviews provided contextual data which aids in elaborating the formal data from the structured interviews.

Field research was carried out over a period of 16 months, divided into three field stays. The first, in the summer of 1990, was essentially reconnaissance. The very limited projects of that summer were designed to explore the feasibility of the research I was proposing as a dissertation topic. The second field stay, from June of 1991 to June of 1992 was the major research period. The final field trip was from September to November of 1992 and was designed to follow-up on a number of questions that had emerged both during the fieldwork period and from preliminary analysis during the summer of 1992.

Funding for this research was provided by a variety of sources. The first summer field trip was facilitated by a travel grant from the Center for Latin American Studies at the University of California,

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Berkeley and in-field support from National Science Foundation grant BNS 87-03838, Brent Berlin, PI. Funding for the bulk of the fieldwork was provided by a National Science Foundation Dissertation Improvement Grant (grant #BNS-9108662) and a Predoctoral Grant-in-Aid from the Wenner-Gren Foundation for Anthropological Research (grant #5387).

Primary data were gathered in four general arenas: 1) During plant collection field trips with informants; 2) in a series of intensive interviews utilizing a special medicinal plant garden; 3) in attendance at healing ceremonies and informal open-ended interviews; and 4) during informal interviews over a range of health related topics.

From August of 1991 until June of 1992, my wife, Susan Niermeyer, a physician, was in residence in Cancuc, conducting a WHO sponsored study on Acute Respiratory Infection. Her help was invaluable as an informal medical consultant during this study.

Plant Collection Field Trips

Plant collection field trips were made with a wide variety of informants, of varying age, temperament, and experience. Plants were generally collected in the area of the informant's choosing, usually where the informant had his primary agricultural fields. It rapidly became clear that informants were most familiar with the plants in the area where they had grown up and had done most of their farming. The informants' knowledge of a particular region was based on their familiarity with the local flora, but also was strongly influenced by altitude. As noted before, the highlands in Cancuc are rugged and extremely steep resulting in substantial climatic, soil and vegetational differences at high vs. low altitudes Relatively few

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people could productively collect in both the low, hot lands below, and the high, cold lands above the town center because often their experience was largely limited to one or another area. The collections range from some of the lowest regions of Cancuc (185 m), near the river Chak Te' to as high as 2100 m and were collected at all times of the year to ensure collection of the widest possible number of plants as proper botanical specimens (i.e., in flower).

Plants known by the informants were collected as they were encountered while walking through the countryside, usually covering 8-15 km per daily collecting trip. Often informants knew where their preferred plants were to be found which usually provided the focal point of the collecting journey. Additional plants were collected as we walked to and from the site.

Field trips with each informant continued until it became clear that we had exhausted the plants known to him. I collected with particularly knowledgeable informants a number of times over the course of the year in order to make as complete a record of their knowledge as was reasonably possible. In the first half of the study I went out on the daily collecting field trips with the informant and a bilingual collaborator. During the second half of the study, when I was doing the garden interviews, the collaborator went out alone with the informants. They would usually return from the field about the time we were finishing up on the garden interviews and I could then review the plants with the informant, sampling them for taste/odor and exploring in more detail particular points noted on the the interview form.

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All collections were made according to standard botanical collecting strategies with the full complement of ethnomedical data as suggested by Croom (1983) and developed and implemented by PROCOMITH, with amendments made to suit the needs of this study (see Appendix A). The majority of botanical determinations were made by Dr. Dennis Breedlove, Curator, Department of Botany, California Academy of Sciences (CAS). Additional determinations were made by other members of CAS and the University Herbarium of the University of California, Berkeley: Frank Almeda, Director of Botany, CAS, Bruce Bartholomew, Collections Manager, CAS, John Strother, Assistant Curator (Berkeley), and Alan Smith (Berkeley). Herbarium vouchers of each plant are deposited at Herbolario Etnobotanica de Chiapas (HECH) of PROCOMITH in San Cristóbal de las Casas, Chiapas, the Instituto de Historia Natural in Tuxtla Gutierrez, the University of California, Berkeley Herbariums (UC), and at the Herbarium of the California Academy of Sciences in San Francisco (CAS). A set of the 51 most common and widely used medicinal plants has been mounted with "trilingual" labels and donated to the community of Cancuc. These labels had in the lower, right hand corner a standard ethnobotanical label in Spanish and Tzeltal. Most of the population in Cancuc are essentially illiterate and so picture labels were developed and affixed to another corner of the herbarium sheet. These labels depicted the essential information on what the plant was used for and how it was prepared. Figure 2.1a and 2.1b contain an example of each type of label.

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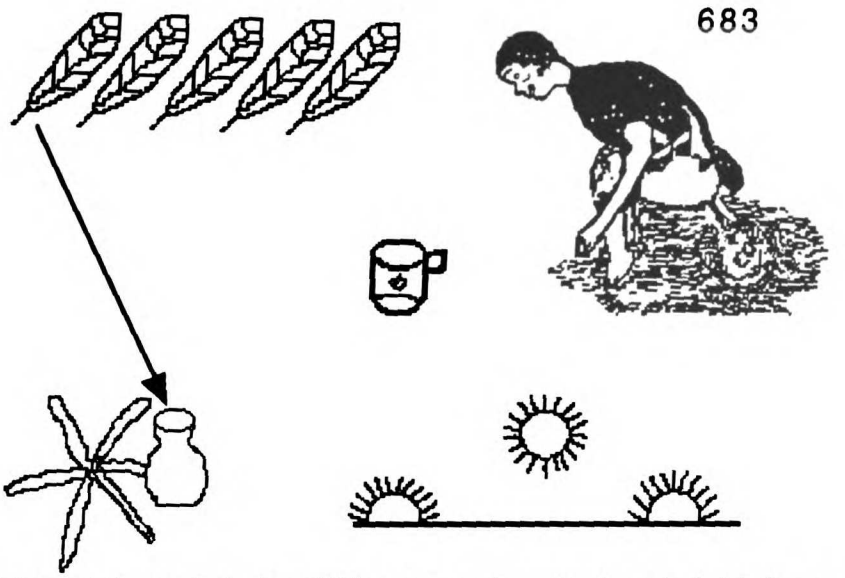

Figure 2.1a: Label attached, in addition to regular ethnobotanical labels, to mounted plants given to the community of Cancuc at the completion of the fieldwork for this project.

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Plantas Medicinales de San Juan Cancuc, Chiapas, Mexico

Erigeron karwinskianus DC. AST

Camino a Tenejapa 6900' roadside vegetation

Hierba de 30 cm, flores blancas

Nombre Tzeltal	sakil nich wamal		
Uso medicinal	ja' ch'ujt		diarrea
Parte utilizada	yabenal		hojas
Preparación/administración	tenbil/uch'bil		machucado/tomado
Informante	Manuel Lopez Gomez	Colector	John Brett
Número	683	Fecha	01/21/92

Collected in collaboration with PROCOMITH (Programa de Colaboración sobre Medicinea Indígena Tracdional y Herbolaria). Supported by funds from the National Science Foundation and the Wenner-Gren Foundation for Anthropological Research. Determinations by D.E. Breedlove.

Figure 2.1b: An example of the standard ethnobotanical label attached to all collections from this project.

Plant collection field trips represented one major data gathering strategy and generated information useful in evaluating the relationship between plants, the illnesses they are used to treat, and the chemosensory quality of the plants. These data were entered into a computer database for analysis.

Another major data gathering strategy involved a series of systematic interviews using plants in a small medicinal plant garden next to my house. The plants included in the garden were selected on the basis of their frequency and consistency of use as determined by analysis of earlier PROCOMITH collections from Cancuc and on the basis of pharmacological potential based on the chemical content of the plant. This last point was designed to attempt a rough test of the relationship between the pharmacological nature of the plant and the way in which the plant was used and evaluated as medicine. Analysis of this portion of the study must await future effort because of the complexities of pharmacological analysis of medicinal plants.

The medicinal plant garden was small (2 x 4 meters), contained 25 species, and included a variety of life-forms. Table 2.1 includes the names, families and a brief description of each of the plants included in the medicinal plant garden.

There were two primary purposes in planting the medicinal plant garden. The first was to provide living plant material for use as common stimuli for intensive interviewing with the most knowledgeable informants. The other main purpose for the garden was to facilitate the inclusion of women in the study. Social and work constraints made it impossible for women to participate in the field collection of plants, yet women are often noted for their healing

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skills and possibly present a unique perspective. Given the public nature of the garden and the proximity (in most cases) to their homes, it was possible for women to participate without undue difficulty. A third use, unintended, was to demonstrate that a medicinal plant garden was a definite possibility for Cancuc. Unlike the Yucatan and other places in Mexico and Central America, home garden plots are uncommon among the Tzeltal Maya. The garden excited a great deal of comment and discussion among local healers and young people.

Completion of the interviews for all of the plants in the garden required 1-3 days, depending on how many of the plants the informant was familiar with, how detailed their answers were, and the number of interruptions we suffered in the course of the day. On several occasions we took cuttings from the garden to the houses of informants, who for reasons of age, infirmity, or social relations could not come to the garden. This worked quite well in all cases.

Plant #	Plant name	Family	Plant type
1	*Acacia angustissima* (Miller) Kuntze	FAB	small tree
2	*Ranunculus petiolaris* H.B.K. ex DC. var petiolaris	RAN	herb
3	*Salvia karwinskii* Benth.	LAM	large herb
4	*Solanum lanceolatum* Cav.	SOL	shrub
5	*Brugmansia candida* Pers.	SOL	shrub/small tree
6	*Cordia spinescens* L.	AST	shrub
7	*Chromolaena collina* (DC.) King and H. Rob.	AST	herb
8	*Fuchsia microphylla* ssp. *quercetorum* Breedlove	ONA	shrub
9	*Piper jacquemontianum* Kunth.	PIP	shrub
10	*Bidens pilosa* L.	AST	herb
11	*Phyllanthus niruri* L.	EUP	herb
12	*Erigeron karwinskianus* DC.	AST	herb
13	*Euphorbia graminea* Jacq.	EUP	herb
14	*Cissampelos pareira* L.	MEN	vine
15	*Polygala floribunda* Benth.	POLY	shrub
16	*Hibiscus uncinellus* DC.	MAL	large shrub
17	*Clematis grossa* Benth.	RAN	vine

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18	*Alloispermum integrifolium* (DC.) H. Rob.	AST	shrub
19	*Salmea scandens* (L.) DC.	AST	shrub
20	*Pluchea odorata* (L.) Cass.	AST	shrub
21	*Eryngium ghiesbreghtii* Decne.	API	herb
22	*Brickellia adenocarpa* var. *glandulipes* Klatt.	AST	shrub
23	*Arthrostema ciliatum* R. and P.	MEL	succulent shrub
24	*Cuphea pinetorum* Benth.	LYT	woody herb
25	*Verbena litoralis* H.B.K.	VER	herb

Table 2.1 Plant used in the garden interviews.

In both plant collection field trips and the garden interviews, a semi-structured interview format was used for data collection. (All forms used in this study are included in appendix A.) This semi-structured format insured consistency of questioning, but was open-ended in nature, allowing flexibility to pursue interesting or important points. This strategy proved very productive of rich data, especially in the garden interviews. All interviews were conducted in Tzeltal with the help of a bilingual collaborator.

The third major data gathering strategy was to attend and participate in a number of healing ceremonies covering a wide range of illnesses. Illness treatments covered a broad range of different conditions, from simple coughs through complex multiday events for major witchcraft induced illnesses. Some of the illnesses treated were *me'winik* (See Appendix B) in a young girl, *k'ajk'al obal* ('fevered cough') in a small child, *muk'ul chamel* ('large illness') or *sikil chamel* ('cold illness') in a middle aged man (probably Parkinson's), psychosocial problems on the part of a young man, "transverse fetal presentation", a house blessing, *jul bak sik* ('arthritis'). The purpose of these visits was to develop some sense for the context in which plant medicines were used and to examine the relationship between ritual and empirical use of plant medicines.

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The fourth area of data collection involved open-ended ethnographic interviewing which was used to explore disease/illness categories, definitions of terms, the general nature of curing, methods of preparation of medicines, witchcraft, and general life in the community.

In conjunction with the above main strategies, I also employed a number of structured interview techniques, or systematic interviewing, as suggested by Weller and Romney (1988). These were designed to generate data on the relationships among illnesses, the understood (perceived) severity of particular illnesses, the relative strength of the taste and smell terms used to evaluate medicinal plants, etiology of illnesses, commonality of particular illnesses, and their relationship to a dichotomous humoral system of classification of hot/cold, common throughout much of Latin America. The structured interviews were of several types: triad tests were designed to test the relative severity of the 58 illness terms and the relative strength of the chemosensory quality terms applied to medicinal plants. In a departure from the usual format of "pick the one that is most different", I asked the informants to tell me which was the most powerful (qualities) or the most severe (illnesses). This necessitated a different analysis than is usually the case. When asking "choose the one most different", there is an implied relationship between the two remaining categories (they are more similar to each other than either is to the one chosen as most different), but by asking "choose the strongest" I required informants to tell me about the relationship between the one chosen and the two not chosen. There is no implied relationship between the two not

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chosen. The triad tests were conducted with each of the individuals who participated in the garden interviews as well as the 7 individuals I interviewed during the third field stay. The triads tests were conducted by explaining the aim of the experiment, practicing with the first 3-5 questions, and then administering the test.

The triads were read one line at a time to the informant, who then chose the item he/she felt was the strongest/most severe among the three. This continued until the full series was completed. In order to reduce boredom, the structured interviews were interspersed among other interviews, e.g., garden interviews, plant collections, etc.

Because 58 illness terms is a number vastly too large to put into a single triad test, the illnesses were broken up into ethnomedically related groups. This was accomplished by asking 17 informants from the community to go through the list of 58 illnesses (on index cards) and answer the question "Does this illness have any companions?", which is to say "what other illnesses are like this one?" Analysis constituted listing the frequency for each of the illness concepts occurred with each of the other terms on the cards across all of the interviews. For example *batz'il obal* (basic cough) occurred 8 times with headache (*k'ux jolobel*), 11 times with fever (*k'ajk'*), one time with 'cold' (*sik*), once each with bodyaches (*k'ux bak'etubel*), throat pain (*k'ux nuk'ul*), and "airway pain" (*k'ux be'ik'il*). Then, in order to group them I started with the card for *batz'il obal* and placed with it all those conditions (of the 58 original illnesses) that were mentioned as companion illnesses more than twice. I arbitrarily set a threshold of two or more occurrences for

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inclusion in the final list. I then continued on to the next illness, starting a new pile (*bel bel on*), adding to it all of the illness cards with which it was said to occur. When I came to a term that was already included in with another illness, a pile was started with that card, going in a different direction. In this manner something of a network of related conditions was developed. (The exception to this was *k'ajk'*, which occurred with substantial frequency in a variety of groups. This is not surprising when one considers that fever occurs with many conditions. There also appears to be a difference in the significance of *k'ajk'*; it may refer to a fever of the body or a fever of a region as one might experience with an inflammatory skin condition.)

When the experiment was completed, 6 categories emerged that roughly corresponded to biomedical groupings by region/organ system affected:

Gastro-Intestinal: *lukum, cha' lam tzotz, nujk'ul ch'ujt, ch'ich' tza'nel, sin ak'al tza'nel, obal tza'nel, k'ux ch'ujtubel, ja' ch'ujt, pumel, ch'ixal yak' mis* (or *wakax*), *bik'tal tza'nel, tza'nel, k'ajk', xenel,* and *tumin k'in ch'ajaw.*

Eye conditions: *mak sitil, sit chay, sak nok, tokal, ch'ul chan, sit mut, k'ux sitil, cha' nujkul.*

Inflammatory and ulcerating skin conditions: *chay k'ajk', tzajal paslam, sijt'el, paslam.*

Wounds and sores: *bel bel on, xoch, ejsel, sijt'ubel, sijt'el, chakal, ixim chakal, bujk' echen, chin, k'ael.* A second grouping of skin conditions appear to be discrete entities, e.g. scabies or boils: *sep chin, sal, muk'ul chin, k'ajk'et chin.*

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Respiratory sorts of conditions: *jul bak sik, k'ux bak'etubel, jik' jik' obal, tzon kok, k'ajk'et k'in ch'ajaw, tuk'ul ch'ujt, k'ajk', tzajal chuel, k'in ch'ajaw, k'ajk'al obal, sik k'ajk', k'ux jolobel, simal obal, batz'il obal.* There were three conditions that failed to group anywhere: *k'ux o'tanil, muk'ul chuel, and sak obal.* Each of these groupings served as the basis of the construction of a triad test. Triads were constructed using ANTHROPAC, version 3.0 (Borgatti 1990).

A second important interview series consisted of a number of constrained pile sorts (Weller and Romney 1988). The purpose of the pile sorts was to establish etiology, the hot/cold status, the perceived commoness of occurrence, and the severity of each of the illnesses. They were constrained in that informants only had a choice of two or three categories in which to put each of the illnesses. This was necessary because nearly all of the informants were illiterate and it is difficult to conduct pile sort exercises with people who cannot read using an unlimited number of categories (Bernard 1988). The pile sort consisted of four sequential tasks, each with different headings under which to group the illness names. As the illness names were read and assigned to a pile, the number on the card was noted in my fieldnotes for later decoding. The four tasks consisted of 1) *sikil chamel* or *k'ixin chamel* ('cold' or 'hot' illness); 2) *batz'il chamel, smantal ta rios,* or *ak'bil chamel* (natural, from God, or witchcraft); 3) *komun chamel* or *ma ba tekuk* (common/not common); and 4) *ip'al chamel,* or *ma ba ip'al chamel* (strong/not strong). These categories were derived from preliminary analysis of the plant collection data and from informal interviews with informants and field assistants. The pile sorts were administered to

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the men who participated as informants in the plant collection field trips, several of the women in the garden interviews, and all of the informants in Cruxton (third field stay).

The following three tests were conducted with informants in Cruxton, a hamlet (paraje) of Cancuc, during the third field stay in the fall of 1992. They were designed largely to test the results of preliminary analysis of data gathered in the first part of the study.

Taste/Odor Experiment

This test was developed with three ideas in mind: 1) to identify or clarify the cultural basis of taste and smell terms; 2) utilize the same sensory stimuli with each informant to gain an understanding of what the various terms applied to medicinal plants signify from the perspective of Cancuc Tzeltal; and 3) to relate Tzeltal terms to tastes and odors familiar to Western tastes.

The underlying assumption for this procedure is that humans perceive the same basic sensations, but that there are (or may be) distinct cultural interpretations of "good" and "bad" or powerful/useful tastes or smells. While we are all capable of sensing the same tastes and odors, we may attend to, or evaluate them in a different fashion based on cultural expectations of odor/taste quality.

The following items were presented to informants: Fresh, and dried, powdered ginger root, commercial tea spice (Taj Majal brand; ingredients: ginger, black pepper, black cardamom, green cardamom, cinnamon and nutmeg), powdered Chinese style hot mustard (China Bowl brand), Hershey's brand unsweetened cocoa, Tiger Balm salve (Tiger Balm Ltd.; ingredients: Cajeput oil, camphor, menthol, and clove oil), salt (iodized table salt, La Fina brand), Sugar (unbleached

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Mexican sugar sold in bulk), instant espresso, mixed strong (Nestle's brand), Essential oils of cinnamon leaf, spearmint, and lavender applied to strips of filter paper (Aura Cacia brand, Weaverville, CA), fresh garlic, and sandalwood incense.

1) Each item was presented one at a time, in random order, noting that nothing is toxic, all edible.

2) The informant was asked to evaluate the substance and state its qualities.

3) What illness could this treat, if it were available for use in Cancuc? How would they prepare it?

4) Observe carefully the process of evaluation, odor->taste, odor alone, etc.

Hot/Cold Test

Using the 24 plants from the garden interview as pressed specimens, a test was done to clarify the dual nature of plants as *sik* ('cold') or *k'ixin* ('hot') and a chemosensory quality. It became apparent during the plant collection field trips that plants were often known to have a particular taste or odor, but were nevertheless defined as being hot or cold. This test was designed to establish the relationship among taste/odor, hot/cold, and the illnesses treated. This was to be complementary data to that in the pile sorts. It was assumed that using the plants from the garden interview, which were frequently collected plants from the PROCOMITH collections would increase the likelihood that more (most) of the plants would be known. This point assumes that the plants are frequently collected because they a) are common, and/or, b) are frequently used for common conditions.

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Procedure: The plants [as dried pressed specimens] were presented to informants one at a time with the following questions:

1) Name of plant?

2) What is it used for?

3) What is its quality?

4) Is it sik? (*Sik bal*)

5) Is it k'ixin? (*K'ixin bal*?)

The aim was to get through the entire series in 30-40 minutes with a minimum of boredom. The exercise worked well though I only have complete data for 5 informants.

Sentence frame substitutions

The sentence that was used/translated was: "A plant that is _____can be used to treat_____. " (Una planta que es_____, se puede usar para curar _____.) In Tzeltal: "*Ini jun wamal toj binti a _____ ya xtuun ta ya xpoxtik_____*. The first blank was to be filled in with one of the quality terms and the second was to be filled in with an illness term.

Procedure: These were done in random order using index cards. The answers were written in the fieldnotes as coded statements B1, B2, B3, etc. followed by a + or - to indicate positive or negative response to the statement. The quality terms will be written on file cards with each being assigned a letter (A-L) and each illness term was assigned a number (1-34). Thus each entry, when combined with the informants initials, would be unique, A-1, C-6, etc. I began with a quality card, then went through each of the illness cards asking the above question, noting the yes/no answers, on to the next quality card and pass through the pile of illness cards once again, etc., until

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all of the quality cards have been processed. The illness terms were randomized (shuffled) before each quality term.

Several taste/odor terms were not included in order to keep the exercise within reasonable bounds: *sak'* and *kojoj* because they are very uncommon, *jik' jik' xial* because I think it is probably the same or nearly so as *jik'jik'yik'* and is very uncommon, and *xuch'* because it is fairly unambiguous in texture and use, and is uncommon.

The 58 health conditions used as a basis of the structured interviews were chosen on the basis of the apparent biological manifestation that each presented. Because the focus of this research was primarily on the biological and empirical bases of medicinal plant selection, the illnesses considered were, to the extent that it could be determined, only those for which a relatively unambiguous biological component could be identified. Health conditions that appear to be primarily psychological, and those for which the description is incomplete, were not included. As can be seen in the descriptions of illnesses in Appendix B, health conditions are various named diarrheas, many different kinds of skin conditions, respiratory ailments, etc. Illnesses whose primary manifestation appeared to be intrusion objects, or which clearly had to do with behavior, were excluded. The health conditions utilized in the study were those that were most frequently mentioned in the ethnomedical databases of PROCOMITH[3], and which had the least ambiguous biomedical equivalents. Whenever possible, health conditions were viewed by myself, my physician wife, and one of the collaborators in the study, a well known local healer. These visits

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were designed to obtain a brief medical assessment/description of the health conditions, as well as a description of the health condition by the curer; the aim being to correlate the salient ethnomedical signs and symptoms of the afflicted person with, biomedical signs and symptoms. The visits were particularly useful for skin, oral, and eye conditions which figure large in the Cancuc scheme of illness. It was thus possible in some cases (too few) to match the descriptions with a brief biomedical examination. These are noted in the illness description in Appendix B with an *.

Informants

Informants were generally chosen based on their knowledge of medicinal plants. At times during the plant collection field trips, it was apparent that a couple of them clearly did not know much about plants. These were young men that my collaborator had chosen because their fathers were very knowledgeable men. It was his assumption that if the fathers knew a lot, then their sons should as well. Twenty years ago this might have been the case, but in this day of primary education, radios and relatively easy transport to the city, many young people choose not to learn the plants. Informants were paid the standard Mexican rate for day labor. Tables 2.2 (plant collection interviews) and 2.3 (garden interviews) give a breakdown of the informants.

Initials	Age	Sex	Type of healer
MVV	45	M	jpik k'abal, ch'abajom, jpoxtawanej
DDT	55	M	jpik k'abal, ch'abajom, jpoxtawanej
APP	50	M	jpik k'abal, ch'abajom, jpoxtawanej
JPR	38	M	jpoxtawanej
JCG	48	M	jpoxtawanej
ACS	44	M	jpik k'abal, ch'abajom, jpoxtawanej

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ESC	55	M	jpik k'abal, ch'abajom, jpoxtawanej
SHG	58	M	jpik k'abal, ch'abajom, jpoxtawanej
MGC	60	M	jpoxtawanej
PLL	35	M	jpoxtawanej
PDR	30	M	jpoxtawanej
JPR	40	M	jpoxtawanej
APM	55	M	jpik k'abal, ch'abajom, jpoxtawanej
MGS	45	M	jpik k'abal, ch'abajom, jpoxtawanej
MHL	27	M	jpoxtawanej
AGP	50	F	jpik k'abal, ch'abajom, jpoxtawanej
MDS	25	M	jpoxtawanej
MHL	28	M	jpik k'abal, ch'abajom, jpoxtawanej
MGL	37	M	ch'abajom, jpoxtawanej

Table 2.2, informants participating in plant collection. *Jpik k'abal* is one who can diagnose illness by pulsing, *jch'abajom* is one who can cure by prayer (knows how to pray), *jpoxtawanej* is a general term for healer, but in this context means one who knows plants.

Initials	Age	Sex	Type of healer
SHG	58	M	jpoxtawanej
SSH and ALS	75/80	M/F	jpik k'abal, ch'abajom
ESC	55	M	jpik k'abal, ch'abajom, jpoxtawanej
JGL	26	F	jpik k'abal, ch'abajom, jpoxtawanej
ACS	44	M	jpik k'abal, ch'abajom, jpoxtawanej
CRT	72	F	jpik k'abal, ch'abajom, jpoxtawanej
AGV	57	F	jpik k'abal, ch'abajom, jpoxtawanej
MCS	69	M	jpoxtawanej
APP	50	M	jpik k'abal, ch'abajom, jpoxtawanej
AGC	50	F	jpik k'abal, ch'abajom, jpoxtawanej
DDT	55	M	jpik k'abal, ch'abajom, jpoxtawanej
MVV	45	M	jpik k'abal, ch'abajom, jpoxtawanej
MPM	27	M	jpoxtawanej
SGM	58	M	jpik k'abal, ch'abajom, jpoxtawanej
AHG*	48	M	jpik k'abal, ch'abajom, jpoxtawanej
DHG*	45	M	jpik k'abal, ch'abajom, jpoxtawanej
JGS*	28	M	jpoxtawanej
LSL*	25	M	jpoxtawanej
NPS*	45	M	ch'abajom, jpoxtawanej
MMS	70	M	jpik k'abal, ch'abajom, jpoxtawanej

Table 2.3, informants in the garden interviews. See Table 2.2 for definitions of terms. *Individuals who participated in the various experiments in the fall, 1992 field season, but who did not go through the garden interviews.

Data were managed on a Macintosh SE/30 personal computer (Apple Corporation) using the Panorama database management

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program (v. 1.5, Provue Development) and Microsoft Word (v. 4.0) (Microsoft Corp.)

This research was submitted to and approved by the Committee for Human Research at the University of California, San Francisco, and at the University of California, Berkeley.

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Chapter 3

Medical Practice and Beliefs

For the purpose of this discussion we can think of the Mayan approach to treatment of illness as composed of two complementary (indeed, inseparable) components. One part addresses ill health from a spiritual perspective and is deeply involved with issues of witchcraft and one's relationship with God[4] and the community. The bulk of the research on healing and medicine among the Highland Maya has focused on the spiritual and symbolic with only passing mention being made to the strategies of intervention based on empirical aspects of illness treatment, e.g., the use of plant-based medicines and other rational activities (e.g., Guiteras Holmes 1990; Villa Rojas 1990). Curing is considered to have taken place when the person has been pulsed (diagnosed) and the appropriate prayer and ritual have been executed. The degree to which this perspective resulted from the professional interests and orientation of the various ethnographers vs. the actual attention to plant use on the part of the people (e.g., of Oxchuc in 1943) is difficult to assess. The number of times Villa Rojas (ibid.) mentions in passing the use of medicinal plants leads me to believe that his professional interest was concerned with the role of witchcraft as a mechanism of social control rather than as part of the whole process of healing. Prayer and ritual are still a fundamental part of the medical process in Cancuc, but represent only part of the full range of activities directed toward healing.

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The other part of the healing process, which I will refer to as the empirical component of healing, is based primarily on the recognition of the biological aspects of ill-health and its attendant treatment through the proper use of medicinal plants and related practices (Anderson 1991; Berlin and Berlin, et al. in press; Browner, et al. 1988; Chen 1970; Colsen 1971; Etkin 1986). Evidence for an empirical component to medical beliefs can be found in a comparison between the work of Guiteras-Holmes (1990) whose focus, like that of Villa Rojas (1990), was on treatment of illness largely in the spiritual sense, and my own work which focused on plant-based healing. Guiteras-Holmes (1990) notes that *abil chamel* (witchcraft) is treated with "pure prayer" as opposed to plants alone or plants and prayer. *Abil chamel* include a wide range of usually serious illnesses (see below), but in the cases to which she refers--intrusion objects (see *ajk' chamel* in Appendix B)--they can be cured only with prayer. This is consistent with my plant collection data where there are very few collections for the treatment of illnesses caused by intrusion objects and similar kinds of conditions. Thus for those illnesses that are clearly of human agency, arising from envy or spite, the only effective treatment is human agency and the intercession of San Juan (patron saint of Cancuc). This constitutes the bulk of Guiteras Holmes' interest in, or attention to, healing. Like her contemporary, Villa Rojas in Oxchuc, her emphasis was on ritual and prayer as the primary treatment modalities, though she makes one telling allusion to the role of medicinal plants when she states: "When the sick person is not cured with prayer, one looks for a healer [curandero] who knows how to make remedies of herbs and plants"

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(Guiteras Holmes 1990), my translation). The implication is that people with plant knowledge are specialists, called in when all else fails. My data and those of PROCOMITH project (Berlin, personal communication), indicate that medicinal plant use (or a visit to the local vendor of pharmaceuticals) constitute the first line of treatment, with resort to more complex, ritual means if the conditions does not respond to first attempts with plant-based medicines. I expect her relatively short stay in the community prevented her from a thorough exploration of medical practices. In present day Cancuc, the situation is much more complex with a wide range of health-care options not available in her time (Harman 1974). Even so, I would predict that plant use was much more wide-spread and important than can be assessed from her writings.

As is the case in many Mayan (Guiteras Holmes 1990; Villa Rojas 1990; Vogt 1969), and other societies world wide (Foster 1976; Murdock, Wilson, and Frederick 1978), one's social relations with fellow community members figure large in the etiology of illness, and in the treatment of illness and amelioration of suffering. A skillful *jpoxtawanej* will elicit any recent interpersonal difficulties or social transgressions in the course of diagnosis (Fabrega 1970; Guiteras Holmes 1990; Metzger and Williams 1963; Villa Rojas 1990). Many illnesses, especially those which are difficult or severe, are considered to be caused by other persons. The two primary reasons for having been bewitched are some infringement of social norms (e.g., swearing at one's mother-in-law, stealing, or using land belonging to someone else without permission) or envy and anger on the part of others toward one's own success (Guiteras Holmes 1990).

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In effect, it could be argued the spiritual aspect of healing is addressed to the cause of illness, while the empirical aspects tend to be addressed at the physical manifestations of the illness. This is in line with Foster's (1976) assessment of naturalistic vs. personalistic causes of illness and attendant treatment. I will discuss this point in more detail below. My focus in this section will be almost exclusively with the empirical components which have been largely ignored in favor of the spiritual and symbolic (e.g., Fabrega 1970; Fabrega and Silver 1973; Guiteras Holmes 1990; Harman 1974; Holland 1963; Nash 1967; Tedlock 1982; Villa Rojas 1990; Vogt 1976; cf. Berlin and Berlin, et al. in press;).

The complementary and inseparable nature of these components can be seen in the following vignettes of several healing sessions addressed to a variety of illnesses. In each case what is reported is only part of a longer series of healing activities. As is common in highland Mayan healing, the treatment process may involve a number of components in sessions lasting many hours, and occur over a period of days or weeks, depending on the nature and severity of the illness and its response to therapy. In some cases the patient may not even be present for much of the activity. For example, in the second vignette, the candles brought by the woman would be burned and prayers offered to counteract the effects of the witchcraft that had caused her difficulties, but this would be conducted by the curer relatively late at night when there was little risk of his being overheard or disturbed. The patient would be at home in bed with her family to avoid suspicion in the mind of the person who had caused her to become ill.

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Prior to any effort being made toward healing there may well have been an initial consultation during which a preliminary diagnosis might have been made and the healer's participation sought (Fabrega 1970; Metzger and Williams 1963). If the curer agrees, then a time and place would be agreed upon and the healer would instruct the patient or representative on what would be needed in order to conduct the healing ceremony: candles (how many and what size), medicinal plants (sometimes brought by the healer, if not common), alcohol (*chi'l ja'*, sugar cane wine or *pox*, sugar cane liquor, and, increasingly, soda pop), incense, chicken (for ritual meal), etc. For simple illnesses the initial visit and brief curing would conclude the process, assuming the patient improved, while some complex, serious or difficult illnesses have a prescribed regimen lasting several days or weeks. Similarly if the patient or his/her family is not satisfied with the healer, the treatment or the results, they may seek another curer or, not infrequently, additional concurrent care. In present day Cancuc this may be from any one of a number of private dispensaries of Western pharmaceuticals (often referred to locally as "clinics", or "pharmacies"), or from the federally sponsored medical clinic.

On occasion the patient may consult another healer concurrently, but given the competition and distrust between curers, this runs the risk of offending one or the other. This potentially puts one at risk of "suspension of services" or, worse, witchcraft from the offended curer. This process of seeking treatment continues until the patient recovers to everyone's satisfaction or it is decided by the curer that the person will die regardless of future treatment.

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Persons deathly ill (by whatever definition) will often not seek treatment or, equally likely, will not find a healer (including the government clinic and private practitioners) willing to assume their care. Thus an old man in the terminal stages of congestive heart failure will not likely seek treatment, except perhaps palliatives for pain or edema, or an infant who is severely dehydrated and weak from a bout of diarrhea may not be brought or accepted for treatment, especially if the child is very young or the family is short on monetary resources. This was a complaint lodged most frequently against the dispensaries (see below), but there were instances of people being turned away from the clinic, and the *jpoxtawanej* will not hesitate to not accept a patient if they feel the illness is incurable.

This apparently fatalistic attitude arises in part from the understood etiology of severe, life-threatening health conditions. In many cases the person encountered *pukuj* ('spirits'), either "accidentally" while out when these agents are abroad (at night and at mid-day) or from having been bewitched by *abil chamel* (sent illness). If the diagnosis indicates that one's spirit (*chulel*) has been consumed by *pukuj* then death is probably imminent and largely unavoidable.

Vignette #1

The first case concerns a woman of relatively high status and wealth within the community. Her complaint was of chronic neck pain and a lump (not obviously visible) in the side of her neck. She had exercised several other medical options before coming to this particular healer, including a several visits to the local government

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clinic (who failed to diagnose anything), a couple of visits to a physician in San Cristóbal (who recommended surgery), and at least one other *jpoxtawanej* (with whom she was not satisfied). I did not hear a name attached to the condition, but she said her throat itched (*sak'*) a great deal, produced a lot of mucus and had a lump, which was implied to be an intrusion object. The diagnosis had taken place the day before, and it was agreed that the healing would be done the following afternoon. The healer had gone out early in the morning to collect roots of *ib te'* (*Zapoteca portoricensis*, Fab) which was one of his most powerful medicines because "it always cures". In the afternoon after the day's other work was completed, the woman came by, stated that she was ready, then returned home. The healer roamed around his yard until he found an old, broken *mano* (grinding stone) and a suitably flat stone, washed the stones and the root, then pounded a length of the root (80 cm) until the bark was well loosened and slightly macerated. The whole was placed in an old can with about 400 ml of water and set on the fire to boil. The can was tended by the man's wife and allowed to boil vigorously for about seven minutes, removed from the fire and poured into an enamel bowl, yielding a greenish-yellow liquid that had a vague chicken-broth like smell. The bowl was then placed in front of the healer (seated) who prayed over it in order to give it strength to heal. He picked up the bowl, held it between his knees, blew on it six times, then began praying, literally, over it. After about five minutes he raised the bowl to directly in front of his face, elbows on knees, blew five more times directly into the medicine and began praying again, ignoring the comings and goings around him. He prayed for

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about five minutes, blew into the medicine five more times, crossed himself and set down the medicine. His wife poured the medicine into a Pepsi bottle and placed it in the bucket on the fire containing the corn for the following day. Shortly thereafter the patient arrived with a large number of candles, including some very long ones[5] (1/2m), hidden in her *huipil*. After exchanging preliminary greetings, the healer blew three times on the side of her neck that hurt and began to pray[6], eyes open but unfocused; praying for about five minutes, blew on her neck four more times and offered the medicine. The patient was instructed to take 1/2 (drinking) cupful (about 40ml), three times a day for three days. She drank the first cup slowly, grimacing and complaining that it was *ya* (picante). She left two bags of commercially prepared *masa* (tortilla) mix (2 kg. each) in partial payment and departed for home. The healer burned the candles and prayed at greater length later in the evening. This process continued over several days until the patient began to feel better or again decided to seek other treatment options.

Vignette #2

The second vignette involves a woman with severe arthritis in her back (*xtiawan jul bak sik*). She had spoken with the healer earlier in the day and he had told her which plant to collect and how to prepare it. The plant was *ich'il wamal* (probably *Polygonum punctatum*) which had been ground into a fine, pulpy, bright green mass. We arrived in the late afternoon, sat down inside her house, door open admitting the late afternoon sun and, with minimal interaction, the healer pulsed[7] the patient to determine the cause, extent and severity of her illness. After about five minutes of

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listening to her blood he took a wad of the plant material and wiped it liberally (*lakbil*) on her right side from scapula to waist. He then sprayed *pox* from his mouth onto her back three times, drinking that which remained in the cup, and began praying; he then signaled me to pour a drink with which he sprayed the patient twice, drinking the rest, and resumed praying more fervently than previously; the patient sat absolutely motionless. After about 10 minutes she was pulsed again after indicating that she has pain in a variety of places. Thereafter followed a long discussion about various aspects of illness and treatment, including several stories of others who have been sick and cured or not cured. Thirty minutes later the curer began again, spraying the patient with *pox*, drinking the rest, and resumed praying, but with a different set of prayers, while the patient peeled chayote root (*Sechium edule*). He finished praying, sprayed her with *pox* three more times, drinking the rest, and began praying yet again, still more fervently, pausing briefly before blowing gently twice on the woman's back and again taking her pulse to determine the status of the illness. He delivered a long lecture on health to the woman's oldest daughter who left shortly thereafter. He sprayed her back with *pox* two more times, drank the rest, blew three times gently, began praying again. This day's healing activities concluded shortly after dark, having lasted approximately two hours. Tomorrow he will use a different plant and burn candles with more prayer with the aim of calling back and restoring her soul (*ch'ulel*).

The interrelatedness of the spiritual and the empirical can be seen easily in this example. The patient is afflicted with severe arthritis, not surprising in a woman of about 50 years who has

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labored under tremendous loads all of her life. The cause is viewed as her soul having become separated from her body which can only be cured via the intercession of the *jpoxtawanej* and his ability to communicate with God, seeking the intercession of San Juan (patron saint) and/or against evil persons who have effected this illness. But the medicine used, *Polygonum punctatum*, produces local vasodilation which makes the area feel very warm, very much in the manner of athletic liniments (e.g., "Ben Gay" ointment or related products), resulting possibly in a temporary relief from pain.

Vignette #3

The third vignette explores the dynamic nature of a curandero's practice. The healer was visited midday by a young couple and their three year old son who they stated had a persistent cough and noisy breathing. They had been to two different *casas de salud particulares* (private dispensaries, see below) where the child had been diagnosed as having bronchitis (probably a reasonable diagnosis) and had received several injections at one (the parents didn't know what he had received), and been given syrup containing tetracycline at the other. They claimed that these medicines had not helped and had come to this healer to see what else might be done.

The curer listened to the child's blood by taking his pulse The child was sound asleep and paid absolutely no attention. In this manner the healer confirmed that the child did indeed have cough and a bit of fever (making the illness more severe, see Table 3.1). He suggested that they give the child a plant-based medicine, a suggestion to which the parents did not respond with much enthusiasm. He then asked them what their religion was (evangelical

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Protestant) which explained their hesitancy (see below). He then proceeded to expound upon his credentials and why he was qualified to help their son: working with me, president of the local healers' association, etc. This seemed to satisfy them and they consented. While they waited we went off to look for the appropriate plant, *sakil nich wamal* (*Erigeron karwinskianus*) which we found a small amount of a hundred meters below the house. We returned with two longish plants constituting *jun tujt jtom* (one small handful). While the healer sat and visited with the parents in the shade, his wife (herself a healer) prepared the medicine by boiling the whole plants in about 1/2 liter of water for 5-10 minutes. The liquid was poured off into a bowl and set aside to cool. After about five minutes *jun olil tujt vaso* (approx. 3 cc) was measured and allowed to cool some more, then given to the child, who resisted mightily and had to be forced to take the medicine. His parents succeeded in getting about half the liquid into him, after which his father, who also had a bad cough, drank the rest. The remaining medicine was poured into a beer bottle, capped with a corn husk and sent home to be given three times a day; they were instructed to come back in two days for a follow-up.

The first point about each of these vignettes is to note the variety of health options utilized. In the first and third, several other medical options had been exercised, including private clinics, government doctors, and private physicians in San Cristóbal de las Casas. This "hierarchy of resort" (Romanucci-Ross 1969) is very common, but unlike that described by Romanucci-Ross, health-seeking behavior is not necessarily "hierarchical" in that there is no

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necessary order or ranking of health care options that applies across the community. The utilization may be hierarchical, lateral or sequential, depending on a number of factors unique to each situation (Young 1981). Significant factors include level of education, experience outside the community, money, perceived etiology and severity, and religious affiliation. As can be seen in the third vignette, religion plays a significant part in the behavior of both the parents and the healer. As noted in Chapter One, there are three religious groups, broadly speaking, Roman Catholic, Folk Catholic (syncretic, "traditional"), and evangelical Protestant (Presbyterian is the oldest and largest). The evangelical group in particular has strong proscriptions against utilizing traditional medicines and such practices are against church teachings and are labeled as evil.[8] Nearly all of the private "clinics" were owned, and utilized most frequently, by members of the evangelical or Roman Catholic congregations, each being patronized by members of their own religious community for the most part. On occasion there was a point at which some evangelicals would turn to the traditional ways. They would usually turn to the traditional practices when they felt that they had no remaining options. They tended to approach the situation surreptitiously (this family lived five hours away) and with some trepidation.

Religion also affects the way in which the healer approaches the healing situation. In the third example he did not pray over the child or the medicine, though this is considered to be an essential element in the preparation and administration of medicine, and in the treatment of illness by nearly all *jpoxtawanej* with whom I

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spoke.[9] An illness of this sort (*k'ajk'al obal*) is a serious health condition that under normal circumstances would require prayer on the part of the healer in order to effect a cure. In this case the healer recognized that to pray over the medicine or child in the traditional fashion would be to antagonize or make more uncomfortable his clients. The treatment was implicitly negotiated based on the religious beliefs of the patient's parents, leaving plant use as the salient and common point of treatment.[10]

The nature of the illness, its expected progress and outcome, and perceptions or concerns with etiology will also affect medical choices. Minor illnesses and injuries may be ignored or treated in-house with the expectation that they will self-resolve in short order, or a local herbalist (who has a good knowledge of plants, but who may not know how to diagnose by pulsing and treat by prayer) may be consulted if witchcraft or offense against God is not suspected (i.e., *batz'il chamel*, 'natural illness'). If the illness is severe, does not improve, or gets worse, then other options will be explored, depending on expectations, availability of money to pay for additional treatment, religion, etc. These other options may involve a visit to the government clinic, a private dispensary, or a *jpoxtawanej*. As the first example indicated, several options may be explored at the same time or in close succession. The order in which various options are pursued will depend again on a number of social, financial, and etiological factors. In the first example, this woman was well educated, of high status and financially well-to-do (by local standards), and so turned first to biomedical practitioners with the understanding that she had a disease which could be treated with

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medicines. When her condition failed to respond as desired or when the options offered (surgery) seemed unwarranted, she then turned to the "traditional" practices and beliefs because it became clear to her that her condition was not merely a biological disease, but a manifestation of envy to her relative success, inflicted upon her through witchcraft, which could only be cured using local practices, though she continued to visit the local government clinic for medications.

Likewise the parents who brought their child for treatment had exercised other options appropriate to their religious beliefs. When these failed to bring about a satisfactory response they moved on to other options. In this case, they opted for traditional methods, modified to suit their religious orientation.

In many respects the practices of the *jpoxtawanej* and the owners of private dispensaries or *nail poxil* (houses of medicine) are very similar. These entrepreneurs were often referred to as *julawal*, 'those who give injections', which gives some indication about what their primary therapeutic activity is. These private practitioners often have had a modicum of medical training, usually as *promotores de salud* (volunteer health workers), but are otherwise working from the same knowledge base as the *jpoxtawanej*. The private clinic practitioners will often take the patients pulse, though for ostensibly different reasons, and if they own their own thermometer, they may take the person's temperature to establish "objectively" that there is fever. Those few who had other instruments (blood pressure cuffs, stethoscope) used them more to establish their legitimacy than in proper diagnositic procedures. Their use of these diagnostic tools

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was as much ritual as it was diagnosis, since most them had little if any training in their use and differential diagnosis based on their findings. Beyond that there are many similarities and parallels in treatment. Both groups use essentially the same illness terminology; both groups are operating from within the local Mayan ethnomedical tradition. (This ability to operate in local terminology at the private dispensaries explains, in part, their success relative to the free government clinic which is within 30 minute walk of many of these pharmacies.) Strong-flavored medicines, especially bitter ones, are favored in the dispensaries much as they are in plant use (aspirin with caffeine is a favorite) (see chapters 4 and 5) and prescribing follows local patterns of medicinal use more closely than that described in the package insert. In much the same fashion as with plants, a particular pharmaceutical will be given in one or a few doses; if the results are not satisfactory, a different preparation may be used. This process of switching medications based on short-term outcome continues until the person feels better or financial constraints limit the search. Medicinal plant use is essentially the same. If one plant or preparation does not achieve success in a day or two, a different preparation will be sought out. This is what I refer to as the "lateral resort to therapy", essentially the search for effective therapy within a single healing modality. The use of injections is valued in part because they produce a painful reaction analogous to that expected from a powerful plant-based medicine. While prayer on the part of the *jpoxtawanej* is an integral part of the treatment process, it is less so in the proximate treatment of people in the *casas de salud.* But, if a person is severely ill or does not

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respond to treatment, the group (the church) may pray for an improvement in their health and well-being. While the prayer is at a different point in the healing process and the entity to which the prayer is directed is different, the expectations of and reasons for the prayer are the same.

While it was not an active area of investigation, there were numerous reports of members of the evangelical church turning to traditional practitioners in desperation when all other options had failed. In this situation there is a clear hierarchy of resort, in that people turned to the culturally tried and true in desperate times no matter what new teaching dictated.

At the outset of this research I decided to focus almost exclusively on health conditions that at some level had a recognizable biological component, regardless of etiology (see methods chapter). Because the purpose of the research was to identify the empirical processes by which medicinal plants were judged, as opposed to expectations based in the spiritual or symbolic realm, I accepted the assumption that health conditions with readily identifiable biological manifestations would more likely be treated with medicinal plants than would conditions without an obvious or identifiable physical aspect. The logic upon which this assumption is based is simply that there should be a relationship between the empirical selection of medicinal plants and the biological reality of illness. Furthermore, the Highland Maya do not have an extensive tradition of the ritual use of plants in curing, e.g., sweeping the patient with a bundle of plant material to remove the illness. Plants are not used for their symbolic significance; rather most plant use involves preparation and

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consumption or application of the plant-based medicine in such a way that there may be biological consequences from its use[11]. This relationship was apparent in the initial medicinal plant collections of PROCOMITH for Cancuc and was validated with the collections made for this study. An indication of the degree to which this relationship holds can be seen in that only 4% (43) of the 974 illness terms in the plant collection database (from this study) do not have an obvious or stated biological manifestation. The plant collection database is based on free collections of plants and their uses by informants and thus reflects the illnesses for which it is appropriate to use plants. This relationship between plant use and an expected biological consequence appears to be largely independent of etiological expectations. Even though an illness may be considered to arise through witchcraft or "from God" and require the ritual activities of the *jpoxtawanej*, there will still be an element of the illness that manifests in the biological realm and will be treated with plants. Table 3.1 displays the results of the pile sort task on the 58 terms used as a focus of medicinal plant use. The pile sort task was designed to elicit data on the relationship among perceived etiology, the commonness, and severity of the 58 illnesses. More detailed ethnomedical descriptions of these 58 terms and additional illness names can be found in Appendix B. This list is not inclusive of all illnesses which may have a biological component, but does reflect the majority of common, recognized conditions.

In general, illness arises from one of three possible causes: 1) *batz'il chamel* (genuine or true illness) are conditions one is likely to be afflicted with in the course of everyday life. For the most part

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they are common and usually not too severe (e.g., *chin* [scabies[12]], *k'ux bak'etaltik* [body pain], *echen* [wounds], *k'in ch'ajaw* ['cold sores']). Treatment is usually plant-based and may or may not require extensive healing activities including prayer, burning of candles and incense. 2) *Abil chamel*[13] (lit. 'placed or sent illness', witchcraft [brujeria]) are nearly always uncommon, usually severe, often life-threatening or debilitating, (*cha' nujkul, mak sitil* [eye diseases often resulting in blindness], *chay k'ajk', paslam* [inflammatory skin diseases], *sak obal* ['tuberculosis'], *k'ael* [tropical ulcer], transverse fetal presentation, cholera). Diagnosis and treatment always requires the services of a *jpoxtawanej* and may or may not include plant medicines. 3) *Smantal ta rios* (from God) also known locally as *kastigo* (castigation, punishment) are afflictions visited upon individuals or the population by God or allowed to enter the community by God. Generally, these illnesses affect large numbers of people at the same time (highly contagious illnesses, epidemics) or afflict most members of the community at one time or another (childhood illnesses) (*jik'jik' obal* [pertussis], *k'ajk'al obal* [fever and cough], *k'ajk'* [fever], *muk'ul chuel* [smallpox], *tzajal chuel* [measles]). Many conditions clearly viewed as from God[14] are considered serious and will require the intercession of the *jpoxtawanej*. Illnesses, whether sent from God, by someone within the community or if they arrive from another community, must ask permission to enter the community of San Juan (patron saint of Cancuc). It is San Juan's responsibility to guard the community and the health of its inhabitants, but if particular individuals have transgressed social rules or the community has in some way failed in

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its responsibilities, then permission may be granted to allow illnesses into the community ("from God"), or to allow illness to afflict individuals. The role of the *jpoxtawanej* then is to intercede with San Juan, other saints and places of power (Vogt 1976) to plead the case of the ill person or to solicit help in sending the illness away from the community.

Table 3.1 presents the results of the pile sorts in which informants were asked, in sequential tasks, to assign each of the 58 illness terms to the appropriate category. Appendix B contains a discussion of each of the illnesses included in the pile sort activity and a table with the exact percentages of informant consensus from the pile sorting task.

Illness name	From God	Witch-craft	True illness	Common	Not common	Serious	Not serious
jul bak sik		X		X		X	
tza'nel			X	X		X	
cha'lam tzotz	X				X	X	
batz'il obal	X			X			X
belbel on		X			X	X	
bik'tal tza'nel	X			X		X	
bujk'			X		X		X
cha' nukul		X			X		X
ch'ich' tza'nel	X				X	X	
mak sitil		X			X	X	
chakal	X*		X*		X		X
xoch	X*		X*		X		X
ch'ixal yak' wakax	X*		X*		X	X	
chay k'ajk'		X			X	X	
sik k'ajk'	X				X	X	
ch'ixal yak' mis	X				X	X	
tokal ta sitik	X*	X*	X*		X	X	
chin			X		X		X
k'ajk'et chin			X		X		X
k'ux bak'etaltik			X		X		X
sak obal		X			X	X	
chul chan	X*	X*	X*		X	X	

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echen	X				X		X
ejsel		X*	X*		X	X	
ixim chakal	X			X			X
ja' ch'ujt	X			X		X	
jik'jik' obal	X			X		X	
k'ajk'al obal	X			X		X	
k'ael		X			X	X	
k'ajk'	X			X		X	
k'in ch'ajaw			X	X			X
k'ajk'et k'in ch'ajaw			X	X			X
k'ux ch'ujtubel		X		X		X	
k'ux jolobel		X		X		X	
k'ux o'tanil		X			X	X	
k'ux sitil	X				X		X
lukum			X	X			X
muk'ul chin	X*		X*		X		X
muk'ul chuel	X			X		X	
nujkul ch'ujt			X		X	X	
obal tza'nel	X*		X*		X	X	
paslam		X		X		X	
pumel			X	X			X
sak nok'	X				X		X
sal	X*		X*		X		X
sep chin	X*		X*	X			X
sijt'el		X*	X*		X	X	
sijt'ubel	X*	X*	X*		X	X	
simal obal	X			X			X
sin ak'al tza'nel	X			X		X	
sit chay	X*	X*	X*		X		X
sit mut	X*	X*	X*		X	X	
tukul ch'ujt	X			X			X
tumin k'in ch'ajaw			X	X			X
tzajal chuel	X			X		X	
tzajal paslam		X			X	X	
tzon kok			X	X			X
xenel	X*		X*	X		X	

Table 3.1. Rated severity of selected illnesses.
Each "X" indicates informant agreement greater than 50%. Exact percentages can be found in the same table presented in appendix B. * Indicates that responses were evenly divided between the options available.

An examination of Tzeltal terms used to label illnesses reveals much about medical understanding and the relationships between various kinds of health conditions. Illness names cover a wide range of health conditions, from the most trivial, to complex, multisign

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"syndromes". As is common in ethnomedical systems worldwide, many common illness labels are what would be defined as "signs" in strict Western biomedical terms. *K'ajk'* (fever), *obal* (cough), *tza'nel* or *ja' ch'ujt* (diarrhea), *k'ux ch'ujt* (stomachache), *k'ux sitil* (eye pain), and *xenel* (vomiting) are frequent examples. They are usually common, often-encountered illnesses, and each stands as a recognized illness for which there are a variety of appropriate treatments. Tzeltal comprehension and categorization of illness is much more complex and encompasses a much wider range of conditions than merely stating the obvious based on the most evident symptom (cough, diarrhea). Many of the common terms noted above are descriptively modified making them more specific. *Tza'nel* (diarrhea) may be modified as *obal tza'nel* (diarrhea with mucus), *ch'ich' tza'nel* (bloody diarrhea), *sin ak'al tza'nel* (diarrhea with mucus and a little blood), *bik tal tza'nel* (diarrhea with undigested food present). Similarly, *obal* is modified to become *batz'il obal* (genuine [common] cough), *k'ajk'al obal* (fever and cough), *sak obal* ('white cough' ["tuberculosis"], and *jik'jik' obal* (pertussis). Because this specificity of naming speaks to a tradition of careful empiricism, it is tempting to match Tzeltal designations with biomedical terms, but this project must be approached with caution. Many Tzeltal medical designations approximate those of biomedicine, thus *ch'ich' tza'nel* generally refers to dysentery-like conditions, *simal obal* is usually the common cold, *chin* is often scabies, etc. Even so, many Tzeltal terms range across a number of more specific biomedical concepts. *Sak obal* is usually glossed as 'tuberculosis' but includes almost any severe, productive cough, including bronchitis.

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K'ael and *belbel on* encompass a variety of suppurating, slow to heal wounds, including scrofula, tropical ulcer, and possibly skin cancer. Finally, some conditions, even though their descriptions in general terms may lead one to expect a biomedical correlate, do not in fact have one. The so-called intrusion object illnesses fit this pattern. Thus *pakum* ('snake') is described as being an object like a snake, filled with, or made of, blood in the abdomen which moves. The fact that this is universally considered to be *abil chamel* and can be diagnosed and cured only by *jpoxtawanej* using prayer and ritual indicates that it probably is best considered a "culture-bound illness". Other hardnesses or lumps, usually named after animals are probably best considered in this light: *pokok* (toad), *nap'ak* (large black worm) and *uch* (opossum). An interesting point of "differential diagnosis" arises in this context. These animal-named *abil chamel* (see *ajk'* in Appendix B) can only be diagnosed and cured by *jpoxtawanej* and are described as lumps of blood in the shape of their signature animal, which move from one place to another usually in the abdominal area. If they don't move, they cannot be treated and the person will die. In this way, these "pure witchcraft" illnesses are distinguished from other kinds of illnesses which may have a more clearly biological origin (e.g., intestinal blockage, tumors, hepatitis) and which would be difficult to treat with traditional practices.

The greatest concordance, or at least the most consistency in names between Tzeltal and Spanish, appears to arise in connection with illnesses for which there have been major surveillance and control or vaccination programs. I can envision a process where

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early vaccination teams arrived, described signs and symptoms of the target illness(es) and asked for local names. Over time and continual usage these concepts become relatively fixed: *jik'jik' obal* (tosferina, pertussis), *tzajal chuel* (sarampion, measles) *sak obal* ('tuberculosis') stand as examples. Each of these common illnesses is included in the vaccination series each child is supposed to receive and so are in common and consistent usage. Additionally they are recognized as serious illnesses which can cause (*jik'jik' obal*) or lead to conditions which can cause death (*tzajal chuel*). *Sik k'ajk'* demonstrates this process in action. In the municipal center (at 1340 m) and at higher altitudes it is generically understood to mean fever and chills (*sik*--cold/chills *k'ajk'*--hot/fever) which could be influenza, bad colds, etc. But in the lower altitude regions of Cancuc, it is nearly universally glossed as malaria (paludismo). The key difference between the two areas is that in the lower elevations the government has an active malaria surveillance and control campaign, while in the upper locations, there is only occasional intervention, usually based on cases whose primary agricultural fields are in the lowlands where they encounter the malaria-bearing mosquito.

Finally, there is a class of illness which may be referred to as "syndromes" in the biomedical sense of a variety of signs and symptoms clustering together to form a named condition without specific etiologic agency. *Cha'lam tzotz* (lit. two layers of hair) is an illness universally recognized as serious which most frequently affects children under 5, though older children and adults may be affected on occasion. As the name suggests, the most salient characteristic is a short, spiky, second layer of hair close to the head.

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This is the most obvious component of the illness and is a significant diagnostic sign, but closer examination reveals that it is only one of a complex of associated conditions. Two other illnesses which regularly co-occur, especially in severe cases, are *bik'tal tza'nel* (or *bos bos tza'nel*), a type of diarrhea where food passes through the intestinal tract largely unchanged, and *nukul ch'ujt,* a condition in which distention of the belly makes the veins of the abdomen prominent and readily visible. Left untreated, *cha'lam tzotz* often ends in death, especially for younger children, hence the acknowledged severity. Biomedically this condition appears to be a cycle of chronic, often high, fever, diarrhea, and malnutrition which once started is difficult to break. While the name clearly refers to the most salient (uncommon) sign, the presence of the other two conditions (fever and diarrhea) is clearly understood. Indeed, *cha'lam tzotz* is said to cause the other conditions if it is not treated. See Appendix B for a more detailed discussion of *cha'lam tzotz* and its various manifestations.

Cancuc has a unique concern with a range of tongue illnesses, among them *tzon kok, ch'ixal yak' wakax* (tongue like a cow), *ch'ixal yak' mis* (tongue like a cat), all of which co-occur to one degree or another with diarrhea, fever and dehydration. *Tzon kok* is more common and less severe than the other two conditions, and is treated differently. What appears to be the case biomedically is that these conditions are manifestations of various degrees of dehydration. *Tzon kok* seems to be the familiar coated tongue which occurs with high or persistent fever, or the dehydration which occurs in the context of heavy physical exercise with inadequate liquid

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replacement. It is noted to occur in the absence of fever, but is usually associated with fever. A common symptom is that one is very thirsty. It is usually treated with repeated consumption of *paj te'* (*Arthrostema ciliatum*), a very sour and very succulent shrubby herb. The object of taking the medicine is to remove the white coating from the tongue, so the medicine is repeatedly squeezed (from the stem) onto the tongue, after which the white film disappears or may be wiped off. The amount of liquid provided in this way is difficult to assess. *Ch'ixal yak' mis* and *ch'ixal yak' wakax* are more serious, largely because they can lead to severe diarrhea and high fever. Someone diagnosed with one of these conditions is considered to be at considerable risk and should be treated immediately. What appears to be the case is that as dehydration progresses the papillae of the tongue become more pronounced and protrude from the surrounding tissue. The importance of these illnesses is not in the appearance of the tongue or anything that will happen to the tongue if treatment is not pursued, but in their association with severe diarrhea and fever. Even though the treatment is directed at the tongue (as *cha'lam tzotz* treatment is directed to the head), the real concern about these illnesses is their association with illnesses known to cause death. There is an element of these illnesses that is covert in much the same sense that Berlin, Breedlove and Raven (1968) used the term to refer to categories of plants. In this case attention is directed toward particular signs with are a cover for much more serious health conditions or "syndromes". (See Berlin and Berlin, et al. in press) for a systematic exploration of

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the concordance of Tzeltal and biomedical concepts; see also (Berlin, Jara A., et al. 1993)

In many respects illnesses are animate; they are entities that are capable of movement within the body and which may be sent through the air (*ak'bil chamel*) or encountered while walking on the trail or in one's fields. Similarly, illnesses appear to have some level of awareness or "will" in the control of their destinies. Evidence for this animate or aware nature of illness may be found in the ability of witches to send (*ak' chamel*) an illness to another person. Sometimes this illness may arrive in the form of a physical being (beetles or other small animal) or it may be left where the intended victim will encounter it (e.g., on the trail to his corn field). The *pukuj*, variously described as being in the form of little men, birds, or small animals, can be agents of illness and misfortune. They can be encountered, and at times an unfortunate may actually see one perched in a tree or on the roof peak, almost always a sign of impending misfortune, ill health and death. That the illness may be detected as an intrusion object, sent by a witch, and which, by definition, moves, indicates a physical nature of some illnesses. Similarly, for some illnesses (*lukum, cha'lam tzotz, k'ael*), the medicine must be prepared in secret and not discussed in the presence of the ill person for fear that the illness will hear of the plans and hide from the medicine, thus limiting the value of the cure. Likewise the affected person may not prepare his/her own medicine for fear of alerting the illness to their intentions. If it is necessary to discuss the illness, vague, euphemistic names may be used to disguise the object of the discussion. The medicine for *cha'lam tzotz* is always prepared and

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applied before dawn so that the illness will be unaware of the plans for treatment. Medicines, whether plant based or pharmaceuticals are often hidden for the same reasons. In the case of particularly severe witchcraft (e.g., *k'ael*), the affected person may actually change residence to an undisclosed location during the course of the treatment so that the witch will not become aware of the treatment and redouble his efforts.

The effects of particular illnesses in or upon the body imply an animate nature. Thus coughs roam around the chest and throat and *o'tanil* (chest/heart[15]) causing one to cough, and diarrheal illnesses want water and so take it from the whole body, causing dehydration. In both cases one of the objects of curing is to bring or join together the illness so that it may be expelled (cough) or stopped/dried up (diarrhea). This partly explains the apparently irrational hydraulic model of diarrhea control which maintains that one part of the control strategy is to withhold liquids. Liquid intake simply means more liquid output, so it is better if the person does not drink during diarrheal illnesses. The object of therapy is to bring together the diarrhea, kill it and stop the outflow (literally to dry up the diarrhea). This is accomplished by taking astringent and bitter medicines and restricting liquid intake.

Many illnesses need to be "brought together" in order that they may be expelled (Etkin 1988a). As already noted, coughs and diarrhea are to be aggregated so that they may be expelled. Several of the eye diseases likewise need to be brought together so that they may be expelled or taken out. In the case of coughs, success is noted with an increased production/expulsion of phlegm; of eye diseases

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when something is, or becomes, visible which either comes out or which may be physically removed; diarrhea stops and one will not have a bowel movement for a day or so and when stool production begins again, the feces will consist of small hard pellets (no small feat, given the extremely high bulk diet normally consumed).

Finally, a surprising number of illnesses are seen to be caused by *chan*, best glossed, in the context of health, as 'worms'. (The literal or usual definition for *chan* is snake as in *ti'el chan*--snake bite. But the most common translation into Spanish, in the context of health and disease, is usually to 'gusanos', meaning worms.) In many respects they are analogous to the general term "microbes", being essentially invisible entities which cause illness and whose death will allow healing or recovery to take place. They are most often associated with skin ailments, eye problems and sometimes with respiratory and diarrheal illnesses. They tend to be associated with severe, bothersome (e.g., itchy, painful) or chronic, apparently intractable conditions. Note that they are distinct from *lukum* which are identifiable, visible worms (parasites) in the feces. The *chan* are proximate causative agents which are killed by medicine, thus permitting healing.

The hot/cold element of illness theory is present in Cancuc, but is of much less importance than in other parts of Mexico and Central America. (See for example Foster 1967; Harman 1974.) There are two primary aspects in the consideration of hot/cold. One involves fairly straight-forward etiologic considerations in which actual temperature changes are in some way responsible for a change (for the worse) in one's health status. Thus, sleeping on cold ground can

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cause or make one susceptible to diarrhea; a cough may get worse if it becomes cold (when cold settles in the chest) which may arise because one is exposed to cold (e.g., getting soaked in a hard, cold rainstorm or the cold night air). This aspect is unambiguous and consistent in many respects with Western folk beliefs about the consequences of exposure to cold (e.g., "you're going to catch your death of cold if you don't wear your hat").

The other aspect is essentially metaphorical in that there is not often an actual temperature related element to the hot/cold nature of illness. Rather, illnesses are, by definition, hot (*k'ajk'*) or cold (*sik*). Table 3.2 presents the results of the pile sort task in which informants were asked to categorize each of the 58 illnesses as hot (*k'ajk'* or *k'ixin*) or cold (*sik*).

Illness	% Sik	% K'ixin	Illness	% Sik	% K'ixin
1 jul bak sik'	77		30 k'ajk'		100
2 tza'nel	92		31 k'in ch'ajaw		92
3 cha'lam tzotz		62	32 k'ajk'et k'in ch'ajaw		100
4 batz'il obal		54	33 k'ux ch'ujtubel	85	
5 belbel on		77	34 k'ux jolobel		92
6 bik tal tza'nel	85		35 k'ux o'tanil	69	
7 bujk'		85	36 k'ux sitil		85
8 cha' nujkul		77	37 lukum	77	
9 ch'ich' tza'nel		54	38 muk'ul chin		92
10 mak sitil		77	39 muk'ul chuel		92
11 chakal		100	40 nujkul ch'ujt	85	
12 xoch		62	41 obal tza'nel	62	
13 ch'ixal yak' wakax		92	42 paslam		92
14 chay k'ajk'		100	43 pumel	100	
15 sik k'ajk'		54	44 sak nok'		85
16 ch'ixal yak' mis		100	45 sal		62
17 tokal ta sitik		69	46 sep chin		77
18 chin		92	47 sijt'el		69
19 k'ajk'et chin		100	48 sijt'ubel	77	
20 k'ux bak'etaltik	77		49 simal obal		62
21 sak obal	85		50 sin ak'al tza'nel	62	
22 chul chan		69	51 sit chay		54

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23 echen		69	52 sit mut		85
24 ejsel	54		53 tuk'ul ch'ujt		100
25 ixim chakal		100	54 tumin k'in ch'ajaw		92
26 ja' ch'ujt	92		55 tzajal chuel		92
27 jik'jik' obal	85		56 tzajal paslam		100
28 k'ajk'al obal		69	57 tzon kok		92
29 k'ael		77	58 xenel	69	

Table 3.2, see discussion below. The number represents percent agreement among informants on the pile sort task.

Several points should be brought out about the data in Table 3.2. In general skin ailments are considered to be hot, while most diarrheal and some respiratory illnesses are viewed as cold. The amount of inter-informant agreement is generally over 75% with the exceptions explainable in many cases by the variable nature of the illnesses involved. Note for example that *tza'nel* (#2) and *ja' ch'ujt* (#26) are clearly viewed as cold illnesses, as are most other gastro-intestinal conditions. But, *ch'ich tza'nel* and *sin ak'al tza'nel* (#s9 and 50 respectively) are not clearly viewed as either hot or cold. The reason in this case is that both of these conditions involve blood in the stool. While gastro-intestinal conditions in general and diarrhea in particular are cold illnesses, blood is associated with hotness, thus informants categorize according to that portion of the illness which is most salient to them--diarrhea or blood. Likewise with *cha'lam tzotz* (#3), it is generally treated as a hot illness; there is often discussion of steam (vapor) arising from the head of the child when the medicine is applied in the predawn hours because the child is so hot (but not necessarily feverish) and the medicine is so cool. Here again, the variable presentations of the illness make unambiguous classification difficult. While the *cha'lam tzotz* (that part involving the head) is unquestionably viewed as *k'ajk'*, there are distinct and well recognized gastro-intestinal components (*bosbos tza'nel* or

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bik'tal tza'nel {#6} and *nujkul ch'ujt* {#40}) which are unambiguously known to be *sik* health conditions. These other components are well recognized as associated with the illness; if someone attends to the gastro-intestinal components over those of the head and hair, then they would classify accordingly.

In a similar vein, several of the respiratory conditions are ambiguously defined, though these are relatively easily explained. In particular *sik k'ajk* (#15) and *k'ajk'al obal* (#28) are somewhat contradictory to themselves, making classification difficult. *Sik k'ajk'* is fever and chills (of variable etiology) and so how does one easily classify it as hot or cold? *K'ajk'al obal* is cough with fever; respiratory conditions with cough are generally cold, but what does one make of a condition marked with fever? This seems the most likely explanation as well for *batz'il obal* (#4) and *simal obal* (#49) which may be glossed as 'true cough' and 'a cold' respectively; both of which may be marked at some point by fever.

Of the remaining conditions which are not clearly categorized I have no data which might explain their ambiguous status. In the case of *xenel* (#58) I assume, that it is again related to the variable nature of the illness. On the one hand it is a gastro-intestinal illness and thus cold, but there is an unquestionable burning sensation when one vomits. Vomiting in the context of a child choking on a piece of bread and throwing up or a drunk vomiting while passed out on the side of the yard excite no particular attention, but in the context of other illness or as a isolated incident it is cause for considerable concern and is viewed as a sure sign of witchcraft. The various eye conditions (*tokal* {#17}, *sak nok'*, *sit chay*, *sit mut* are

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generally viewed as hot conditions, but I believe are not particularly well known as some informants clearly were guessing as to their status.

Hot and cold status exhibits a complex relationship to perceived etiology. As noted above, there are cases where cold in the literal sense may be a causative agent. In other cases there is a difficult-to-discern line between the actual and the metaphorical. In the case of *sik ta ch'ujt ta antz*, which is best glossed as 'failure to conceive' (lit. cold of the stomach/belly of women), it is often considered to occur because air entered the womb during a previous birth or a girl was exposed to cold prior to adulthood, either by eating to much 'cold food' or being exposed to cold, wet weather at a crucial time in her development. Treatment in all cases requires the physical heating up of the woman, usually using a mixture of 'hot' medicines, often involving ingredients which will indeed cause one to feel warm upon ingestion--cloves, honey, alcohol, black pepper, cinnamon, ginger, etc. *Jul bak sik* (#1), 'arthritis' and *sijt'ubel* (#48) 'edema', are cold conditions and likewise must be heated up with the application of 'hot' medicine. Again, the medicines are such that there may be a local increase in heat brought about by cutaneous vasodilation, etc. But there is also an important element of witchcraft involved so treatment will include a large component of prayer. On the other hand *sijt'el* (#47) 'inflammation', is a hot conditions and is treated with the application of 'cold' medicines. It, too, is often considered as witchcraft and so prayer will be integral to treatment.

As might be noted in the above discussion, a large component of the Tzeltal hot/cold classification system is intimately related to

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actual physical sensation. Thus most of the skin ailments are classified as hot and do indeed produce heat, through inflammation, severe itching, or pain. Most conditions marked by severe pain, headache, wounds and ulcers, will be hot conditions. Treatment in many cases involves the application or consumption of medicines that do indeed produce a physical sensation of heating or cooling. Thus in the case of the various skin conditions and headache, the expectation of the medicine is to cool (relieve) the pain and is done with the application of plants which appear to be cooling--succulent plants--orchid pseudobulbs, members of the Crassulaceae, *Peperomia*, *Commelina*, and plants that grow in cool, moist, shady locations (*Stelleria, Pilea*). When asked what the outcome of medicinal use will be in these contexts, a frequent answer will be something on the order of *sikub te sijt'ele*, 'cooling of the inflammation'. This means the actual cooling of the inflamed condition, but by extension means relief from pain and a beginning of the healing process. Likewise for cold illnesses, there will be an effort to warm the person physically, this being the only way to counteract the coldness associated with the problem. This is most commonly done with warming plants as noted above, but also with the use of the *pus* or steam bath, at one time common throughout the highlands, now restricted in use to few communities (Oxchuc and Chamula especially, but Cancuc on occasion). Another indication of the literal physical nature of plants as 'hot' or more often 'cold' was noted by several informants who took up plants, held them to their cheek and pronounced them *sik*. There was a physical measurement of the leaf temperature, which indicated that this plant was cold and

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could be used to treat a hot ailment, most often a skin conditions characterized by inflammation and pain.

While most people can state the hot/cold status of a medicine, it is relatively unimportant in most cases. This can be seen in the fact that most plants are not viewed as hot or cold. Rather, if asked to state the quality of the plant one will be given, in most cases, a quality relating to its taste or odor. If an informant does not know the illness treated with a particular plant, they usually cannot state its hot/cold status, whereas they can determine its empirical quality (by tasting) and thus establish a possible use for it. It became apparent during early collections that the plant's hot/cold quality, when it was assigned one, was dependent on the perceived hot/cold quality of the illness being treated. As noted in Table 3.2, these are fairly consistently labeled. To test this hypothesis I presented each of the 24 plants used in the garden interview to informants and asked what it could be used to treat and what it's hot/cold status was (see Methods chapter). Table 3.3 contains the results of this procedure and demonstrates clearly the dependent nature of plant classification relative to the understood status of the illness being treated. Most of the illnesses mentioned spontaneously were also (previously) included in the pile sort task. Those which were not in the pile sort exercise are marked with a #.

Plant name	hot illnesses	plant quality	cold illnesses	plant quality
Acacia angustissima	k'ajk'	cold	k'ux ch'ujt, k'ux baketaltik, tza'nel	hot
Bidens aurea	k'ux sitik, echen, sik k'ajk	cold	k'ux o'tanil	hot
Phyllanthus niruri	k'ux sitik, k'ux jolol (balil)	cold	cha'lam tzotz+	hot

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Erigeron karwinskianus	ch'ich' tza'nel, k'ux o'tanil	cold	k'ux o'tanil, k'ux ch'ujt, obal	hot
Euphorbia graminea	k'ux sitik, sijt'el	cold	k'ux ch'ujt	hot
Cissampelos pareira	bik tal tza'nel+	cold	tza'nel, sik k'ajk', k'ux ch'ujt	hot
Polygala floribunda	sak obal (one person)+	cold	sak obal, balil (k'ux) jolol+	hot
Hibiscus uncinellus	jik'jik' obal+ lok ch'ich' ta ni'tik (bloody nose)#	cold	sik k'ajk', jik'jik' obal	hot
Clematis grossa	tza'nel+, chin	cold	xoch+, sal, bik tal tza'nel	hot
Alliospermum integrifolium	tza'nel+, k'ajk'al nuk (reflux)#, k'ux o'tanil	cold	k'ajk'al nuk+, k'ajk'+	hot
Salmea scandens	k'ux o'tanil, k'ux jolol	cold	k'ux jolol+, jul bak sik	hot
Ranunculus petiolaris	cha'lam tzotz,	cold	tza'nel, k'ux ketik (toothache)#	hot
Pluchea odorata	k'ux o'tanil, echen	cold	sak obal, k'ajk'+, sik k'ajk'	hot
Eryngium ghiesbreghtii	cha'lam tzotz, bujk, chin	cold	k'ux o'tanil, ch'ixal yak' wakax+	hot
Brickelia paniculata	------	----	tza'nel, k'ux o'tanil, k'ajk'+	hot
Arthrostema ciliatum	k'ux sitil, cha'lam tzotz	cold	tzon kok+	hot
Cuphea pinetorum	tza'nel+, k'ux sitik	cold	sak obal, paslam+, obal	hot
Salvia karwinskii	ch'ich' tza'nel	cold	tza'nel, k'ux jolol, k'ux ch'ujt	hot
Solanum lanceolatum	echen	cold	sik k'ajk', echen+	hot
Brugmansia candida	sik k'ajk'	cold	sik k'ajk' (one person)	hot
Cordia spinescens	k'ux o'tanil	cold	tza'nel, k'ux baketaltik, k'ux o'tanil, ch'ich' tza'nel	hot
Chromolaena collina	k'ux o'tanil, cha'nukul	cold	tza'nel	hot
Fuschia microphylla	k'ux sitik, k'ux jolol	cold	k'ux sitik+, jik'jik' obal	hot
Piper jacquemontianum	chin, xoch'	cold	echen+, xoch+	hot

Table 3.3. Hot or cold designation of the illnesses is according to the results of the pile sort task and was determined independent of this experiment. Informants were asked what the plant cured and what it's hot/cold status was.
not included in pile sorts, but included for illustration of point.
+ denotes illnesses which are in the "wrong column" according to the predictions of the hypothesis.

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Most of the plants fit the expectations of the hypothesis that the hot/cold status of the illness determines the status of the plant used to treat it. A plant is defined as cold when it is being used to treat a hot illness and the same plant is defined as hot when being used to treat a cold illness. While there are exceptions to this general statement, I believe that the above conclusion is clearly supported. For the most part, in those cases where the illness is in the "wrong" column relative to the hot/cold status of the plant, I would ascribe it to inter-informant variation. There were only 5 informants interviewed for this test so the patterns are suggestive rather than definitive, though I would predict that an equally similar amount of variation would appear, no matter the size of the sample. For example, *Hibiscus uncinellus* is almost universally known as a treatment for *jik'jik' obal*; on this there is no disagreement, but some disagreement on its hot/cold status. This can also be noted in Table 3.2 as well, where there is clearly some variation in consensus in that 85% agree that it is a cold illness, but 15% view it otherwise. Likewise *tza'nel* is nearly always considered to be a cold illness, but some view it otherwise, at least in relation to plant classification.

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Health Status

In general, Cancuc fits the pattern common in the developing world. Most illnesses are in the realm of infectious diseases, principally gastro-intestinal, respiratory, and skin ailments. To a large extent these can be readily linked to lack of sanitary facilities. All water was from, usually open, wells and had to be carried from 50 m to a kilometer or more to the home. This makes bathing, and to a certain extent handwashing with soap, a luxury, especially in the

dry season when water is in extremely short supply. There are essentially no sanitary facilities. People go to the bathroom wherever they can find a bit of privacy, often in small groves of coffee trees located throughout the settlements. Animals roam at will, undoubtedly contributing to the circulation of pathogenic organisms. Housing is generally inadequate, cooking is done on open wood fires in the middle of the floor, and water for washing dishes and cooking equipment is scarce.

Concepts of health prevention are limited, but are becoming more widely known under the influence of public health efforts on the part of the state health worker and education within the organized religious establishments. A number of beliefs can be interpreted from a strictly functional perspective to yield some insight on preventative practices. The *pukuj* are thought to be out at midday and late at night and can attack people, making them ill. These are both dangerous times to be abroad, midday because of extreme heat, and night because of darkness. There is also a general belief that it is not good to swim or bath in pools or streams resulting from rains following an extended dry season. These are thought to make one sick, as well they might with the accumulated human and animal waste that gets washed into the water when the early rains come. On a social note, bad interpersonal relations, especially with senior or superior persons can contribute to ones ill health through bewitchment. See footnote 30 for discussion on tonics and health maintenance.

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Medical Resources

In contrast to the situation encountered by Guiteras-Holmes (1990) in Cancuc and (Villa Rojas 1990) in Oxchuc in the 1940s when available medical resources were extremely limited, those available today are much more extensive, though still arguably inadequate. The situation as reported by Guiteras-Holmes and Villa Rojas was one in which there were virtually no outside medical resources. All medical attention was derived from local personnel who relied principally on ritual and, I assume, medicinal plants. Pharmaceuticals were available on occasion, brought in by itinerant peddlers and perhaps the occasional health worker or teacher. But, there were no formal medical options available in or near the community. Etiology was almost entirely in the social and spiritual realm. Descriptions by both Guiteras-Holmes and Villa Rojas indicate active neglect on the part of the Ladino health authorities based in San Cristóbal. Both researchers were present in times of severe epidemic outbreaks (dysentery in Cancuc, typhus in Oxchuc). Although the regional medical authorities were alerted to the outbreaks, nothing was done to deal with them. Both anthropologists described being primary sources of medicine during their stays in the community and both expressed frustration at how little they could do in the face of severe health crises and official apathy.

Formal Medical Care

The situation as it stands now is both officially and informally better, but still far from adequate. Both the state and federal governments have invested in medical care in Cancuc.[16] While there was reportedly considerable competition and conflict between the

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federal and state efforts, they can be roughly divided into clinic-based health care (federal) and community-based public health efforts (state). During our stay, there was an apparently uncommon degree of cooperation among the various health agencies in Cancuc. Efforts were made to cooperate on the vaccination programs to avoid duplication and take advantage of combined resources allowing for increased coverage and decreased waste. This degree of cooperation was rare, but according to the various health workers, very successful. This success was largely due to the unique combination of personalities working in Cancuc that particular year rather than any policy or practice of cooperation on the part of their respective agencies. The physician in the federal clinic was a very enthusiastic, dedicated individual who made a genuine effort to be present in the community. (This in itself was notable, there reportedly had not been a physician resident in the community for three years prior, though someone had been assigned to the clinic.) The health worker working for the state health department (SSA, Secretaria de Salubriadad y Asistencia) was similarly an intelligent, dedicated individual who made a genuine effort to do his job.[17]

There were three federally sponsored clinics (IMSS)[18] in Cancuc: one in the municipal center, one in Pozo, an hour and a half walk from the center and another at Nich Te'el, a three hour walk from the center. All were (at one time) served by bus lines (though the road had washed out to Nich Te'el and there was no indication that it would be repaired soon). There was active agitation on the part of the people in Chak Te' to get a clinic placed there, as it was a three hour walk to the nearest medical facility (at Tenango, or

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Cancuc); this was unresolved when I left. There is a resident physician in Cancuc, reportedly one in Pozo (although, to the best of our knowledge, not in residence during our stay), while Nichteel was staffed by trained health workers (enfermeros). The clinics were all staffed with bilingual health workers (the enfermeros) who had received at least one year of post-secondary medical training as well as ongoing, monthly, seminars on various health topics. They provided the invaluable service of translation when and if the physician was present. By and large they were capable of managing many of the basic medical needs of the population: dressing wounds, dispensing antibiotics for diarrheal and respiratory illnesses, providing oral rehydration solution, etc. While in the absence of a physician, they often were the primary point of contact between the community and the federal health system, they were, according to regulations, not supposed to diagnose illness or dispense medicine. Compared to the situation encountered by Guiteras-Holmes the situation was vastly improved. Yet, the health workers lacked skill and training in differential diagnosis and so could supply only stock answers to most situations.

The physicians, when present, are "pasantes", i.e., recent medical school graduates doing their one year of social service, usually in rural or inner-city clinics. The idea behind the program is to provide rural communities with basic medical care, and physicians the opportunity to encounter and cope with a wide range of health conditions. As a concept it is very good; in execution it lacks quality since even the most dedicated physician will only be in the community 2/3 of the time (they work 20 days, 10 days off). Many

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pasantes have perfected the art of not being in the community at all while still achieving official recognition for having served their time. Similarly, because this year of service is also in many ways analogous to internship, there are on-going training seminars which often coincide with the pasante's period of residency in the community. In short, it was rare to have a physician in the community more than 15 days in 30.

In addition to paid staff each clinic had affiliated with it a health committee (Comité de Salud) and a variable number of volunteer health workers (promotores de salud). There was often substantial overlap between the two, but the members of the health committee tended to be older (30s-50s) while the promotores were often young men in their twenties, many of whom had finished secondary school. The role of the health committee was to oversee the maintenance of the clinic and grounds (fill the water tank, haul fire wood, maintain the grounds, etc.), but more importantly to be the liaison between the community and the federal medical establishment. They were instrumental in organizing and coordinating locally for vaccination campaigns and organizing labor for cleaning wells, getting people notified and in attendance at health related meetings, etc. From the other direction they were supposed to represent the needs of the community to the federal health authorities. The system was designed such that the committees provided input to the system which would then figure in the development of policy, at least at the local level. In our experience this worked well at the community level because both the state health worker and the pasante in residence were willing to listen to

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the health committee and to the degree that it was possible to institute programs of interest to the local people (esp. nutrition and small animal husbandry).

The promotores had received a modicum of training and were ideally the first line of defense in their immediate neighborhood, working, in a very limited way, to improve public health conditions and provide emergency care for injuries, etc. But, their primary responsibility was to provide manpower during vaccination campaigns. They rounded up families, gave shots, kept records, etc., often for several days running, meaning that they could not be attending to daily responsibility of farming and making a living. Many of these young men had an interest in going on for additional training to become enfermeros, so this provided opportunities for practice and exposure. Some of them had in previous years established private dispensaries discussed below.

The clinic seemed to be usually well stocked with basic medications and supplies, though at times some medications, especially antibiotics were in very short supply. Any major outbreak (e.g., cholera) would have quickly exhausted the available resources if the regional authorities did not respond quickly.

The state health worker had as his mandate basic health education, providing those communities distant from the federal clinics some access to medical supplies and attention to basic public health issues. His was a thankless, difficult job as much from official corruption and lack of cooperation on the part of the municipal authorities as from substantial cultural differences, ignorance and complacency on the part of the population. He tried to identify local

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projects which would have the most impact on the state of health, but which were accessible organizationally and financially to the local community. He had adopted the somewhat radical idea that the people were best able to help themselves rather than waiting for the government system to decide to get around to dealing with local level issues. He had devised a number of very low cost projects and strategies for certain communities including latrines, water storage facilities (critically important), and pig houses, and had set up "casas de salud" where people could theoretically have access to a basic supply of medicines. (These seldom had medicine for more than few days or weeks, as most of the medicines were appropriated [stolen] by local private practitioners who then sold them in their "pharmacies".) With the exception of the cooperative vaccination campaigns, I got the sense that much of what he attempted to do failed through a combination of cultural misunderstanding, official and unofficial corruption, and lack of infrastructure and support. Even so he had the attitude that if he saved the life of one child by having convinced a mother to continue breast-feeding, or to boil water used for mixing the formula, he had done his job.

The state university of Chiapas (UNACH) had just begun a major health survey as I was leaving in the fall of 1992. As it was explained to me, it was to be a cooperative arrangement whereby students and faculty of the university from a wide variety of fields had opportunity to do field work, while the community theoretically benefited from the recommendations generated from the study. The object of the project was nothing less than a complete survey of all health related activity in the community. The research team

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consisted of physicians, public health experts, agronomists, veterinarians, hydrologists, anthropologists, all of whom were to work together with the community to identify problem areas, develop and implement solutions as well as develop long term strategies for ongoing problems. They had done a similar study in another community the year before and, they claimed, it was an outstanding success, significantly improving the overall health of the community.

One final health and medical resource which stands somewhere between the formal medical care options and the informal (below) is the public health teaching done by the organized religions in the community, especially the evangelical Presbyterian mission and the Catholic church. The messages are simple, but potentially invaluable: keep the animals out of the house and away from food preparation; wash hands and faces regularly; whenever possible boil drinking water; keep the house and yard free of garbage; defecate well away from dwellings and away from streams. There were also basic messages for illness treatment, such as keeping persons with diarrhea well hydrated. In my wife's tours through the community, she felt that she could often predict which houses were occupied by members of the organized religions because they were substantially tidier, cleaner and the children generally seemed cleaner and healthier.

Informal Medical Care

In spite of reasonable access to federally or state sponsored medical resources, the informal sector is still of fundamental importance in health care. The two primary resources are the

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jpoxtawanej (traditional healers) and the *nail poxil* (pharmaceutical dispensaries or private "pharmacies"), which, as noted above, share substantial features. The *nail poxil* ('house of medicine') are generally run by members of one of the organized religions, whose owners have had a modicum of training, usually as health promoters (volunteer health workers). The general scenario appears to be that they work as promoters for a few years before realizing that there is money to be made with their knowledge. I encountered two models within this approach. In one model, the men were itinerant, going where they were requested or needed, very much in the model of the traditional healers. It was not uncommon to encounter these men on the trails, stethoscope hanging over their shoulders and a small bag with medicines (largely pharmaceuticals), which they would sell on the spot if there was a need. They were often referred to as enfermeros ("nurses"). The other model was of men who opened a small "pharmacy" (really dispensaries) or private clinic. Some of these simply sold medicines and dispensed advice, while others actually had a small examining room where patients could be seen. To my knowledge, these men had a minimum of training and they could best be described as entrepreneurs who had chosen pharmaceuticals as their path to wealth and fame. They were viewed with ambivalence within the community; being recognized on the one hand as a potentially valuable source of medicine and advice (they were referred to by some people as "medicos"--doctors), while on the other hand being strongly resented because their prices could be described as nothing short of exorbitant. Generally they sold the medicine by the dose, whether it was a pill, an injection or a spoonful

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of syrup. To buy the whole bottle of syrup (the usual course of treatment) meant buying all of the doses contained therein. The obvious consequence of this was that, in a very real sense, care depended on ability to pay. The other point of resentment concerned their general unwillingness to make "house calls" which ran against cultural expectations of appropriate behavior. If they did make a house call, there was often a hefty charge, often well beyond what would have been expected had the person been a traditional healer (*jpoxtawanej*). The usual reason given was they needed to stay and attend the store which they could not do if they were going here and there visiting sick people. They were viewed by some people as better than the clinic because there was usually someone there. The clinic was only open certain hours and on many days (vaccination campaigns, training workshops) it was not open at all, whereas at the dispensaries, someone usually was in attendance, if not the owner, then his wife or older child.

In most cases the owners traveled to San Cristóbal periodically and bought a supply of medicine which they then dispensed by the piece at a substantial markup. (I saw prices as high as 400% over the price paid in the pharmacy in San Cristóbal.). A few practitioners, who were still ostensibly in the state promoters system, engaged in resale of basic medicines which were intended for dispensing free of charge.

Pharmaceuticals were also available from itinerant peddlers. These men, often from neighboring communities, traveled the primary trails with a shoulder bag of medicines, mostly a collection of antibiotics and pain relievers. They went house to house in the

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smaller, more remote communities. There were always a half dozen or more vendors at the weekly market who had a collection of pharmaceuticals. Most of these were men from neighboring communities and some were the same individuals who traveled during the week. Finally, most tiendas (small stores) have a small selection of medicines available for sale, again by the dose.

The other major medical source in the informal sector is what would generally be glossed as traditional healers. (Though, as noted above, I believe the line between the "traditional healers" [*jpoxtawanej*] and the owners of the private clinics/pharmacies is ill-defined and would be difficult to articulate.) There is no easy way to designate types or numbers[19] of healers because different individuals have different skills and degrees of success in their healing enterprises. A term that seems to cover those who know medicine (especially medicinal plants) is *jpoxtawanej*, though many consider this as a term similar in meaning to *jpik k'abal*, 'one who can listen to the pulse'. On the informant information form in which I asked a question about who had knowledge about the uses of medicinal plants, it became apparent that the most respected and knowledgeable healers were the *jpik k'abal* because it was only they who could listen to the blood and determine what was afflicting a person. Without that knowledge, how can one expect to be a good healer? If one can't diagnose illness, how is possible to know how to cure it? In consequence, while some individuals may have a good knowledge of some medicinal plants and will be noted for their knowledge[20], they will not be recognized as particularly powerful healers regardless of the extent of their medicinal plant knowledge if

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they don't know how to diagnose through pulsing. It is only those who know how to pulse (diagnose) illness who will likely have extensive medicinal knowledge because, the argument goes, if you don't know the illnesses, there is no way to have an extensive plant knowledge. If you can't diagnose illnesses, there is no way to become familiar with the wide range of plants necessary to treat them. This was unanimous among informants, whether they were themselves *jpik k'abal* or "merely" herbalists.

Even so there appeared to be a certain amount of specialization among healers. Some were noted for particular skills (e.g., midwives) while others might be noted for their special skills in certain types of prayer; to restore one's soul or divine lost or stolen objects. In my experience, the primary area of expertise seemed to be midwives, who were usually, though not exclusively, women. Even here, the ability to pulse and determine the difficulty faced by the laboring woman would indicate someone of superior skill and knowledge. While they claim to be able to detect malpresentation of the fetus and correct it by manipulation of the fetus and mother, the cause (i.e., who inflicted this upon the mother) could only be diagnosed through pulsing and cured through prayer and ritual. The cure is not complete, i.e., the manipulation would not be successful, if the *abil chamel* is not addressed and counteracted. One informant gave the following terms to designate different types of healers: *Jpik'kabal* ('one who can pulse'), *jch'abajom* ('one who prays'), *jk'aesay alal,* ('midwife').

Keeping in mind that there are different abilities among the *jpik k'abal* which are recognized and acknowledged on the part of

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others healers and of patients, in general one who could diagnose through pulsing could also cure through prayer, using medicinal plants, and perhaps setting bones, treating severe wounds, etc. The ability to cure through prayer and ritual is of such importance because of the still widespread use of witchcraft to inflict suffering and illness on the population. Because of both religious and secular (governmental) changes over the last four decades, the power of witchcraft over the population is much diminished, compared to that noted by Villa Rojas (1990) and Guiteras-Holmes (1990), but still figures large in the lives of the people of Cancuc. Those who can successfully counteract witchcraft and restore one's soul are often respected and in some cases, feared. If one could counteract witchcraft, it is assumed that one could also send illness just as competently. Villa Rojas (1990) states that in Oxchuc in the 1940s, there was a distinction between *ak'chamel* (witchcraft) and *jpik k'abal* (his transcription) (pulsing/healing). In the case of *ak'chamel* these people could both send and counteract or treat witchcraft induced illness, while *jpik k'abal* only treated illness caused by witchcraft, but could not (or did not) themselves engage in witchcraft. The distinction is not so clear-cut in Cancuc in the 1990s. While there are individuals who clearly were only *jpik k'abal*, they were generally not recognized as particularly strong healers. All of the highly respected and sought out healers with whom I had contact were also clearly capable of inflicting illness as readily as treating it. For reasons of good social relations they would deny any ability beyond healing.

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Unlike the owners of the private pharmacies who went into business selling medicine, with perhaps the best of intentions, most *jpoxtawanej* do not choose this as a profession. Rather they are chosen or elected to the position by 'God'. The following excerpt from my field notes indicates how one both is chosen and learns the profession. The woman telling the story was at the time 70-75 years old, recently widowed, widely respected and still very active in her healing, especially as a midwife.

In the informant information interview she [the informant] noted that the *jpik k'abal* have the best knowledge of plants because only they can listen to the blood and learn what illness(es) a person has, learn how serious it is and then decide which treatments will be best, whether pure plants, pure prayer or some combination of each, as there are some ailments that are cured in each of these ways. She learned her plants by virtue of dreams, she said. In reality, as the story unfolded, she learned them watching her mother and father who were both curers, especially her mother to hear her story. Her mother knew everything, plants, prayers, pulsing, she was always with her mother when curing, watching plant selection, preparation, etc. When she was in her early teens she had a dream in which 3 Ladinos brought an ill person to her to be cured. She thought to herself, "I know how to cure this person", and so the Ladinos told her to cure the ill person, and if she succeeded she would always be a good curandera, but she couldn't do the curing because she didn't know the prayers to cure this particular illness. For this reason she still doesn't know some of the prayers, especially for severe pain. She was always asking of her mother "how do you do this?", especially about pulsing, "how do you hear the illness the person has?". Her mother told her to be patient, she would learn when she was older, she could never hear anything in the pulse. When she was 14 or so she had a dream in which she was given 3 (again) books on curing, indicating that she would cure. She told her mother who indicated that it was time for her to learn curing. "But I can't pulse" she said; "you'll learn" said her mother. When ill persons came she tried pulsing before her mother arrived, to try her hand, telling the ill person not to say anything about what she had diagnosed. When

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her mother returned and pulsed she diagnosed the same thing; in this manner she learned to pulse.

It can be seen that while one is elected and therefore learns healing in dreams, there is a definite element of learning by watching and practicing new skills.

I will not discuss in any detail the role of witchcraft in the lives of the people of Cancuc because it has been widely discussed for other communities in the Highlands (Vogt 1976) and adequately addressed for Cancuc by Guiteras Holmes (1990), and for the neighboring community of Oxchuc by Villa Rojas (1990). I would simply amend their reports by noting that while witchcraft, and the attendant ritual and prayer used to treat it, are still very important components of health and illness, the use of medicinal plants is an integral part of the healing process. Plant use was mentioned in passing by these authors, but was not noted as important, while in my experience the preparation and use of medicines, while less spectacular to the outsider (and perhaps to the locals), was nevertheless fundamental to the treatment of illness. At some point in the healing process, plant medicines would be used.

Traditionally, the *jpoxtawanej* generally worked alone and were sought out based on their reputation and special skills. This is still the case: a well-known and respected healer can be very busy (indeed it can be a burden). There may be a certain amount of competition among healers, increasingly so, because as the local economy becomes more and more cash-based, there is a tendency for traditional healers to charge for their services. Previously the family of the ill person had to provide a meal, alcohol and the necessary

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paraphernalia (candles, incense) for the healing and would give the healer a small gift of corn, chilies, or in the case of a major effort, a chicken. This is still the norm, but I did witness healers being paid cash upon completion of the ceremony. Because of social changes (esp. religious pressure, and changing national policies), there is a trend on the part of traditional healers to organize into associations and to come together to talk about what it is that they do and how they might preserve their practices, skills and knowledge. During the year in which I was in residence there were two congresses of traditional healers held in Cancuc to discuss their status in the community and in the region, what they could do to enhance it, and how to preserve their knowledge. Much of the discussion centered on the loss of knowledge due to young people not being interested, inroads on the part of organized religion, medical clinics and the private pharmacies. Interestingly, much of the discussion centered on the erosion and loss of medicinal plant knowledge. This particular perspective has only recently become an important issue among community members and local activists. It provided a central point of focus for people with different (though broadly similar) healing traditions and often substantially different expectations of the meeting. Rituals vary from one community to the next and are, to a certain extent, proprietary, but plants are common property which may be discussed in groups. Plant use is also the most concrete, the part that outsiders understand and have an interest in whether it is WHO, the Instituto Naciónal Indígena (INI) or IMSS. It is much easier to talk about the preservation of medicinal plant knowledge than it is about ritual and symbolic healing. One of the major

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proposed outcomes of the meetings was a plan to establish a large medicinal plant garden, with each healer donating his/her five favorite plants. When I departed, the plans were mired in problems of lack of money, who was going to be responsible for maintenance, who would have access to it, etc. But, the significance of the whole discussion is that medicinal plants are emerging as one of the most important components of the traditional healing process, and therefore worthy of preservation.

I have mentioned at various points who is inclined to use which medical resources. While there did appear to be patterns to the way in which people used the various medical options available, it is also reasonable to argue that, at some level, everyone used, or potentially used, all available resources. Thus a dedicated, busy *jpoxtawanej* would turn to the clinic or one of the private pharmacies for an injection or antibiotics if he felt it necessary (usually for himself, but occasionally for family members). Members of the evangelical Christian churches tended to avoid the traditional practices, utilizing instead the clinic and the private pharmacies, except in times of extreme duress when all else has failed. Many people did not like the government clinic because they felt that the physician (and at times the Tzeltal-speaking health worker) did not respect them, or understand their needs and illnesses. Nevertheless, many people did utilize the clinic because, for those who lived close (within 30 minutes walk), it is convenient, it is free, providing an option for those without cash, and it represented an alternative therapy when other healing strategies had not succeeded.

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I will follow convention in reference to health conditions. As is common in most medical anthropological writings of the last 20 years I will use 'disease' when referring to a biological entity of ill health as generally defined in Western biomedical terms. In this context I would refer to dysentery, influenza, and viral hepatitis A as diseases. The main point at which I will use "disease terms" is in providing approximate glosses to ethnomedical categories of ill health. The term 'illness' will be used throughout to refer to the individual and cultural (ethnomedical) experience of ill health. Thus all of the Tzeltal named health conditions would be, given the nature of this study, considered illnesses. I am restricting the definition somewhat in that I have limited this study to health conditions which, to the best of my knowledge, have an identifiable biological manifestation. Sickness usually refers to health conditions which are in some way located in the social sphere. Again, given the nature of this study, this concept will not be used.

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Chapter 4

Chemical Perception

Plant chemistry

Most phytochemicals of pharmacological importance and those encountered during chemosensory sampling of plants are generally referred to as secondary metabolites (Rosenthal and Berenbaum 1991a; Rosenthal and Berenbaum 1991b; Rosenthal and Janzen 1979). These chemical constituents are so-called because they appear to be not strictly necessary to the primary metabolism of the plant: photosynthesis, growth and reproduction. Their role appears to be ecological rather than metabolic, though still derived from and part of basic metabolic processes (McKey 1979), serving in large part as the plants' primary adaptive strategy to environmental stresses (Rhoades 1979). The bulk of this activity can be thought of in terms of defense and communication where these chemicals are "involved with external regulation, mediating interrelations between plants and animals, or between plants and other plants" (Hsiao 1969, cited in Kingsbury 1983). "These relationships may be either positive (attraction, stimulation, etc.) or negative (defensive)" (ibid.). The positive relationships include attraction or encouragement of pollinators, dispersal of seeds, or reward to insects providing protection to the plant. Negative compounds are for the most part involved in defense of the plant or manipulation of the environment, whether against other plants (allelochemicals), herbivores (generally insects) or disease organisms. Many of the defensive chemicals are toxins which deter herbivory by a variety of means. Some are

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antifeedants which merely discourage or prevent feeding (e.g., tannins, some alkaloids) while other chemicals may affect the population structure of the consumer organism (e.g., juvenile hormone analogs, alkaloids, saponins and others) (Rhoades 1979). Importantly, while insects are the most intensive herbivores, and therefore the environmental pressure under which evolve the majority of secondary metabolites, most of the chemicals have a broad spectrum of activity, potentially affecting a wide range of consumers (ibid.). Specialist consumers, especially insects, often develop complex physiological counteradaptations against particular defensive phytochemicals in their preferred host species whereas generalist consumers do not interact with sufficient intensity to develop adaptive mechanisms (ibid. p.11). There is also evidence indicating that some chemicals affect organisms of various taxonomic groups (e.g., insects, birds, mammals) in diverse ways because of different metabolic pathways (ibid.). Thus insects may devour the leaves and birds eat the berries of *Solanum* spp. that would cause illness in a human consumer. Humans, as generalist consumers, have poor or inadequate biological adaptations against most toxic plant chemicals. While humans are metabolically capable of detoxifying many plant toxins, especially in low concentrations (e.g., cyanogenic glycosides; see discussion in Johns (1990a:33ff), the majority of our response has been behavioral and cultural, either through manipulation of plant populations (domestication, with attendant decrease in toxic metabolites), avoidance, or through specific mechanisms to detoxify the plant materials at hand (Jackson 1991; Johns 1990a; Johns and Kubo 1988). These same cultural skills have

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allowed humans to avoid toxic chemicals in food plants, but recognize their value as medicines. The nature of this process has been much discussed in relation to domestication of food plants (Hayden 1981) and more recently in chemical ecology (Johns 1990a), but relatively little attention has been devoted to the biocultural processes by which many of these same toxic chemicals came to be recognized not just as toxic substances to be got rid of or avoided, but also as chemicals having value as medicines.

One of the difficulties encountered when discussing plant secondary compounds, whether as toxins or as medicines, is the considerable potential for variation in chemical makeup, content and concentration (Janzen 1979; McKey 1979). The discussion by Janzen (1979), McKey (1979) and others (Evans 1989; Gershenzon and Croteau 1991; Louda and Mole 1991:198ff) might be summarized by noting that plants will have different concentrations of different (various) chemicals in different parts at different points in the life of the plant in different geographical locations. Normal genetic variability within and between populations often results in substantial variation in species at any given time and space. There also may be a remarkable degree of phenotypic variation as well from the unique natural history of the individual plant or population under consideration.

A major factor which can effect differences in secondary metabolites is the degree, intensity and type of herbivory. Plants can often mobilize defenses in response to specific attacks, thus heavily damaged plants may have a different defensive chemical profile than plants less affected. The reverse is also true; a plant less

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affected by herbivorous attack may be undisturbed because of more effective chemical defenses. The availability of nutrients, water, sunlight, the age or maturity of the plant or part, time of day, the part involved (leaves, roots, bark) all can impact the chemical makeup of individual plants, their constituent parts, or the populations to which they belong. The age of the plant or plant parts will often result in different levels and kinds of defensive chemicals (Robinson 1974). Generalizations are difficult because of the wide range of possible adaptive responses and the dynamic nature of predator/prey relations, but younger, immature, and fast-growing parts (especially those whose damage will most adversely affect the plant's fitness) usually will be protected with different kinds of chemicals than will older, mature, or permanent parts. This may be related to the observation that "alkaloid formation is greatest in those tissues that are most active in overall metabolism" (i.e., rapidly growing tissues) (Robinson 1974:433). Defensive components of young growth tend to be toxic at lower concentrations and often can be metabolized into other kinds of compounds as maturation proceeds (e.g., alkaloids). The protective compounds found in older material are often large, complex, "permanent" molecules (e.g., tannins) (McKey 1979), whereas those in younger material will be smaller, easily translocatable and metabolically labile, "allowing" the plant to use them in other metabolic processes as maturation proceeds with minimal energetic cost. Similarly, different parts of the plant will often have different chemicals or concentrations in response to the micro-environmental or ecological pressures to which they must adapt (Hartmann 1991). The chemical response to root

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nematodes or pathogenic fungal mycorrhizae will be different than that necessary to defend against leaf beetles or bark insects.

The implications of this variation in secondary metabolites when considering how people select plants for their medicinal properties is considerable. If we accept that there is an empirical component to the selection process, that it is not merely random or magical in its rationale, then some accounting of this variation needs to be taken. Given the consistency with which many plants are used as medicines within and across the southern highlands of Mexico (Berlin, et al. 1990; Berlin and Berlin, et al. in press) and the well documented fact that many medicinal plants have pharmacological properties (Lewis and Elvin-Lewis 1977) one can only conclude that whatever variation exists, it is largely in quantity rather than quality. Substantial variation in presence or absence of pharmacologically active principles would decrease the likelihood that generalizations about valuable plants could emerge. It seems reasonable to argue that, for species with pharmacologically active chemicals, or alternatively, toxic defensive compounds, across time and space most individuals or populations will have adequate chemical content to elicit a response which may result from chemosensory sampling (taste and odor) and/or medicinal response. Thus while there may be genotypic and phenotypic variation in the quantity of secondary metabolites, their presence could usually be assumed (predicted) if indeed they are adaptive responses to evolutionarily significant selection pressures.

For at least some chemical classes there appears not to be much variation. Hartmann (1991) in his detailed analysis on the role of

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alkaloids in plant-herbivore interactions notes: "In general, alkaloids are regarded to be part of plant constitutive chemical defense. This means that in a certain plant, alkaloids are found in a species-specific and genetically programmed accumulation pattern, which remains rather unaffected by herbivory, microbial attack, and mechanical damage or stress". Given the tremendous complexity of ecological relations (McKey 1979; Janzen 1979) there will be exceptions to this general statement, but for the most part I believe it to be an arguable and demonstrable stance.

The data from the present study lend support to this argument in that in many cases the same part(s) are used as medicines regardless of the condition(s) being treated suggesting that pharmacologically active phytochemicals are known to occur in particular plants. Table 4.1, based on data from the garden interviews, demonstrates that there is relatively little variation in part used even though a wide range of health conditions are treated. Without detailed phytochemical analysis on each plant and part, unavailable for this study, it is difficult to make firm conclusions, but the patterns suggest hypotheses for phytochemical studies. Based on the patterns in Table 4.1 it could be hypothesized that the greatest concentration of pharmacologically active chemicals are to be found in the parts most frequently used. Alternatively, for the Tzeltal of Cancuc it could be argued that the parts most consistently used are those with the strongest or most distinctive characteristic, usually flavor or odor, because a notable taste/odor quality is often considered to indicate a strong(er) medicine than a plant not so marked. But, as will be discussed below, there is the possibility that

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strong or distinctive flavors or odors also correlate with important classes of potentially pharmacological phytochemicals.

In response to question number 4 in the garden interviews "why is this part used?", the most common response reflects the recognition that part a, b, or c is in some way stronger. "It is strongest; there is much strength; only these have strength" are typical responses of this nature. In a related vein there is a class of statements indicating the plant's quality: "it is bitter; it is piquant; it is sour, etc. These were answers given as the reason why that part was used as medicine. The fact that this or that part was known to possess a (more) intense chemosensory quality resulted in its preference as the part to be used. Interestingly, this question preceded question number 6 which solicited the chemical quality of the plant, indicating at some level that the chemosensory quality has some relationship to the perceived ability to heal. Finally, there is a small class of responses that could be glossed as "convenience of use": "it is the part we use; there are more leaves; there are no roots; the leaves are easier to grind; the only part that can be boiled".

Plant Name	% consistency of use/illness classes	Plant name	% consistency of use/illness classes
Acacia angustissima	73 (root)/5	Euphorbia graminia	43 (whole plant)/5
Alliospermum integrifolium	80 (leaf)/4	Fuchsia microphylla	50 (leaf and stem)/5
Arthrostema ciliatum	100 (stem)/2	Hibiscus uncinellus	70 (flower)/3#
Bidens aurea	60 (leaf); 40 (leaf and stem)/4	Phyllanthus niruri	100 (leaf)/2
Brickellia paniculata	75 (leaf)/5	Piper jacquemontianum	100 (leaf)/1
Brugmansia candida	100 (leaf)/4	Pluchea odorata	60 (leaf)/3
Chromolaena collina	80 (leaf)/1	Polygala floribunda	85 (root)/7
Cissampelos pareira	100 (root)/1	Ranunculus petiolaris	56 (root)/3
Clematis grossa	100 (leaf)/3	Salmea scandens	56 (leaf)/5*
Cordia spinescens	50 (leaf)/3	Salvia karwinskii	83 (leaf)/4

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Cuphea pinetorum	50 (whole plant)/3	Solanum lanceolatum	50 each (leaf/root)/3
Erigeron karwinkianus	83 (leaf)/3	Verbena litoralis	57 (leaf)/1
Eryngium ghiesbreghtii	83 (root)/4		

Table 4.1 Plant parts used to treat particular kinds of health conditions.
Note: "illness classes" indicate broad classes of ethnomedically related health conditions, gastro-intestinal, respiratory, skin ailments. Gastro-intestinal conditions, for example, may include a wide range of possible conditions including vomiting, diarrhea, parasites, stomachache, etc.
It is important to note that in this case, the flower is the key part even though it may be used with other parts. 3 illness conditions is somewhat misleading since 8/10 are for pertussis (jik'jik' obal).
* This one too is somewhat misleading. While the leaf is the most frequently used (barely), there is clear recognition that the bark or root are clearly better for some conditions than others.

When considering the use of leaves as medicines, the Tzeltal of Cancuc usually use the younger leaves. For some plants the young growing tip (yuninal sni') is specified as the part to use and includes just the last few, expanding leaves, or 5-15 cm of terminal stem, depending on the species, size of leaf, amount needed, etc. Even in those cases where the tip is not specified, it will usually be included and in many cases may still make up the bulk of the collected sample. This results, in part, simply from convenience; when harvesting leaves, especially from large herbs, shrubs and trees, the branch ends are the most accesible, and usually the most easily cut or broken. Smaller herbs will often be harvested whole. This selective use of plant parts, whether intentional or based upon convenience as discussed above, will affect the chemical content of the medicines. McKey (1979) notes that the chemicals found in leaf tips are usually more toxic in smaller doses than are those found in older, more mature parts. Increased toxicity presumably means greater pharmacological potential for some conditions. If, as McKey (1979) suggests, alkaloids (usually bitter) and related kinds of

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chemicals will be found in higher concentrations in young leaves, then the chemosensory evaluation of the plant will favor the part which has the strongest flavor and/or odor. In Cancuc some qualities are considered stronger than others (*ch'a, ya*) and a plant with a pronounced flavor will be considered a better medicine than one that is less intense.

A thorough test of this hypothesis is beyond the scope of this study, but some indication may be gotten from an examination of certain patterns in the data, see below. To test this proposition carefully would require detailed phytochemical studies to elucidate the pharmacological properties of particular species, the parts used and not used and ultimately consideration of the pharmacological activity of the plant chemicals on living systems.

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The Nature and Role of Chemical Perception in Humans

In the discussion which follows my concern will be primarily with the chemosensory evaluation of those secondary chemicals most important to humans as medicines or toxins. Most of the chemicals of concern in this context have been elaborated by plants as toxic defensive mechanisms (Kingsbury 1983:680). Many of these chemicals have distinctive characteristics, often of taste, odor, or sensation which permit recognition and discrimination (Bryant et al. 1991; Chapman and Blaney 1979; Frazier 1991). This ability to discriminate chemical components of particular plants and link them to medical use is fundamental to a consideration of the place of humans in the natural environment and our ability to manipulate available resources. This has important implications for cultural ecological and (co)evolutionary theory. The discussion is divided into

several parts. The first section is a consideration of the biological basis of chemosensation with primary emphasis on the psychobiological: the way in which humans perceive, process and interpret the chemical environment. The second section is a discussion of the perception of plant secondary metabolites as they relate to medical uses.

Chemosensation

There are three principle modalities by which chemosensation proceeds, smell, taste and detection of irritation. Though each of these rely on distinct receptors, follow largely independent nerve pathways and are processed in different areas of the brain, there are significant, as yet poorly understood, interconnections such that chemosensory experiences are usually perceived holistically. This is especially the case for taste where odor, "mouth feel" (e.g., texture, temperature), and irritation are fundamental components of what we perceive as "taste"[21], but also with olfaction where factors of irritation are perceived as part of the "smell" of a substance (e.g., ammonia). While it is possible to stimulate individual components of the chemosensory system experimentally (Miller and Bartoshuk 1991), and it appears "that the receptor mechanisms associated with various categories of taste qualities are rather distinct" (Scott and Planta-Salaman 1991:346) there is increasing evidence that at the level of processing by the brain, there is not a "taste center" (Pritchard 1991:122). Presumably the same is true for the other modalities. Each of the three modalities will be discussed individually but the integrated nature of chemosensory perception will be emphasized throughout. The distinction between taste, odor

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and irritation is important for analytical purposes but is, from a functional perspective, an artificial division or distinction. From an adaptive (evolutionary) standpoint, the issue is not how a stimulus was perceived and processed, but what information was gained, the way in which it is interpreted, and how that knowledge affects individual behavior and survival. The Tzeltal of Cancuc do not smell or taste a plant to determine if it smells (or tastes) good or bad as a medicine in the sense that we might evaluate a perfume or glass of wine. Rather, this is the primary way by which one knows anything about the plant; it is the primary pathway to learning if the plant has characteristics that might make it useful as a medicine.

This distinction between hedonic evaluation (good/bad) and the basic chemical sensations (taste and odor) of the test item is made in wine tasting (Amerine and Roessler 1983) and professional evaluation of food (Jellinek 1985). The panel members are instructed to describe the characteristics of the items under study without consideration of the pleasantness or unpleasantness of the food or drink. There is a common vocabulary to which everyone is trained that permits panel members to describe the sensations without necessarily considering it as good or bad (hedonic evaluation) (Amerine and Roessler 1983; Jellinek 1985; Meilgaard 1988). Others argue that this is not possible; that hedonic considerations are inherent in taste and odor evaluation because of the adaptive advantage of knowing the difference between edibles, nonedibles, and toxins (Scott and Planta-Salaman 1991). While this is undoubtedly the case for animals and basically so for humans, the heavy dependence on culture on the part of human populations

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makes the situation considerably more complex; human ability to define something that is normally aversive as "good" (e.g., chilis as food (Rozin 1990), espresso/coffee, or extreme bitterness as a desirable medicine) makes straight-forward adaptive arguments difficult. Even among animals there are numerous reported cases (albeit largely anecdotal) of animals, especially primates, consuming plants outside of the normal diet which normally would be considered unpalatable and avoided (Huffman and Seifu 1989; Janzen 1978; Wrangham and Nishida 1983).

The primary distinction to be made here is that interpretation of chemosensory input, while it follows the same neural pathways, may vary because the reason for smelling and tasting, expectations of what the odor or taste should be like, what it is best used for, and the knowledge to be gained may be fundamentally different. Moreover, the Tzeltal do not smell or taste a plant merely to determine what it smells or tastes like as we likely would, but rather to know what its properties as a medicine might be. Usually when we smell (or taste) something, it is in order to learn "what it smells like" and in a related vein, "does it smell good" (or how does it smell--good, not good). Our primary interest is to categorize an odor or taste into a framework of familiar (known) odors/tastes and to determine if it is a "nice" smell. In a very real sense the hedonic evaluation of an odor is one of the primary classificatory criteria--good or bad is a very important organizational principle, indeed it may be the primary one by which we categorize odors/tastes. Secondarily, if pressed, we will try to place the odor/taste in a category of like items--"it smells like. . . ".[22] For the Tzeltal Maya,

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the hedonic value appears to be of secondary importance and will seldom be noted, except where the odor/taste is extreme and "forces" one to acknowledge the hedonic value. This became apparent on the numerous occasions when a collected plant was intensely fragrant, yet absolutely no mention of it was made during the discussion of the plant (e.g., *Blepharidium mexicanum*). When I commented on the odor, there was usually a distracted acknowledgement that it smelled "good", but seldom any further consideration. Rather, at least in the context of medicinal plants, it is a question of its potential value as a medicine. It is a question of, implicitly, determining the chemical content of the plant in relation to expectations about what particular odors and tastes will be like for treating illness. The odor/taste of the plant informs the healer about the chemical content of the plant. The odor and taste terms applied to the plant inform the healer (and others) what kinds of illnesses they might treat with a plant of that quality. This is one part of the evaluative process. The other major part, discussed in detail in Chapter Five, involves the continuous trial by healers applied to medicines.

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Taste

From an evolutionary perspective all of the senses are arguably involved in monitoring the environment whether to avoid danger or to enhance life. Taste, in its broadest conception, is the most proximate and intimate of the senses, involved as it is with that which enters the body. It is principally through the mechanism of taste that we must determine the value or risk of something to be ingested. Is it "good" (food/nutrition) or is it "bad" (toxic) is the fundamental question that must be addressed by any organism

whenever faced with a novel, unfamiliar or unexpected substance (taste) (Scott and Planta-Salaman 1991:366). This is especially the case for generalist consumers (e.g., rats, chimpanzees, baboons, humans) who lack the stereotyped feeding behavior of specialist feeders and who must contend with many different kinds of chemicals on a regular basis, some of which will be toxic and must be sorted out from those which are desirable.

Taste, at its most basic level is the detection, perception and interpretation of electrolytes (salts and sour [acids]) and organic compounds (bitter and sweet), each of which involves important components of nutrition and risk to the organism. The detection of taste stimuli takes place throughout the oral cavity with taste buds located on the tongue, soft palate, pharynx, larynx, and epiglottis (Miller and Bartoshuk 1991:216). Contrary to popular opinion and to scientific opinion of many years, the ability to detect particular tastes is not restricted to particular areas of the tongue, though certain areas are somewhat more sensitive to some taste sensations than others. There is also a certain amount of variation in taste sensitivity among individuals that may be related to numbers and density of taste buds in taste receptor areas (ibid. p.215). The traditional view that one detected sweet on the tip of the tongue, salt on the front edges, sour at the back edges and bitter on the back is belied by anyone who has carefully watched people sample foreign substances. There is nearly always the most hesitant nibbling of the plant and tentative chewing with the incisors at first encounter. If it is in some way aversive (bitter, sour, pungent) it will be noted and spit out after this first cautious trial. Only if inadequate information was

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gained or further exploration felt necessary would more material be taken and considered at greater length, deeper in the mouth. Nowlis (1977) has postulated that the concentration of sweet sensitive taste receptors at the front of the mouth and bitter sensitive receptors at the back combined with stereotyped behavior responding positively to sweet and negatively to bitter tastes are adaptive mechanisms to accept or reject potential food items.

Taste stimuli are transmitted to the brain via several nerve pathways serving various parts of the oral/nasal region. The tongue is principally served by the seventh cranial (intermediate or facial) nerve, the back of the tongue and the pharynx are innervated by the ninth cranial (glossopharyngeal) nerve and the esophagus and epiglottis by the tenth (vagus) nerve. The fifth (trigeminal) nerve carries the all important somatosensory components of oral (and nasal) sensation (temperature, texture, pressure, irritation, etc.). Pritchard (1991) provides a detailed discussion of what is presently known of the multiple nerve pathways through the brain, concluding, as noted above, that as currently understood taste sensations are not centrally processed but rather are probably processed in a variety of locations under the context of other stimuli and experience and in accordance with initial perceptions. Highly aversive substances will initiate rejection processes, based on proximate processing before it is "known" that the chemical is in some way undesirable or hazardous. The body reacts to dangerous stimuli before it knows (consciously) what the cause of the reaction was, whether it is hot water, bright light or noxious chemicals.

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What one tastes has been a much debated topic that is not yet settled definitively. The issue that historically has generated the most discussion is the idea of the so-called taste primaries, analogous to the color primaries of vision. The debate has centered principally around the number and identity of the taste qualities and how they relate to one another (classification) (Miller and Bartoshuk 1991:205-6), with little attention being paid as to whether there are primary classes (Erickson and Convey 1980; Scott and Planta-Salaman 1991:350). Historically, various authors have noted additional qualities of taste. Aristotle, in addition to the four presently recognized as primary, noted astringent, pungent and harsh (Beare 1906, cited in Miller and Bartoshuk 1991:206), Theophrastus considered seven or eight to be the appropriate number (depending on which of his writings consulted) (Sharples 1985), while others note rough, urinous, spiritous, aromatic, acrid, putrid, insipid or alkaline (Miller and Bartoshuk 1991); see also (Myers 1904:125). The current consensus of four primary tastes, sweet, sour, salty and bitter, is generally considered to have arisen from the work of Horn in 1825 and formalized by Henning in 1927. This formalization was in the form of a "taste tetrahedron" where each corner represents one of the four primary tastes (Bartoshuk, Cain, and Pfaffman 1985). The difficulty appears to derive from the fact that, to date, no clearly identified mechanisms by which tastes are recognized and coded have been identified. This may represent merely a lack of knowledge or processes basically different from those found in vision and hearing (and upon which assumptions and models have been based much of the research in taste and odor) (Scott and Planta-

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Salaman 1991:346). If there are taste primaries, then there must be sensory equipment and neural pathways dedicated to their recognition and coding. Recent research, while suggesting the possibility of neural pathways corresponding to the traditional four primary flavors, is as yet inconclusive (ibid.). Summarizing an impressive set of arguments put forward by McBurney (1978), based largely on psychophysical data, Scott and Plata-Salaman (1991) conclude that the idea of taste primaries "offers the advantage of conceptual organization while not grossly misrepresenting the gustatory system". (1991:350-351). They admit that the data often are "not compelling" (ibid.) and that firm conclusions are difficult to defend but that consensus opinion seems content to accept the concepts until proven otherwise (Miller and Bartoshuk 1991:205-206).

Others have been less sanguine about the consensus and have argued forcefully that the concept of a taste continuum vs. discrete categories better explains the psychophysical data (Erickson 1982; Erickson and Convey 1980; Schiffman and Erickson 1980). Schiffman and Erickson (1980:110) argue that phenomenologically many taste stimuli cannot be easily assigned to one of the four so-called primary categories either as exclusively one or another or as some combination of them. They prefer to think of the "traditional" four primaries as particularly salient points on a continuum of taste sensations. It should be noted that they made every effort in their experimental situations to exclude odor or irritation as confounding variables[23]. Past classificatory schemes, based on experience and introspection, often included or "confused" "pure tastes" with other

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inputs. But, if processing is holistic or unitary (Pritchard 1991), as would be expected from an evolutionary perspective, then the idea of the four basic "tastes" may well be an artifact of Western scientific methodology though they may have some basic physiological correlates (Scott and Planta-Salaman 1991:346ff). Schiffman and Erickson (1980) note that if studies are designed with the assumption or expectation that there are 4 primary tastes and use stimuli known to be sweet, salty, sour and bitter, then most of the time the results will indicate that there are four primary tastes. Studies are seldom designed to test whether these are exclusive and unitary categories; rather they assume that they exist and proceed accordingly.

The largest single perspective which calls into question the existence of "only 4" is the controversy around the flavor umami (MSG, monosodium glutamate) which for Japanese is a "flavor" usually glossed in English as "savory" (Kawamura and Kare 1987). Psychophysical studies (Ishii and O'Mahony 1987) indicate that umami represents a distinct sensation to persons of both Asian and Western heritage. Additionally "there is support from studies of the receptor processes, through sensory coding and to behavior that umami is a taste quality of independent standing" (Scott and Plata-Salaman 1991:351).

Another factor which leads to a questioning of the concept of only four basic tastes is the frequent confusion of taste names in which individuals in test situations confuse sour with bitter (O'Mahony, Goldenberg, Stedmon, and Alford 1979), and sour with salty (Myers 1904), among others (O'Mahony, et al. 1979). The

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argument states that if there are four primary flavors which are unitary and obvious, there should not be any significant confusion among the flavors; bitter is bitter and sour is sour, they should not be confused. In the realm of the real world (e.g., plants), unitary tastes are uncommon. As the discussion below demonstrates there is clear recognition in Tzeltal of the "basic four" tastes, but the matter is much more complex.

A consideration of some cross-cultural data on taste terms can shed some light on this as well. While some of this could be rejected on the basis that people are naive and will confuse taste, odor and irritation, it could equally be argued that what people experience should not be discounted too heavily. This experiential data within the cultural context in which it is interpreted will inform, indeed largely determine, peoples' actions and reactions to particular environmental stimuli. From an adaptive standpoint, the ability to distinguish taste from odor from irritation would seem largely immaterial. Most environmentally significant chemicals are not received as "pure" (single) odors or tastes, but rather as "whole" sensations (complexes of taste, odor and irritation) which will be (indeed must be) analyzed from as wide a sensorial perspective as possible and evaluated in terms of risk/benefit to the individual. I suggest that the four primaries perspective is an important approach for pursuing basic properties of perception (recognition and processing) but is of limited value and indeed may inhibit, a broader conception of the way in which tastes/odor/irritants are understood by humans and how these stimuli influence behavior.

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In Tzeltal there are terms that are equal in meaning with the English words for the "four primaries" (as there appears to be in many, though apparently not all, languages (Chamberlain 1903; Myers 1904; O'Mahony and Tang 1980): *ch'a* (bitter), *paj* (sour), *chi'* (sweet or salty--see below). The special saliency of these terms may result from their physiological importance (Scott and Plata-Salaman 1991). But there are three other terms used with equal frequency and consistency to describe taste sensations: *ya* (pungent/piquant [may also be said of odors]), *sup* (astringent) and *xin* ('disagreeable', also said of odors), (Table 4.2). The sensations entailed in the Tzeltal terms *ya* and *sup* are not uncommonly noted concepts (Myers 1904; Miller and Bartoshuk 1991), but *xin* appears to be unique. *Xin* is interesting, not easily comprehended within any taste scheme. *Ya*, 'pungent' and *sup*, 'astringent' are based on irritation, detected via the trigeminal nerve system (see below) and fit within the usual conceptualizations of taste and odor evaluation. *Xin* is in part hedonic in that the best gloss appears to be 'disagreeable', but it is only part of the designation because plants which are labeled *xin* are not describable by any of the other terms. A plant labeled as *xin* is just that, *xin*. In my notes made during plant collections, a plant noted to be *xin* was usually described as "vaguely unpleasant", "tasted like bean-leaf", "had a distinct plant-like flavor", "no real flavor, vaguely disagreeable", etc., though at times it also indicated a very strong, unpleasant, flavor. Should another taste quality be present that would usually be noted as an additional flavor (*xin sok ch'a tebuk*--'unpleasant and a little bitter'), indicating that *xin* stands as a concept of equal rank to *ch'a*, *ya*, etc.. Table 4.2 bears this out: A

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large number of plants are labeled as *xin* and the percentage of plants labeled as *xin* alone (not modified or combined) is not any different from those labeled as *ch'a, ya*, etc. *Xin* is a concept that in Tzeltal, when dealing with whole odors/tastes, is no less unitary than any of the other terms used to describe plants. My notes on the plant collections indicate that there are no other tastes which predominate, they are not bitter, pungent, or astringent, they are *xin*.

As is discussed in greater detail in Chapter Five, the productive nature of the Tzeltal language allows the combination of these various terms to produce descriptive phrases which can theoretically comprehend any stimulus, including those combining modalities (taste, odor, irritation, texture). From a Western scientific (psychophysical) perspective these are phrases combining various concepts in a string to describe the chemosensory experience at hand. Table 4.2 demonstrates that while the seven taste words commonly used in Tzeltal (counting *chi'* as both sweet and salty) are frequently used as unitary descriptors, there is a significant portion in which they are either modified (*jtebuk ch'a*, 'a little bitter') or more often, combined with other terms to better describe the chemical (medicinal) makeup of the plant at hand.

Quality term	% unmodified	% modified	% in combination
ch'a (n=269)	67	16	17
paj (n=32)	63	13	25
chi' (n=35)	66	31	3
sup (n=168)	67	11	21
xin (n=84)	64	11	25
ya (n=163)	71	12	18

Table 4.2 based on the expanded plant collections database. The "n" is the number of times the term was the first term in the description. Instances where a term was mentioned secondary to others are not included in this number.

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The ability and tendency to label or describe plant chemistry using a variety of concepts in combination seems particularly important in light of the fact that these plants will be ingested, and the way in which they are used is partly determined by the sensations produced upon sampling. For example, a plant like *Polygonum punctatum* which produces a tremendous burning sensation (*lom ya!*) in the mouth with only the slightest nibble is almost never ingested but is restricted to external applications. But, what is still more important is that for a native Tzeltal speaker *ch'ach'atik xyaal* is not only a way of saying "it is kind of bitter and pungent", but represents a concept meaning that sensation and appears to carry with it some indication about how the plant might serve as medicine. For native English speakers there is no more to a phrase of this nature than a description of the sensations produced upon sampling. But for the Tzeltal, to describe a plant in the context of medicine as *ch'ach'atik xyaal* is to provide also some information about how the plant could be used. Thus this plant will not likely be used for treating eye, skin, or wound conditions, but might be used for some kinds of gastro-intestinal or respiratory illnesses. The descriptive terms carry with them not just information about the quality of the plant but contain also some information about the potential value of the plant as medicine. Modified concepts will also add to the plants' significance as medicine. A plant considered to be *lom ch'a* (very bitter) often will be considered more powerful medicine than one considered to be *ch'a jtebuk* (a little bitter). This became apparent during the garden interviews when some informants would label a plant as 'very bitter' (pungent, etc.) because

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they felt that it was a strong medicine. This labeling often would be in contradiction to what everyone else felt the sensation to be.

O'Mahony and Tsang (1980) found that in Cantonese the four primary terms were used when the stimuli were "appropriate" (e.g., sodium chloride, sucrose, quinine, citric acid), but even here the terms were often modified with other words (bitter-rancid, bitter-bland) to reflect the individual's perceptions. A similar finding resulted from an earlier study (O'Mahony and Muhiudeen 1977) in which different concentrations of NaCl were given to English and Malay speakers. English speakers labeled all concentrations of the salt solution as "salty" with no modifications, whereas the Malay speakers were much more apt to modify the term to match perceived similarity with environmental cues ("salty like seawater", "salty like soy sauce", "salty-obnoxious"), indicating that even with the same stimulus, there was considerable variation in description based purely on concentration. Similar variation was found among native English speakers when considering different concentrations of sucrose, glucose and citric acid (O'Mahony et al. 1976).

Odor

Odor is at once less important and more basic than taste in the consideration of plants as medicines. It is less important in that relatively few individuals rely on the sense of smell as their primary mode of evaluating plants, sampling by mouth is much more important. This is borne out by a consideration of the relative frequency of taste terms vs. odor terms mentioned in the plant collection and garden interview databases. There are 490 instances in the plant collection database and 113 in the garden interview

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database in which a plant was unambiguously assigned a single quality term, e.g., *ch'a, xojet*. The plant collections database contained only 29/490 and the garden interview database contained no instances where odor was considered the principal evaluative criterion. But, considered from the perspective of holistic perception, odor is a fundamental component of the process by which plants are evaluated, even though it is seldom overtly stated as such. Plants will be occasionally described using a taste term as the primary word with an odor term as a modifying concept or secondary characteristic. More subtly, many of the plants considered as *ya*, either as the primary designation or in combination with other words often have a highly aromatic component to the taste. While the primary taste sensation is, for example, bitter, there is often a strong sense of spiciness or pungency which only becomes readily apparent when the plant is tasted, it may or may not be detectable simply by smelling (e.g., *Buddleia crotonoides* var. *amplexicaulis, Piper aduncum*, and *Piqueria trinerva*).

The biological workings of the olfactory system are too complex, too little understood with too many alternative interpretions of the data to be meaningfully summarized here in any but the most superficial fashion. Of greatest significance is the very complex way in which the nasal passages are innervated and the multiple processing pathways for the detected odorant chemicals. An odorant chemical enters the nasal passages via the airstream either through the nose or from the mouth. Its detection depends on a cascade of events beginning with capture by the olfactory mucosa, an area of approximately 2.5 cm^2, in the upper portion of the nasal

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passages. Chemicals of appropriate (adequate) vapor pressure (the detection threshold level) dissolve in the olfactory mucus, immediately beneath which is a mat of chemosensitive cilia arising from the distal end of the receptor cells. In a process not yet fully elucidated the chemical is detected by the olfactory receptor cells (probably by adsorption to the olfactory cilia) and a chain of chemo-electrical transduction events results in conduction of the signal to the olfactory processing spaces, both intra- and extra-cranial, primarily through the neural pathways of the first cranial nerve. The intracranial path of the olfactory signal is through the olfactory bulb to the olfactory cortex with important interconnections with other chemosensory nerve pathways (Getchell and Getchell 1991; Greer 1991; Holley 1991; Kinnamon and Getchell 1991; Takagi 1989).

An important point about the neural pathways is that at each juncture there are alternate pathways and the opportunity for action, based on the perception of the chemical in relation to previous experience or expectation (Holley 1991).

Of the various theoretical issues debated by olfactory researchers over the years (Bartoshuk 1978; Bartoshuk, et al. 1985; Cain 1978; Doty 1991), that of greatest relevence here is that of classification of odors (Harper, Bate Smith, and Land 1968). The primary effort has been to develop classification schemes that could encompass and make sense of the tremendous diversity of odors in the environment. Most of the efforts reported by Harper, Bate Smith and Land (1968), Bartoshuk, Cain and Pfaffman (1985), Doty (1991) and others document the work of the scientific community attempting to elucidate an olfactory classification system rather than

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any effort to understand how particular populations organize the olfactory environment. The questions driving these projects largely centered on attempts to understand memory, perception and cognition as opposed to questions of natural history, adaptation and the role of smell in mediating the environment (cf. Engen, Gilmore, and Mair 1991). Unlike color and taste (though still debated), there has never been any successful proposal for "olfactory primaries" (cf. Amoore 1977). Though many have been proposed, none have stood up against scientific testing (Bartoshuk, Cain, and Pfaffman 1985; Engen 1982; Harper, Bate-Smith, and Land 1968). The increasing use of multidimensional scaling has identified broad categories that seem to be "universally" recognized (Bartoshuk, Cain, and Pfaffman 1985; Doty 1991), though I strongly suspect that this universality has not been tested in a cross-cultural context. Among the most prominant attempts at viable classification schemes have been those of Linnaeus (1752)[24], Zwaardemaker (1925) and Henning (1924). Henning's "odor prism" was perhaps the most robust because it postulated relationships among the odors which could be tested for psychological saliency (Bartoshuk, Cain, and Pfaffman 1985), though all of these and subsequent hypothesized relationships eventually failed to gain widespread support.

Most of these classic schemes attempted to identify and label overarching classes into which could be fit the majority of odors one is likely to encounter, while most modern work is applied and concerned with product or commodity (e.g., drinking water) evaluation (Doty 1991:191). In the interest of illustration and comparison with Tzeltal, below, two major systems are repeated

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here: that of Linnaeus (1752), which in many ways is antecedant to most others, and that of Henning (1924); both taken from Harper, Bate Smith and Land (1968). Many other schemes, both general and specific, have been developed and are discussed in detail by these authors, but need not be discussed here to make my point.

Linnaean System	Provisional Translation
Aromaticos	Aromatic
Fragrantes	Fragrant
Amborciacos	Ambrosial (Musk-like)
Alliaceos	Alliaceous (Garlic-like)
Hircinos	Hircine (Goat-like)
Tetros	Foul or repulsive
Nauseosos	Nauseating (Disgusting)

Table 4.3. The Linnaean system of odor classification. From Harper, Bate Smith and Land (1968)

Henning (Fig. 4.1) has the corners of his "odor prism" labeled as Flowery, Fruity, Putrid, Spicy, Burnt, and Resinous. Odors theoretically can be placed along the axes or faces of the prism according to the perceived relationship to the dominant odor principals which are represented by the corners. When opened out the inside of the prism "contains" various odor qualities that would be represented along the faces of the prism.

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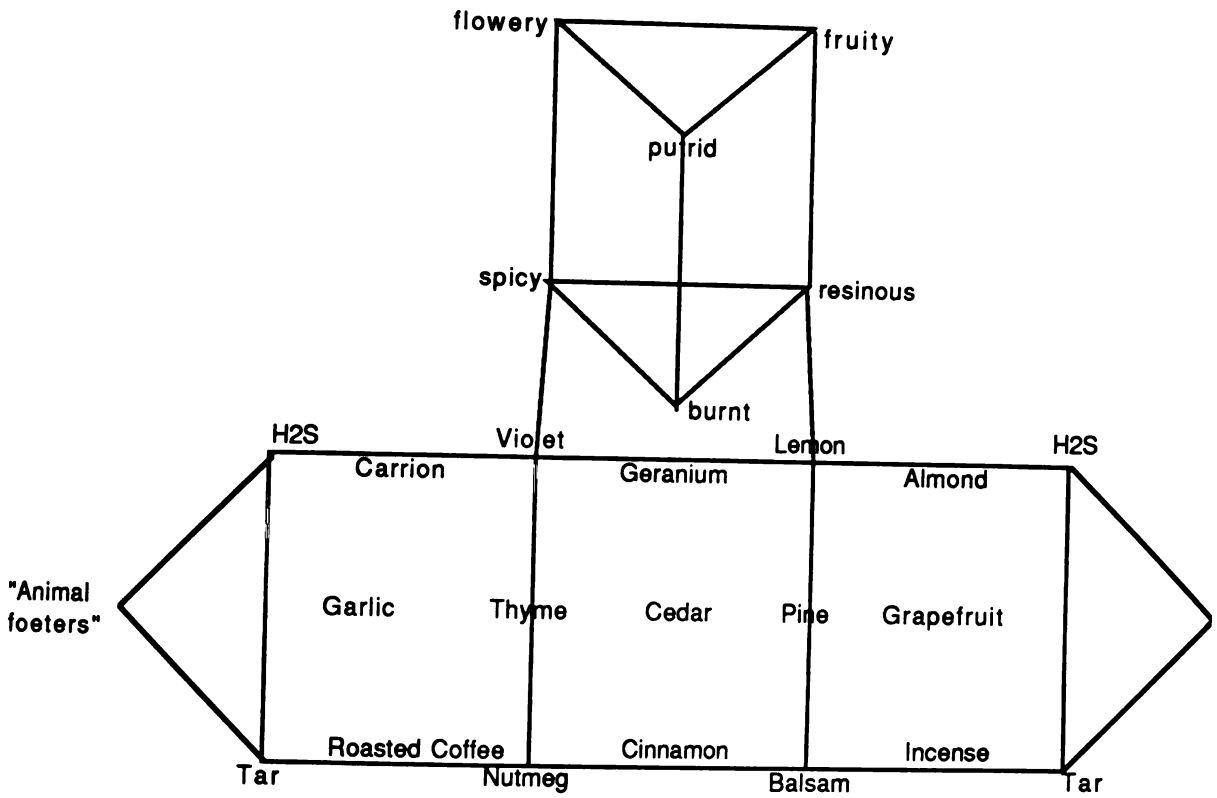

Fig. 4.1 Henning's odor prism. (from Harper, Bate Smith and Land 1968:29)

Most of the classification schemes outlined in Harper, Bate Smith and Land (1968) and represented by those of Linnaeus and Henning (all of which arise out of the Western scientific tradition) contain a mixture of evaluative or organizational principles. These principles can reasonably be glossed as depending on analogy or upon hedonic consideration or some combination of each. The analogic approach classes odors based on what they are like: flower-like (flowery), goat-like; musk-like (musky), garlic-like, etc. While these are considered to be broad categorical statements which encompass a large number of subsidiary or similar odors, they nevertheless rely on reference to culturally recognized odor categories.

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Hedonic categorization is based on the culturally agreed upon degrees of "goodness" (pleasant, nice, pretty) or "badness" (unpleasant, ugly, nasty). Categories such as putrid, nauseating, foul, burnt are all unpleasant, negatively valued, olfactory experiences. It might be similarly argued that flowery, ambrosial, or aromatic which are words positively valued as "good", denote pleasant, desirable odors. This distinction was explicitly recognized by Linneaus and a contemporary author (Haller 1763) and some who based their work on Haller, e.g., Boring (1942). Earlier still, Plato was apparantly content to divide all odors into pleasant or unpleasant (Beare 1906 cited in Cain 1978:203). Each had three categories. Concerning the seven categories in Table 4.3 Linnaeus states: "of which Fragrant and Aromatic odours are pleasant (Suaveolentes) and the Foul and Nauseous unpleasant (Fœtidi). Ambrosial and Hircine odours are pleasant to some and unpleasant to others", and "we feel it (i.e., odours in class I and II) to be kindly and desirable to our nerves and even to life itself", and finally "unpleasant is the name given to that which is repellent to life" (translation from Latin by Harper, Bate Smith and Land 1968:21). Haller denoted "sweet-smelling or ambrosiac odours, intermediate odours, and stenches" (ibid. p.22). Given the level of medical knowledge at this time and the still prevalent view that illness was caused by malodors (Corbin 1986:11ff; Doty 1991:192), it is hardly surprising that odor would also be ascribed healthful or unhealthful value.

In Tzeltal a different system of classification appears to operate. Predominate odor words do not refer to <u>any thing</u>, but rather appear to be conceptual constructs which comprehend or

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include a variety of perceptually related odors. They are abstract concepts which contain within them any number of possible odors, but the labels identifying each category are not likened to anything[25]. In order to explain them to non-native speakers, an informant must rely on specific examples to make explicit these concepts. Thus, the example commonly given to explain *xyuket yik'* is that of very ripe mangos which even at a distance of several meters will fill the air with a rich, heady aroma, immediately noticable, often making one consciously take note of the odor, even though we are otherwise occupied with the business of buying the day's produce. But, *xyuket yik'* is not the smell of fresh, ripe mangos, it is the mental construct which, among other odors, encompasses the smell of fresh, ripe mangos; of which ripe mangos is a readily relatable example. This issue is one of reference. As noted above, many terms in English and related languages rely on analogy, even at the most general level to label odors; flowery (flower-like), earthy (earth-like), etc. It is a reference to some known thing with which most people will be familiar, whereas in Tzeltal *xyuket yik'* does not refer to any known thing. The closest terms in English that seem to be conceptually similar are general terms like "aromatic", "fragrant", "ambrosial", or "putrid". Interestingly, these are terms that were used more frequently to classify odors by early scholars (Linnaeus, Haller), than by latter scholars who, in the interest of detail and precision, relied much more heavily on analogic words (see Table II (1), in Harper, Bate Smith and Land [1968:21]). To invoke a particular odor term in Tzeltal depends on the physical nature of the odor and the individual's relation to it. Thus as noted above for

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xyuket yik', one of the important elements of that kind of odor is a clear presence even, or especially, at a distance. Based on my understanding of the odor I would suggest that *Allysum*, *Tilia*, and *Ligustrum* are common U.S. urban examples. Similarly *jik'jik' yik'* is any odor which causes one to catch one's breath (hence the onomatopoeic term), indicating the possibility of trigeminal nerve stimulation. Roasting or burning chilis is the common Tzeltal example, while ammonia or Mentholatum (or Tiger Balm) would be common examples in the U.S. Table 4.4 lists the odor words commonly encountered in relation to medicinal plants and a brief English gloss or explanation. Complete descriptions and representative plants may be found in Appendix C.

Tzeltal word	English gloss/explanation
jik'jik' yik'	any odor which is sudden, surprising, piercing--burning chilis
k'ojoj yik' = kojoj	the smell produced when something is toasted, like a tortilla-->tostada
xyuket yik'	something with a strong odor, perceivable at a distance, *Allysum*, mango
tuj (tul)*	foul odor, like feces
tzij yik' (tzijtzijtik)	medium bad odor, musty, earthy, dense
xojet (sowjet)	very pleasant, sweet odor
*siset yaal**	the sensation of Vick's vaporub applied under the nose
xinxintik (xin)	not good not terrible, vaguely unpleasant, likened to raw meat, raw eggs

Table 4.4 Tzeltal odor terms. Those terms uncommonly encountered are marked with an asterisk.

The arbitrary (nonreferential) nature of these categories can be found in a consideration of *tzij yik'* and *jik'jik' yik'*. *Tzij yik'* is not a common term in relation to medicinal plants, mentioned only twice in the garden interviews and five times in the plant collection database, but the examples given to explain it demonstrate the range

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of possible odors within it. It is generally described as mildly to medium unpleasant. There are four examples from various aspects of the research each of which demonstrate a particular facet of the odor category *tzij yik'*. The first example arose when I was seeking definitions and and explanations of the terms. It was explained in terms whose cultural specificity perfectly illustrate the complexity of the concept. It was described as being like the smell of the water which drips through an old thatch roof (usually *Muhlenbergia* spp.) during a heavy rainstorm. An old thatch roof is moldy, insect and rodent infested, dense with 10 or more years of wood smoke and dust. The resulting filtrate is light yellow and *tzij yik'*. A second example is from the domain of health: When a person with a very high fever urinates, it is dark yellow and *tzij yik'*. The plant *Bidens aurea* was described occasionally as *tzij yik'* (also *ch'a*--bitter, and *xin*--disagreeable). Finally, during the taste/odor experiment, lavendar oil was nearly universally described as *tzij yik'* (one person described it as *pajpajtik*--sour).

Jik'jik' yik' or merely *jik'jik'* is a complex term whose signal characteristic is the element of surprise. An odor which is *jik'jik'* generally makes one take note physically, recoiling to one degree or another, regardless of the perceived pleasantness of the odor. The primary reason for this, in my experience, is that substances which are *jik'jik'* often stimulate trigeminal nerves, or alternatively, they are simply very intense odors. (Some odors become irritating and often are perceived as unpleasant at high concentrations (Green and Lawless 1991) There is no necessary hedonic evaluation implied in the term, although because of the intensity with which the odor is

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perceived, they are not always positively regarded. The most frequent, spontaneous example people give when asked to define *jik'jik'* is hot chili peppers toasting or burning on a *comal* (griddle) or in the fire. In this case the resulting "odor" will surely stimulate trigeminal nerves and cause one to automatically withdraw. But, during the taste/odor experiment Sandlewood incense, Indian tea spice, spearmint oil and cinnamon oil were all labeled as *jik'jik'*, though not routinely. Similarly, during the plant collections, a wide range of plants were considered *jik'jik'*, some of which were very pleasant to me. *Litsea neesiana* (coll. #312) has a delightful, piercing odor that I described at the time as something between fresh-cut apples and cherry. Another plant, *Nama dichotomum* was described in my fieldnotes as "an incredibly intense, quite pleasant odor. Can't think of any way to describe it" (coll. # 424a), or on another occasion "Has a delightful 'wintergreen' odor, a little hot to the taste" (coll. #497). One other example: *Poropyllum ruderale* was described as "*jik'jik'*, very strong, surprising smell, I couldn't identify it as familiar" (coll. #409). A point to note here is that although the term was obvious to them, I needed, and often failed, to label or identify the odor according to something with which I was familiar.

A final point to make about *jik'jik'* is that it may be combined with other terms either to portray more exactly the odor or to state a hedonic value. Thus *jik'jik' xyaal* implies an odor which is clearly piercing and potentially painful or hot (*Peperomia liebmanii*). Or, *jik'jik' xojet* clearly implies something that smells intense but very agreeable: cilantro (*Coriandrum sativum*), mint (*Mentha sp.*), lemon

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grass (*Cymbopogon citratus*), or marigold (*Tagetes lucida*) are examples given to illustrate this term.

These two examples illustrate the complexity and breadth of Tzeltal odor concepts and likewise demonstrate that they are not perceived as being <u>like</u> anything, but rather are cognitive categories which comprehend within them a number of distinct odors (as we would view them). The Tzeltal system, like that of Linnaeus, is not concerned with precise identification and grouping of specific odors, as later schemes tend to do, so much as it labels particular kinds of olfactory stimuli as similar (i.e., belonging to a class).

The question arises: if there is no universal organizational scheme for odors, as there clearly is for color (Berlin and Kay 1969), and for plants and animals in the natural environment (Berlin 1992), how do humans cognitively maintain control of the potentially huge number and variety of odors with which they must contend? As will be discussed below, the issue is less one of classification and organization, but rather and more importantly recognition (implicit or explicit) of the <u>value</u>, real or potential, of an odor (or taste). Value in this context has more to do with the hedonic evaluation of the odor as good or bad. "Good" and "bad" in this context need to be considered from a physiological and adaptive standpoint--what are the consequences of chemical sensations to an organism if ingested or not avoided. It is obvious that, put in this context, odor cannot be easily divorced from taste. The problem for the organism is that of defining the chemical sensation as pleasant/unpleasant, valuable/not valuable, useful/not useful, desirable/dangerous, etc. In a sense it is a dichotomous classification system, but this classification never (or

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seldom) occurs in isolation, but always in the context of other evaluative criteria.

When I speak of the value of an odor, it is not in the same sense as value (use) is spoken of in the "utilitarian vs. intellectualist" debate in ethnobiology (Berlin 1992:3ff), but rather value at a more fundamental level of physiology, and ultimately survival of the individual. It was evolutionary pressures which required that humans, no less than other animals, learned to recognize (categorize) good (beneficial or harmless) odors from bad (deleterious or discomforting) odors. Value in an evolutionary framework has more to do with evaluation and recognition of environmental chemicals as potentials; potentially edible, potentially poisonous, potentially medical. The process by which this value is elucidated is a complex of chemosensation (biological), cultural knowledge and individual learning. I will explore this process in more detail below.

Many early classificatory systems were explicitly based on the value of an odor (or taste) in relation to the health of the organism. Plato, as discussed by Theophrastus said that "[o]dours...admit of no <true> classification, but are distinguished by their painful or pleasant <effect>" (Stratton 1917:145).

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Trigeminal

The trigeminal nerve system (cranial nerve V), originally defined as the "common chemical sense" (Parker 1912) because of its role in detection of chemical irritants provides sensory innervation to nearly the entire face and which fibers serve a variety of physiologic roles: mechanoreceptors, thermoreceptors (warm or cold),

nocioceptors (responding to pain), and proprioceptors (detection of muscle and joint position) (Silver and Finger 1991:97). In the posterior portion of the mouth, detection of irritating substances is carried out by the glossopharyngeal nerve (ibid. p.104). While the trigeminal nerve system is involved in a wide range of somatasensory tasks, the primary concern in relation to medicinal plants is chemethesis--the detection of irritant chemicals. The trigeminal nerve endings are heavily invested in the mucosa of the eye, mouth and nose. The largest populations, exclusive of the ocular system, are in the anterior two-thirds of the mouth and throughout the entirety of the nasal passages. These free nerve endings are found at varying depths in both the oral and nasal mucosa in association with taste buds and olfactory reception cells. Having "free" nerve endings very near the epithelial surface perhaps explains the very short reaction times from irritating chemicals which may interact directly with the nerve endings (Silver and Finger 1991:101). Additionally, nerve endings at various depths may prevent, or inhibit (limit) adaptation and fatigue to irritating stimuli. While sensory endings near the surface may become fatigued, those at deeper levels respond as chemical stimuli migrate through the upper epithelial layers. If the trigeminal system is primarily to detect noxious and/or potentially dangerous chemicals, then there is an advantage to being able to continue monitoring the environment after initial exposure. Odor sensation quickly abates while trigeminal sensation continues over a much longer time and is maintained at much higher levels (Cain 1990:53). While this is a

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plausible explanation, the physiology is yet too little understood to make a definitive statement.

Stimulation of the free nerve endings of the nasal mucosa (which may occur via the mouth) produce "physiologic reflexes that are among the strongest in the body". (Silver and Finger 1991:101). Anyone who has eaten too much "Chinese" mustard or wasabi ("Japanese style" horseradish) or suffered a sudden, unaccountable sneeze can attest to the strength of these reactions which are designed to "minimize the effects of noxious stimuli and protect the animal from further exposure" (ibid.). The strength of the reaction may be due to a) the particular chemical stimuli and b) the relative strength of the stimulus, though there is as yet no evidence indicating there is reaction specificity to particular chemicals on the part of individual trigeminal nerve endings; i.e., there is limited indication that different chemicals elicit different responses (Silver and Finger 1991:103-104).

The trigeminal nerve system is both independent of and closely linked with the senses of taste and smell. It is independent in that chemicals which predominantly stimulate the taste and odor modalities generally will not stimulate the trigeminal nerves until their concentration has reached very high levels (Silver and Finger 1991:102). Similarly, the trigeminal nerves are much less subject to adaptation (loss of sensation under continual exposure) than taste and odor receptor cells. Chemicals which have an odor and which are irritants (ammonia, formaldahyde) will cease to have a noticable odor fairly quickly but will continue to produce a sense of irritation for a considerable time. This seems pretty obviously an adaptive

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mechanism suggesting that trigeminal response is geared toward detection of noxious environmental chemicals whereas the sense of smell (and/or taste) is more broadly concerned with environmental evaluation and diet (Cain 1990). But, while in the laboratory setting it is possible (usually) to separate odor from irritation from taste, when considered in a naturalistic light, they appear, at the level of central nervous system processing, to be holistic. Perception is holistic for most materials, being clearly recognized as a "taste", "odor" or "irritant" only at the extremes or when dealing with the "pure" stimuli necessary in laboratory based experiments (ibid.).

Tzeltal recognition of trigeminal stimulation has been discussed somewhat above in the context of taste and odor. There are four terms which seem unambiguously to indicate irritative stimuli: *ya* (pungent, may be oral or nasal), *sup* (astringent), *sak'* (produces itching), and *jik'jik'* (piercing, sharp odor). *Ya* and *sup* are frequently mentioned descriptive terms for medicinal plants, each representing approximately 18% of the instances in which a single term was applied to a plant in the plant collection database. *Sak'* and *jik'jik'* are uncommon, having been mentioned only eight and nine times respectively out of a total of 490. Each of the terms is fairly unambiguous in its designation, and based on my sampling of the plants, would probably map clearly against similar concepts in English. *Jik'jik'* has been discussed in detail under odor and will not be considered here. While *ya* is best glossed as pungent and/or piquent, it covers a range of sensations or flavor/odors. *Ya* describes either a taste or an odor, though the former is more usual when considering medicinal plants. An odor may be *ya* when considering

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something which has a pungent, highly aromatic quality to it. The taste/odor experiment indicates the range that this may take in that Tiger Balm, spearmint oil, and fresh ginger were each described as *ya* by some informants, even though, in the case of ginger, it may not have been tasted before pronouncement of quality. The more important manner in which odor acts to define a chemical as *ya* is via the mouth. Often when a plant is sampled (tasted) there is an unmistakable, often intensely aromatic sensation throughout the oral/nasal region. These plants would inevitably be labeled as *ya*, often in combination with other terms, usually *ch'a*. *Piqueria trinervia* (#709), *Salvia urica* (#616) and *Solanum torvum* (#469) are examples of plants which produce a clear sense of bitterness, but which are also perceived as pungent. More often the sensation is simply that of pungency, though here too there may be a definite aromatic component as well. Garlic, Chinese mustard, fresh and dried ginger are all examples of food items consistently labeled as *ya*, while *Achmella oppositifolia*, *Clematis grossa*, *Erigeron karwinskianus*, *Polygala* spp., *Salmea scandens*, and *Sisyrinchium* spp. are commonly used medicinal plants which produce a pungent sensation upon tasting.

There are two types of phenomena which produce the sensation of *sup*. The distinction between them is in part the difference between physical and chemical stimuli. The physical manifestation is the result of, usually dense, covering of leaf hairs, which produces a sensation similar in feeling to the more usual chemically induced astringency. Chemical astringency usually results from changes to the proteins of the tongue when exposed to

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astringent chemicals, especially tannins. *Achimenes grandiflora* and *Clitoria polystachia* are examples of physical astringency, and *Psidium guineense*, *P. guajava*, and *Brysonima crassifolia* are examples of plants which produce a clear chemical astringency when tasted.

Sak', like *sup*, can result from physical or chemical stimuli where leaf hairs may cause itching because they are sharp or because they contain irritant chemicals; *Desmodium aparines* and *Salvia urica* are excellent examples of plants which cause itching due to the stiff hairs on the stem or leaves, while *Acalypha macrostachya* and *Crusea microcephala* may be indicative of chemical involvement, though they too have leaf hairs.

To sum up this discussion I will present the results from the taste/odor experiment (see methods chapter). I am presenting them separate from the rest of the discusion because these data nicely illustrate the variable nature of chemosensory experience in that a) different people attend to different aspects of the same stimulus, and b) interpret that stimulus differently according to individual perception. In the first case some individuals will label an item according to its odor, while others will comment chiefly upon its taste. Note also that in some cases the results are radically different from what would have been expected had the same question been asked in the U.S. These data are presented in their "raw" form, in part, because it is the variability in response that is instructive, and in part because the relatively small number of informants (7) makes meaningful summarization difficult. In the cases where there are

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identical answers, the number of informants who gave that answer is in parentheses following the quality term.

ITEM SAMPLED	TASTE/ODOR DESIGNATIONS
Chinese mustard	ch'a (2)
	chi'tik, yayatik
	lom (ben) ya (2)
	ya
	yayatik
Cinnamon oil	jik'jik'et butz'an
	paj
	pajpajtik (3)
	pajpajtik xyaal
	xojet
Cocoa	ch'a (2)
	ch'a jtebuk/ch'ach'atik (2)
	supsuptik xyaal
	xiket, yayatik
	xojet, ch'ach'atik
Espresso	ch'a (50
	mero ch'a (2)
Fresh ginger	xojet, ben ya
	ya (5)
	yayatik
Garlic	ya (3)
	yayatik (4)
Incense	----
	jik'jik'yik'
	kojoj
	pom (incense)
	tokok
	tzijtzij yik'
	tzijtzijtik
Lavendar oil	ch'a
	pajpajtik
	tzij yik' (2)
	tzijtzij yik' (2)
	xiket yik'
Powdered ginger	ch'ach'atik
	ch'ach'atik xyaal
	lom ya
	ya (2)
	yayatik
	mero ch'a, ya
Salt	ben chi'
	mero chi'
	chi' (5)

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Spearmint oil	ch'a, jik'jik'
	jik'jik' yik' butz'
	tzijtzij yik'
	xiket yaet
	xojet
	ya
	yayatik
Sugar	chi' (7)
Tea spice	ch'ach'tik, teb ya
	jik'jik' yik'
	xojet
	ya (2)
	yayatik (2)
Tiger balm	jik'jik' yik'
	xinxintik
	xojet
	ya (2)
	yayatik (2)

Table 4.5, taste/odor experiment data. The purpose of this exercise was two-fold: 1) to present culturally novel items to Tzeltal informants for evaluation with the aim of testing the degree to which taste and odor evaluation is culturally mediated; 2) to elicit Tzeltal terms for items likely known by readers of this report.

In the realm of taste there are no particular surprises with one exception: salt and sugar (or salty and sweet) are designated by the same term, *chi'*. In discussing this with informants, no one was able to state why this might be the case--it simply is. But, while the term to describe something as sweet or salty is the same, the two 'flavors' are not the same; there is no confusion about something being salty or something being sweet. Confusion arises only if there is no context in which the term is used. Thus when soda pop is referred to as *chi'* there is no expectation that salt is the flavor being described. Likewise beans being referred to as *chi'* would not be so because of the presence of sugar. One person summed up the difference in this fashion: "El sal es unicamenta para la comida, es muy podoroso, se afecta la boca, no puede chupar mucho, muy fuerte" ("Salt is only for food, it is very strong, it affects the mouth, one can't consume much,

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very strong") whereas "Azucar es para bebida, es muy sabroso, no se afecta la boca, no es muy fuerte". ("Sugar is for drinking, it is very tasty, doesn't affect the mouth, it is not very strong".). Something that is very (unpleasantly) salty is "*ch'a chi'*" (muy salado, directly translated it could be "bitter sweet"), or if there is merely too much salt (too salty) one could say "*ay bayel yatz'am*". Too much sugar (or very sweet) on the other hand would be "*lom chi'*" (very sweet). A lot (or too much) sugar could be expressed as "*ay bayel xchi'il*". This indicates to me that, perhaps the root meaning is applied to sugar and then is extended to salt as an evaluative/emotive expression because *ay bayel xchi'l*--there is much sweetness--and *lom chi'*--very sweet--use the same root *chi'*, whereas *ch'a chi'*--very salty--and *ay bayel yatz'am*--much salt are different.

Explaining why there is no clear distinction in taste terms between 'salty' and 'sweet' is difficult. The reason does not lie in the fact that at some point they did not have access to one substance or another. There was a thriving salt trade in highland Chiapas when the Spanish arrived and wild honey was frequently available. There are distinct words for each concept *asukar* (clearly a Spanish loan denoting refined sugar) and *atz'am* (salt), and *chab* refers to honey, even though the evaluative word is the same, *chi'*. Meyer (1904) noted a similar situation in several societies: "The literal meaning of the phrase commonly used in Torres Straits to denote sweetness is 'tasting good'....The same phrase is applicable to denote saltiness." (p.119). I think there is an element of this same sense in the use of *chi'* in Tzeltal; foods (or plants) which are pleasant, good, desirable (or innocuous), but which do not have any other clear taste/odor

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may be labeled as *chi'*--good. This concept stands opposite to *xin* in this sense--something which is unpleasant, undesirable, not good, but which does not have a clear bad taste/odor may be described as *xin*. This is in contrast to several Algonkian languages cited by Chamberlain (1903:152) in which he notes that the same root is used to denote (with modification) 'sour', 'acid', 'salt', and 'sweet'.

Finally, it is tempting, in this light, to speculate that the reason why these two concepts are evaluated using the same term relates to their fundamental significance physiologically. Both sugar (glucose) and salt (sodium, potassium) are essential biologically and detection of these flavors serve as important indicators of underlying food value. At the same time both are potentially scarce, however valued they might be. They are necessary, potentially or actually scarce and therefore valued in much the same way (Johns 1990a:235). Some small evidence of this can be found in the following anecdote. The paraje of *Chi'il ja'* ('sweet water') in Cancuc is named after a spring which arises near it. In a conversation with a friend about the community, he noted in passing that: "The people there are really lucky, they don't have to buy salt, they just get it from the water". The spring is called *Chi'il ja'* because of the saltiness of the water, so salty in fact that it satisfies their needs for salt-taste.

One other point which warrants comment is the variable assignation of quality terms to 'Chinese mustard' and 'powdered ginger'. In both cases three informats labeled these items as bitter (*ch'a*) where the other informants labeled them in accordance with the usual expectation of pungent (*ya*). In the case of ginger, there is something about the powdered form which produced the sensation of

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bitterness, since fresh ginger did not elicit any responses of bitterness. The mustard had been freshly prepared with water so any effects of powder would not be apparent.

In the realm of odor, the variation both among informants, and between Tzeltal and that which I would have stated as a native English speaker is fascinating. Most of the items exclusively sampled by smell would be counted as 'nice' smelling in U.S. society: cinnamon, lavendar, and spearmint oils, sandlewood incense, and "Tiger Balm" liniment. 'Cinnamon oil' is labeled with words denoting "pleasure" or "nice" (*jik'jik'et butz'an, xojet*) by only two informants, while all others stated that it had a sour odor (*paj*). Lavendar oil was labeled as *tzij yik'* which implies that it is not a particularly pleasant odor, while the spearmint oil is labeled by a wide variety of terms; each informant seems to have perceived it differently. The label applied to Tiger Balm indicate the stimulation of the trigeminal nerve system, not surprising given its ingredients (camphor and menthol). Finally the incense, while as a concept is not novel, this particular variety (Sandelwood) is foreign. Again, there are a wide range of terms applied, depending on individual perception, including one where the informant simply could not think of any way to describe the sensation. One term warrants mention--*tok'ok*. This is a very infrequently mentioned term and refers to or describes a sensation of something perceived deep in the sinus cavity. We might describe it as filling the head with odor, it is not so much smelled as felt as a presence deep in the sinuses.

These data are consistent to a large extent with laboratory research in which people can generally identify and label "correctly"

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taste sensations, but are much less consistent when defining or describing odor concepts (Engen 1991).

Chemosensation and Medicinal Plant Selection

This section will address the way in which chemosensation serves to identify and categorize plants as medicinal. The questions addressed center around two related issues. 1) What is the role of chemical perception in defining plants as medicinal? How are biological abilities and cultural skills brought to bear on identifying plants as medicines? 2) To what degree is this related to the chemical, or more specifically, pharmacological potential of the plants? Given the relative lack of biochemical data on most of the plants used as medicines in Chiapas, the second question can be addressed only in the most general way, providing a framework for future, more specific, investigations.

Trotter and Logan (1986) discuss a variety of approaches to identify medicinal plants which may warrant investigation for their pharmacological activity. All of these methods rely in one way or another on consistent patterns of usage. This consistency may be across geographic space where related plants are used for similar conditions in (ideally) geographically isolated locations (e.g., Elvin-Lewis 1986). The assumption of empirical skills among traditional societies would argue that a consistent usage over a wide geographic area indicates that these plants exhibit properties that meet the needs of practitioners and patients, presumably resulting in a positive change in health status. In a related vein, continuity through cultural space or time ("historical continuity") (e.g., Ortiz de Montellano 1975) argues that if a plant is continuously used across

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societies or through time in any given region, it is because it has some properties that generations of people consider valuable. The plant meets health needs in such a way that the medicine is maintained in the pharmacopoeia across time. These plants too deserve attention for their potential pharmacological activity. A derivative method, informant consensus, assumes also that consistent use of particular plants across a large number of informants within one cultural setting (or perhaps cross-cultural within a small geographic area) is indicative of possible pharmacological value. Informant consensus, implicitly or explicitly, is the basis of much current medical ethnobotanical and ethnopharmacological research (e.g., Berlin et al. 1986; Berlin et al. 1989; Browner 1985a; Browner, et al. 1988; Heinrich, Rimpler, and Antonio Barrera 1992a). The basic tenet of informant consensus is that "[t]he greater the degree of group consensus regarding the use of a plant based therapy, the greater the likelihood that the remedy in question is physiologically active" (Trotter and Logan 1986:95). Those plants which are consistently used to treat the same or similar conditions by a large number of individuals are those which should be investigated in greater detail for their pharmacologic components. The fundamental assumption underlying this methodology is that the empirical skills people bring to their use of medicinal plants will, through time (and across space), identify and continue to utilize those plants which make a difference in the health of the individuals being treated. This assumption has been verified in a number of studies (Berlin and Berlin, et al. in press); Browner, Ortiz de Montellano and Rubel 1988; Heinrich, et al. 1992a; Trotter and Logan 1986).

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A second assumption, essentially the reverse of the first, is that those plants inconsistently or infrequently used will less likely exhibit effective pharmacological properties. From an ethnopharmacologic approach, this is probably true; the data presented by Trotter and Logan (1986) would seem to bear this out, but there is another dimension to this process. Although the reference point of these methods is ethnomedical or ethnopharmacological, the usual focus is toward the identification of plants that may be usefully researched further for their anticipated pharmacological properties. Thus the emphasis is on the "pharmacological" half of the equation rather than on the "ethno" half. The data are gathered or utilized largely to orient biochemical research toward those plants most likely to yield useful compounds (Duke 1986). A focus on the "ethno" portion of the statement reveals other dimensions by which to consider medicinal plants. The data reported here support the informant consensus model and verify it as an important approach to identifying potentially effective medicines. But, of equal significance is the revelation of the underlying cultural logic by which these plants are selected and evaluated as medicines (cf. Browner 1985a; 1985b; Messer 1978). The data presented here indicate that from an ethnomedical perspective, there may be criteria linking apparently disparate species.

By inquiring into why or how plants are known to be good medicines a new complex of data emerges which demonstrates on the one hand part of the logic of the informant consensus model, while on the other hand explaining some of the otherwise seemingly

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meaningless (or patternless) variation. If our interests are purely chemobiological, seeking only to identify plants for additional biochemical investigation, then the variation is relatively unimportant, so long as it does not obscure the dominant usage patterns. But, from an anthropological perspective identifying and explaining the variation in use and thus knowledge is of at least equal interest and importance.

Tables 4.6 through 4.8 contain the data for the following discussion. Table 4.6 is drawn from the unexpanded plant collections database, 4.7 is from the same data set, but in its expanded form, while 4.8 is from the garden interview database. Each dataset will be discussed following the table in which it is presented.

Plant name	Dominant illness class	Dominant quality term
Calea ternifolia (5)	gastrointestinal (7/8)	*ch'a* (5/5)
Ageratina bustamenta (5)	gastrointestinal (4/5)	*ch'a* (4/5)
Stevia ovata (6)	gastrointestinal (4/9)	*ch'a* (6/6)
Cordia spinescens (6)	gastrointestinal (4/7)	*sup* (3/6), *ch'a* (2/6)
Pluchea odorata (6)	gastrointestinal (3/6)	*sup* (3/6), *ch'a* (2/6)
Prunella vulgaris (6)	gastrointestinal (6/6)	*sik* (2/6)
Salmea scandens (8)	G-I (7/12), tooth decay (4/12)	*ya* (6/8)
Clethra suaveolens (5)	respiratory (5/5)	*sup* (5/5)
Lantana camara (6)	respiratory (3/7), fever (2/7)	*ch'a* (3/6)
Erigeron karwinskianus (6)	respiratory (5/7)	*ya* (6/6)
Viburnum hartwegii (6)	respiratory (8/9)	*ch'a* (6/6)
Valeriana scandens L. var. candolleana (7)	wounds/severe rashes (6/7)	*sik* (4/7)
Anoda cristata (6)	wounds (8/9)	*bilil* (3/6)
Asclepias curassavica (6)	wounds/severe rashes (8/9)	*sik* (2/6), *ya* (2/6)
Iresine celosia (6)	wounds (4/6)	*sik* (3/6), *xin* (2/6)
Achmella oppositifolia (6)	wounds (4/8) [G-I (2/8)]	*ya* (4/6)
Euphorbia graminea (8)	skin/wounds (4/8)	*sik* (4/8)
Gnaphalium attenuatum (5)	eye conditions (5/7)	*sup* (4/5)

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Monnina xalapensis (8)	eye conditions (6/8)	*sik* (4/8), *chi'* (2/8)
Salvia coccinea (5)	eye conditions (3/6)	*sik* (3/5)
Alloispermum integrifolium (5)	headache (3/5)	*xin* (4/5)
Polygala paniculata (6)	severe body pain (6/8)	*ya* (5/6)
Passiflora sexflora (5)	body pain (3/6), earache (2/6)	*ch'a* (4/5)
Rhus terebinthifolia (6)	tongue conditions (7/9)	*paj* (6/6)
Plantago australis ssp. hirtella (6)	tongue conditions (10/10)	*sup* (3/6)
Lobelia laxiflora (6)	female reproductive (4/7)	*sik* (2/6), *ya* (2/6)
Tagetes lucida (5)	female reproductive (4/6)	no pattern

Table 4.6 The data are from the plant collection database, unexpanded version, representing all species collected 5 or more times. The number in parentheses following the plant name is the number of times the plant was collected, those following the health condition categories represent the proportion that the species is used to treat conditions of that type. The numbers following the health conditions do not agree with those of the plant collections because in many cases the plant is used to treat more than one illness. Finally, the numbers following the quality designation represent the proportion that the designation was applied to that plant.

Table 4.6, consisting of all plants represented by 5 or more collections, demonstrates clearly the principles of informant consensus. Plants collected from different informants, at different times and locations, show remarkable consistency in use for treatment of particular classes of illness. With only a few exceptions, each species is clearly used to treat ethnomedically related conditions within single illness classes. Based on the kinds of conditions treated (e.g., wounds, diarrhea, respiratory conditions) and the consistency with which each is applied by a variety of informants (overall 72%), these plants would warrant additional investigation for possible physiological effects as Trotter and Logan (1986) suggest. The third column of the table is equally instructive in that it clearly demonstrates the consistency with which these plants are labeled according to their chemosensory properties. In the majority of cases they are clearly known to be of a particular quality. Often, if there is

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"disagreement" among informants, it arises because the taste/odor quality is in some way ambigious. Many plants have more than one detectable taste or odor, none of which is necessarily more pronounced than another. In a similar fashion there may be variation in chemosensory quality among different parts of the same plant. Roots, stems or leaves may all be used by different informants, and have different chemical makeup resulting in unique taste/odor qualities. Occasionally there is often substantial variation among plants of the same species, at times, even within the same population. In consequence different informants may report different sensations, no one of which is more "correct" than another. And, as discussed in chapters 3 and 5, *sik* and *k'ixin* are generally applied in response to the perceived status of the illnesses they are used to treat.

A point to be developed in more detail in the following two tables is also evident here: the tendency of particular chemosensory terms to cluster with illness classes. An especially clear example is the way in which bitter (*ch'a*), and to a lesser extent, astringent (*sup*) plants are used to treat gastro-intestinal kinds of health conditions (cf Heinrich, et al. 1992a). Not only are plants of particular taste often consistently used to treat classes of illness, but of equal importance, these plants tend to be of similar chemical quality. Note that with the exception of *Prunella vulgaris*, and *Salmea scandens*, all of the plants used to treat gastro-intestinal illnesses are *ch'a* or *sup*.[26] A consideration of tables 4.7 and 4.8 will permit a deeper examination of this point.

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Quality	G-I	Respir -atory	Eyes	Skin grp 1	Skin grp 2	Wound	Fever	# of species
ch'a	64	20						124
ya	35	22	15			15		86
sup	25	31	25					103
paj		48		35				13
xin	42	22				17		61
chi'	29	42					16	26
sik			19			42		73

Table 4.7 Data from the plant collection database, expanded format. The data are expressed as percentages and are those for which plants of that quality are used to treat the corresponding illness categories. Only those illness/quality relationships which occurred with a frequency greater than 15% are included, hence most rows do not add up to 100%.

Quality	G-I	Respir -atory	Eyes	Skin grp 1	Skin grp 2	Wound	Fever	# of species
ch'a	83							19
ya	22	17		22	19	15		16
sup	44	16	25					13
paj	40	60						2
xin	50	50						6
sik		16		42		19	16	11

Table 4.8 Data from garden interview database. See Table 4.7 for explanation of data.

The data presented in tables 4.7 and 4.8 are from two different data sets collected under considerably different circumstances, yet they present very similar patterns[27], notably that plants of particular chemosensory qualities are used to treat ethnomedically related health conditions across species. The significance of this is that while plants of specific taxa will often be used consistently to treat single or similar kinds or illnesses, as would be predicted by the informant consensus model, it may well be the underlying chemical sensation that determines plant use, rather than the fact that it is taxon x, y, or z. This can be easily seen by an examination of Table 4.7 where 84% of the plants labeled *ch'a* are used to treat only two classes of illness, gastro-intestinal and respiratory, with gastrointestinal conditions clearly predominate at 64%. Table 4.8 is

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even more pronounced in that 83% of the plants whose primary designation is *ch'a* are used to treat gastrointestinal illnesses. The data in these two tables are based on the qualities of the plants and how they correlate to illnesses. By turning this around and considering the illnesses in relation to the plant qualtities used to treat them we get a pattern which further strengthens the argument. Fifty percent of all ethnomedically defined gastrointestinal illnesses are treated with plants whose primary designations is *ch'a* (vs. 16% and 14% for *ya* and *sup* respectively). If we decompose this 50% figure a bit further and consider individual illnesses we see that the pattern is stronger still: *K'ux ch'ujt* (stomachache) occurs 41 times in the plant collections database, 29 (71%) of which are treated with bitter plants; *k'ux o'tanil* (upper gastric pain) occurs 51 times, 38 (75%) of which are treated with bitter plants. Conversely, a consideration of *lukum* (intestinal parasites) demonstrates a different pattern, easily explainable in ethnomedical terms about how to cure particular illnesses and the action of medicines on disease entities. Of the 28 collections for *lukum*, eleven (39%) are bitter plants, while 13 (46%) are pungent (*ya*) plants. This is easily understood in light of the expectation of medicines used to treat parasites. The usual expectation is that the medicine will kill the parasites, resulting in their expulsion. In most cases where the etiology involves *lukum* or *chan* ("worms"), the treatment is by *ya* plants which are known to kill the causative organisms. From this perspective , it can be seen that whether one considers the nature of the plant (its chemosensory quality) or the ethnomedical expectations of what constitutes appropriate qualities to treat

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particular kinds of illnesses, the results are much the same; one of the primary features of plants used to treat gastro-intestinal conditions is their bitterness.

The other point of import in tables 4.7 and 4.8 is the numbers of species mentioned as effective in treating the classes of health conditions in each column. This figure, in the last column of each table, indicates that while there are a large number and wide variety of taxa used to treat, in this example, gastrointestinal illnesses, most have one thing in common--bitterness. It is the bitter taste quality of the plants that defines them as medicine. Embedded within these large numbers are the clusters of specific taxa that characterize the informant consensus model discussed above (Table 4.6). Also included here are the many plants which were collected fewer times (often only once or twice) which therefore fall outside of the criteria of the informant consensus approach and yet, ethnomedically they are no less medicines than the more commonly known and used plants. An important consideration, outside the scope of this study, would be a comparison of frequently used, well-known plants with lesser known and used plants, all with common chemosensory qualities, to determine their potential healing properties (pharmacological) and their actual curative nature (clinical).

It is clear that for gastrointestinal illnesses, not just any plant will suffice as treatment. One of the fundamental criteria for medicinal plants in this realm of health care is that they be bitter. Plants used in the treatment of gastrointestinal conditions should have a bitter and/or pungent and/or astringent chemosensory quality. This expectation derives from the biological nature of the

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illness, the ethnomedical knowledge about the etiology, course and outcome of the illness, the ethnomedical understandings of bodily processes, and the effects of the medicine on the body and its illnesses. Chapter Five will more fully explore these relationships.

The patterns presented by the other qualities are, at first glance, less obvious than those of bitterness, but viewed from the perspective of the way in which the medicines are considered to work provides some clarity. The mechanisms by which plants serve as medicines is elaborated in more detail in Chapter Five and so will be discussed only briefly at this juncture. In general, *ya* plants serve to cure one by "overpowering" the illness or "killing" the causative agent, often a *chan* ("worm" e.g., *chan eal*, toothache), or by calming the itching and irritation that accompany skin conditions, wounds and cough. There is also an element in which *ya* plants overlap with *k'ixin* plants, serving to warm one upon ingestion. This would serve to aid one when treating most respiratory illnesses which almost universally are considered to be "cold" illnesses (see Chapter Three). *Sup* plants, in general serve to "dry up" or "draw together" the illness. In the case of diarrheal illnesses the connection is obvious; respiratory conditions can be brought together thus permitting expulsion, while for eye conditions the illness is overpowered and leaves the eye, allowing the vision to clear. *Paj* plants are used predominantly to treat oral conditions ethnomedically associated with respiratory conditions and serve to soothe or loosen the illness (*tzon kok, k'in ch'ajaw*). *Xin* in many ways appears to parallel *ch'a* in use and expectations while *chi'* is primarily used to treat respiratory, associated fever and related conditions, though the mechanisms are

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not clear. Thus, the nature of the illness and the expectations of the way in which the medicine cures influence the assignation of plants of a particular quality to particular illnesses. Even in cases where the pattern is not so striking as it is for gastrointestinal conditions and bitter plants (e.g., pungent plants), the reason for the plant's use is its pungency, the perceived nature of the illness and the expected consequences of using the medicine against that type of illness.

While it is clear that "taste" and "odor" are important in the identification and definition of plants as medicines, this is only part of the evaluative process. As is detailed in Chapter Five, there is an important component of trial by healers. Only those plants which have been used with success by individual healers will be considered useful medicine. Thus, the fact that a plant has any given chemosensory quality does not in and of itself define it as a medicine. It is the qualities in interaction with use and anticipated outcomes that ultimately define a plant as medicinal.

From this perspective then, it is not the plant that determines the use as medicine, but rather the chemosensory properties that permit one to know that this may be a medicine (within the cultural context of health, see Chapter Five). In this way we can explain at least some of the variation in collections--if plants are chosen for their chemical content, we can expect to see a wide range of potentially disparate species used for relatively few illnesses and not necessarily used particularly often or by a large number of informants. From an ethnomedical perspective, it is the chemosensory quality of the plant and attendant expectations about what that plant might do as a medicine that determines its selection

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and use, not just its taxonomic status. Taxonomy will clearly play a role in that similar species (whether 'folk', or 'scientific') will be viewed as being similar in their medicinal quality. Similarly, particular kinds of plants will be viewed as more likely medicinal than others. Many Asteraceae are bitter and so would more likely be chosen as useful for gastrointestinal illness than some other family not known for its bitter qualities. As will be discussed in more detail in the next section, this also could go some way toward explaining how people came to understand the value of particular kinds of plants as medicinal. How is that we came to recognize some plants as medicinal and others not? This is the key to the logic underlying the puzzle of "trial and error".

Another indication of the significance of taste and odor as indicators of the value of medicinal plants can be seen in Table 4.9 which compares the results from the triad interviews with the frequency of which the plants are represented in the plant collections database.

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Quality	Triad results (%)	Collections (%)
ch'a	71	27
sup	50	18
ya	50	18
jik'jik' yik'	37	◁
paj	33	3
xin	----*	10
tzij yik'	32	◁
k'ixin	30	◁
bilil	27	◁
xyuk et yik'	25	1.4
xuch'	24	1.4
xojet	20	◁
sik	18	10
chi'	16	3.9
kojoj	----*	◁
sak'	----*	1.6

Table 4.9, Comparison between the stated strength of sensory qualities from triad interviews with frequency of collections as represented in the unexpanded plant collection database. *not included in triad interview.

The important point about Table 4.9 is that the three plant qualities judged as most powerful in the triad interviews account for the quality designation of 63% of the plants in the plant collection database. This indicates that not only is the chemosensory quality of a plant of importance in the selection process, but that some sensations are considered superior to others. Thus plants which are bitter, astringent or piquent/pungent are considered to be more powerful medicines than plants of other qualities and consequently are more frequently used as medicines. We can take this a step further by a consideration of the relationship between frequency of plants of a particular quality used to treat illnesses of varying degrees of severity. Table 4.9a considers this relationship for the five most serious gastro-intestinal illnesses as defined from the triad tests. (Complete triad results are presented in Chapter Three.) The percentages in each column labeled by a quality term indicate the

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frequency with which that illness was treated with plants of that quality. *Ch'ich' tza'nel,* was rated as severe in half of all possible triads. 35% of the plant collections noted to treat that condition were bitter, 42% astringent, and 13% piquant. These three qualities account for 90% of all plants collected with were noted to be useful to treat these conditions. Recall from Table 4.9 that these three qualities are rated as the three strongest qualities which means that the strongest qualities are used to treat the most severe illnesses. Tables 4.9b-e explore other illness categories in the same fashion. These are presented in a slightly different fashion. The first column still represents the severity of the condition from the triad tests. Because different illnesses within the same ethnomedical class ("respiratory") are treated predominately with different quality plants, columns a, b, c, and d list those qualities that correspond to the illness term in the corresponding row. In Table 4.9b *Jik'jik' obal* is rated as the most severe in 56% of triads; 33% of the plants used to treat it are *k'ixin*, 33% are *paj*, and 33% are others.

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Illness (n)	Triads %	Ch'a %	Sup %	Ya %	Other %
xenel (6)	59		33		66
ch'ich tza'nel (31)	48	35	42	13	
sin ak'al tza' (7)	37	43	29		
cha'lam tzotz (*)	37	#			
k'ux ch'ujt (41)	37	71	5	15	

Table 4.9a., relationship between the most serious gastro-intestinal conditions and the chemosensory qualities of plants most frequently used to treat them. The "n" is the number of plant/illness pairs in the plant collection database.

Illness (n)	Triads %	Quality a (%)	Quality b (%)	Quality c (%)	Quality d (%)
tzajal chuel (2)	59				
jik'jik obal (6)	56	k'ixin (33)	paj (33)	other (33)	
sik k'ajk' (12)	44	ch'a (25)	sup (33)	xin (15)	other (25)
k'ux jolobel (33)	41	ch'a (42)	sup (18)	xin (18)	ya (15)
jul bak sik (22)	41	ch'a (18)	sup (14)	ya (18)	odor (46)

Table 4.9b, relationship between the most serious respiratory conditions and the chemosensory qualities of plants most frequently used to treat them. For reasons about which I am not sure, *tzajal chuel* (measles) is rated as one of the most severe illnesses, but there are very few collections of plants which serve to treat it. My guess is that it may be recognized as a named condition only recently (see Chapter. 3) and the majority of treatment is usually directed toward symptom relief--fever, rash, cough, etc. *Jul bak sik* is considered by many people to be witchcraft and thus the majority of healing effort is directed toward prayer and ritual. In this connection it is interesting to note that the majority of the plants have notable odors, usually not particularly important.

Illness (n)	Triads (%)	Quality a (%)	Quality b (%)	Quality c (%)	Quality d (%)
belbel on (0)	55				
k'ael (5)	55				
sijt'ubel (3)	42				
sijt'el (58)	37	sik (40)	xin (17)	ch'a (12)	others (31)
xoch (4)	36	ch'a (25)	ya (75)		

Table 4.9c, relationship between the most serious wounds conditions and the chemosensory qualities of plants most frequently used to treat them. In the case of *belbel on* and *k'ael*, and *sijt'ubel*, there were so few collections that there are no patterns evident. These diseases, while generally known be be very severe, are so uncommon that most people have not had any experience with them and so would not necessarily have any plant knowledge about them.

Illness (n)	Triads (%)	Quality a (%)	Quality b (%)	Quality c (%)	Quality d (%)
tzajal paslam (2)	54				
chay k'ajk' (22)	32	sik (27)	paj (23)	xin (14)	others (35)
paslam (20)	17	sik (45)	sup (25)	xin (15)	paj (15)
sal (8)	35	ya (75)	ch'a (12.5)	xin (12.5)	
sijt'el (above)	30				

Table 4.9d, relationship between the most serious skin/wound conditions and the chemosensory qualities of plants most frequently used to treat them. Here too, many of the conditions, while known, are uncommon enough to have not been experienced by many healers who would therefore not know medicines resulting in very few collections.

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Illness (n)	Triads (%)	Quality a (%)	Quality b (%)	Quality c (%)	Quality d (%)
chul chan (7)	53	sup (71)	sik (14)	xin (14)	
cha' nukul (12)	41	sup (58)	ya (25)	others (16)	
tokal (13)	41	sup (62)	sik (15)	others (23)	
sak nok (8)	35	ya (63)	others (37)		
sit chay (2)	32	sik (100)			

Table 4.9e, relationship between the most serious eye conditions conditions and the chemosensory qualities of plants most frequently used to treat them.

Considering tables 4.9a-e as a whole, the following conclusions may be drawn:

1) For well-known, serious illnesses, the medicines used to treat them will be predominantly of those qualities considered strongest.

2) Although chemosensory evaluation appears to be the primary method by which plants are assigned qualities, other processes are clearly in evidence as well; most notably the doctrine of signatures (*ch'ixal yak' mis/wakax*) and humoral theory. As is discussed in detail elsewhere, the humoral theory is of particular importance when addressing illnesses which produce significant amounts of inflammation, swelling or pain (*sijt'el, chay k'ajk', paslam*).

3) As is discussed in Chapter Five, the ethnomedical theory on how medicines are expected to work is one part of the selection process. In the case of eye diseases, astringent plants figure large because the object is to "dry up", or "draw together" the illness, allowing it to come out of or be expelled from the eye.

4) In a like manner, illnesses which do not have a clear presentation (*cha'lam tzotz*) or which are considered to be caused by witchcraft (*jul bak sik, sijt'el*) will not be consistently treated with plants of certain qualities.

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5) Very serious but uncommon illnesses (*belbel on, k'ael*) will also be inconsistently treated because relatively few people will have encountered them and so will not know of medicines which are useful.

Human Chemosensation, Phytochemistry and Plant Selection Criteria

This discussion can proceed at only the most basic level. After many years of intensive investigation, olfactory and gustatory detection, perception and the behavioral correlates in relation to plant chemicals are yet poorly understood in even the most intensively studied insect models. The picture is still less clear for vertebrates (Frazier 1991:124) and is very little studied for humans (cf. Johns 1990). Most research with humans has been directed toward understanding basic physiologic and morphologic prinicples (e.g., Getchell et al. 1991) with little attention devoted to the nature of these process in ecological and evolutionary contexts.

Food research is at base about chemical perception and processing, but most of this work is largely concerned with palatability (broadly speaking) and ultimately with marketing of the tested product (Jellinek 1985:17). The notable and important exception to this general trend is the role of chemosensation in nutrition and eating (e.g., Barker 1982; Friedman and Mattes 1991; Weingarten and Gowans 1991). Even so, much of this work is oriented toward the general concepts of homeostatic maintenance of the individual (e.g., Friedman and Mattes 1991; (Shepherd 1990); Weingarten and Gowans 1991). Relatively little attention is devoted to the role of chemosensation, food choice/selection/procurement

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from an ecological or evolutionary perspective (but see Harris and Ross 1987 and Glander 1982). Johns' (1990) pioneering work is to my knowledge the only work explicitly to address human chemosensation from a cross-cultural, ecological and evolutionary perspective. Less explicitly, Engen (1991) and Cain (1987) try, with variable success, to place laboratory research in a broader evolutionary/adaptive framework.

This section consists of two parts. The first is a brief discussion about "trial and error". Trial and error is the model generally invoked to explain how it is that people come to recognize the food or chemical value of plants. But, as commonly used, the basic assumption upon which the model is based is flawed, it cannot support the argument it proposes. The second part is a consideration of the role of human chemosenation in the selection of medicinal plants and the relationship of this process to the pharmacological potential of plants.

There are two concerns with the trial and error model, the first I will only mention, and I will discuss the second at some length. 1) Implicit in statements invoking trial and error as the process by which "native peoples" (whether prehistoric or modern) evaluate and become familiar with particular components of the natural environment is the perception of the process as a hit or miss, haphazard approach to problem-solving, as would be befitting the "primitive mentality". The assumption would seem to be that in the absence of "science", in the Western cultural tradition, there can be no adequate generation of knowledge except by the random exploratory process of "trial and error". 2) What does it become if

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the sampling, selection, and change is based on a systematic and/or detailed understanding of, in this case, plant resources and a clear understanding of what to expect from organism a, b, or c?

In the common-sense understanding of trial and error, one tries something, if it works, (meets cultural expectations) then it is accepted as having value and will be used again in the future. If it doesn't work (meet expectations), the error half of the equation, then it is rejected and something else is tried. This effort continues over time until a body of useful plant knowledge is acquired.

But there is a fallacy here, or at least an unexamined assumption. This process of accepting or rejecting something requires an underlying logic upon which to make decisions. There must be some sort of criteria by which a medicine is deemed successful/not successful, useful/not useful. If there is no basis on which to evaluate plants in terms of effectiveness, then there can be no accumulation of knowledge, no "advancement" in the ability to treat illness. There must be cultural rules that allow people to recognize when a plant has done what it ought to do as a medicine, to establish that it has some qualities, or produces some result that allow us to state that "this is a medicine".

One part of the trial and error formulation is probably more or less valid; that which deals with acutely toxic organisms (e.g., Mann 1992). I suspect that this may indeed be the primary assumption upon which the model is based. An acutely toxic plant will in very short order be noted as such by an unwary consumer who will realize the error in this trial and in the process learn to approach the plant with caution in the future. A violent or sudden response to the

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plant will inform the consumer something about the nature of the plant. This knowledge will then be integrated into the system of knowledge about plants, either to be avoided as food (or in need of processing), or perhaps explored in further detail as medicine or poison. Some informants reported occasions of violent illness or reaction to the sampling of medicinal plants. This always occurred in the context of trying a plant thought to be medicinal, but with which they were unfamiliar, or occasionally in the context of trying novel plants. While this process may well apply to acutely toxic organisms, the majority of plants used as medicines do not generate an especially acute reaction.

The traditional view is clearly exemplified in "Indian Givers" by Jack Weatherford where he states (1988:85): "This diversity [in native American food crops] developed through the Indian farmers' profound understanding of practical genetics. To make the corn grow the farmers had to fertilize each plant by putting corn pollen on its silk (where did he get that idea?). They knew that by taking the pollen from one variety of corn and fertilizing the silk of another variety, they created corn with the combined characteristics of the two parent stalks. Today this process is known as hybridization and scientists understand the genetic reasons behind this process; the Indian farmers developed it through generations of trial and error" (emphasis added).

Aside from the fact that it is difficult to imagine where he got data to support an assertion like this, it is self-contradictory. If the Indians knew the process of hybridization and knew what to expect

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as a result of their actions, is it "trial and error" (Bye 1981; Kunstadter 1978)?

Weatherford also gives a long list of medicines and "drugs" (e.g., cocaine) derived from Indian knowledge. Many of these are well known, quinine, ipacac, coca, peyote, ayahuasca, others less so. But the distinction worth noting is that it is one thing to "discover" the consequences of a toxin which immediately (or very quickly) alters the bodily or mental state, e.g., ipacac, peyote, etc., but it is quite another to a) develop the processing technologies to use these most effectively and conveniently, and more importantly b) to identify the properties and method of preparation of a "medicine", something that does not have immediate consequences, e.g., quinine, salicylic acid, and any number of other possibilities. He simply discourses on them, marveling at what great skill and knowledge this requires and the consequences to humankind for their efforts. The question never addressed in this kind of work is the process by which this knowledge "came into being", except as the old "trial and error" statements.

It seems reasonable enough to talk about "trial and error" (in the broadest sense), but this process arises from a detailed knowledge of the environment, broadly conceived. Out of this knowledge arise/derive certain expectations or foreknowledge about what will be encountered within any given realm of the environment. Thus while an individual may not know what to expect from any given, novel, plant (i.e., one not encountered previously), it is entirely reasonable to suggest that a (small) range of possible answers can be predicted by the informant (sour, bitter,

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etc.). For some groups, e.g., the genus *Solanum*, some genera of the Asteraceae, the range will be narrower still (bitter or astringent). Thus while it may not be systematic (in the sense that we like to think of hypothesis driven science as operating) it is based on sufficient knowledge as to allow predictions of the outcome. As is detailed elsewhere the expected medicinal use and outcome will also be, to a certain extent, predictable.

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Plant Chemistry, Human Chemosensation and the Use of Plants as Medicines

Rhoades (1979:40-42) makes an important point when he states "Taste and odor are proximate qualities, whereas toxicity is an ultimate one. Animals avoid certain foods because they possess toxicity or some other noxious quality, not because they have a bad taste or smell. . . Taste and odor. . . are evolved responses to the fact that chemical compounds of certain molecular configuration have either noxious or beneficial qualities to the animal in question or are correlated with the presence in the food of substances with such qualities". Kingsbury (1983:682) suggests a similar point when he notes that "[p]erception of toxic compounds in plants must obviously relate to their reactivity, but not necessarily directly to their toxicity". The point may be illustrated in a consideration of tannins and alkaloids. Tannins elicit in humans the response of astringency resulting from mucosal protein changes which, though it "is [perceived as] a proximate and subjective quality" (Rhoades 1979:40) in the mouth, this sensation is correlated with potentially more severe consequences should the plant be ingested in quantity. It

thus becomes identified as a "bad taste", negatively valued and avoided. In the case of tannins I would amend what Rhoades suggests because what is detected as astringency apparently results from actual physical changes in the oral mucosa (it is "tanned") (Hagerman and Butler 1991). I suggest that this physical change directly deters feeding or ingestion of the plant. Tannins do not signal or indicate anything in the sense that bitterness may indicate toxic alkaloids, rather the effect on the oral mucosa demonstrates the consequences of continued or increased ingestion. The initial discomfort from the changes in the oral mucosa are enough to convince one that this is not acceptable as food.

Alkaloids, though they are a large, diverse group of chemicals with a wide variety of effects on consumers (animal or human) they "almost uniformly invoke a single taste--bitterness" (Rhoades 1979:42; Gaffield, Keeler, and Baker 1991; Hartmann 1991). It is not the bitterness that gives the plant toxicty, rather many toxic plant chemicals are perceived as bitter or occur in association with bitter chemicals. In this case the bitterness serves to indicate that the plant may be toxic. There is nothing inherent in the bitter taste which informs the consumer of potential risk. This is experientially acquired knowledge that once learned may cause the animal to avoid many bitter plants as though they were toxic, even though many may not be. This has been clearly demonstrated in research on taste aversion and is well known to anyone who has suffered severe food poisoning--any adverse reaction following ingestion of an item (food, medicine), ranging from nausea to vomiting to diarrhea can condition one against that particular flavor (Garcia et al. 1985). Research

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summarized by Scott and Plata-Salaman (1991) indicates that there may be a physiological basis to detection and/or recognition of toxic compounds. They conclude that "Stimulus toxicity. . . provides an excellent basis for predicting relative taste quality across a wide range of chemicals" (1991:348). In a multidimensional scaling analysis of taste response data with rats, the more toxic chemicals clustered together and apart from the less toxic or beneficial chemicals (e.g., sugars). This indicates that the response to toxic (bitter) chemicals in rats may be innate with learning playing a secondary or subsidiary role. The degree to which this applies to another group of wide ranging omnivores, humans, cannot be easily assessed, but given the near universal dislike of extremely bitter compounds, it is a possibility that can be entertained, but will be difficult to demonstrate for ethical reasons.

There is an important distinction between these two examples. In the case of tannins the perception of astringency results from physical changes on the mucosal surfaces of the mouth which serves as a deterrent to further consumption. Bitterness is a true taste which is a chemosensory response not resulting in any physical changes to the mouth. The two reactions indicate different toxic phenomena, the results of which can be learned. The physical (health) consequences resulting from consuming plants high in tannins will be different from those resulting from consumption of toxic alkaloids; astringency and bitterness serve as signs for different kinds of toxic reactions. If, as appears to be the case for bitterness and astringency, different flavors/sensations indicate different classes of chemicals (kinds of toxins or medicine) (T. Johns, personal

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communication; Hartmann 1991:85; Gershenzon and Croteau 1991:175; Malcolm 1991:261), this could in part explain why there is a fairly clear consistency in the use of plants with particular qualities for particular kinds of illnesses. This is important in considering the role of chemosensation in identifying medicines and evaluating their effectiveness. In the case of bitterness, this linkage between bitter taste and potential toxicity would usually, though not always, indicate that something is likely to happen if the plant/medicine is consumed. I suspect that the same may be the case for pungent and astringent plants as well. As discussed elsewhere there are at least two levels to a change in bodily state, one proximate and immediate (one feels worse as a result of having taken the medicine), the other more removed in time (a positive change in health). In the case of bitter, astringent, and pungent plants, there is a good possibility that this would occur if consumed or applied. At some level the expectation of change upon taking the medicine could be generalized to all taste sensations because "bad taste" is to a certain extent culturally defined (Rozin 1990). Consuming *Arthrostema ciliata*, which is at least as sour as natural lemon, and causes one to pucker and gasp upon ingestion, could be easily enough defined as "feeling worse", though not comparable to the nausea, pain or discomfort caused by very bitter, pungent or astringent plants. Even if the chemical constituents were not particularly toxic (acutely), if they were especially bitter (or whatever sensation), one could experience nausea or some other physical response upon taking or using the medicine. But, if many alkaloids (or other chemical groups under consideration) are often bioactive, then the bitterness (astringency,

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piquency, sourness) serves both as a warning of toxicity and for humans as an indicator of medicinal potential.

This distinction can be noted for humans and their ability to overcome the nearly universal and unchangeable natural aversion to strong chemical stimuli, e.g., chilis (Rozin 1990). In this case no other animals have been convinced, despite much effort, that chilis are suitable as food, whereas humans in many societies place great value on the consumption of chilis and other pungent plant parts (ginger, black pepper). Similarly, humans are able to redefine or revalue the meaning of other chemosensory responses, depending on context. Thus bitter, sour, astringent, etc. may be negatively valued in general food consumption behavior (though not necessarily), but will indicate something important and of positive value in reference to medicinal plants.

While a test of these ideas is beyond the scope of this project, I would propose that it should be possible to develop a research strategy to test the above hypothesis. Using any sizable indigenous medicinal plant collection in which the stated quality was known (e.g., the PROCOMITH "traveling herbarium", Brett), the use patterns by family or genus could be developed, as is commonly done, then in collaboration with pharmacologists, phytochemists, and/or pharmacognosists, the illnesses with which the plants are treated could be compared with the pharmacologically active and taste-eliciting compounds. If the above hypothesis is correct, then we would expect to find a significant correlation between the stated quality, its use(s) and the pharmacological potential of the plant's chemistry. Clearly this would be an imperfect test because there are

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many factors which affect the medicinal properties of plant medicines, be it collection, part used, preparation, administration, admixtures, etc. But this too could be tested with several case examples. The clearest patterns could be submitted to more careful examination involving preparation similar to that in the field, biochemical analysis, *in vitro* screens, etc.

A brief look at data from the expanded version of the medicinal plant database offers some insight into the possibilities to be derived from this approach. If we consider the three most common qualities, *ch'a, sup, ya*, each of which is judged to be a strong quality, we see that there are definite patterns both in the relationship of the quality to particular plant families and also to the illnesses that are treated with plants of those qualities and families. Thus, of plants judged to be bitter (27 families), the majority (70%) are accounted for by 3 families, Asteraceae, Verbenaceae, and Solanaceae; but when considering a plant judged to be astringent we find a different pattern altogether. Here the majority of the plants, in 31 families are accounted for by 6 families (56%) which, with the exception of Asteraceae, are entirely different from those considered to be bitter. A still different group of families account for those plants considered to be pungent. It is also obvious, as has been discussed earlier, that plants of each quality are generally used to heal different ethnomedical classes of illnesses. Thus bitter plants are mostly represented by the family Asteraceae and are usually used to treat gastro-intestinal illnesses, while astringent plants are used to treat a wider range illnesses, but still within a restricted number of families. Pungent plants, principally from 4 families are

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used against a still different set of illnesses. With the exception of Asteraceae, each quality is represented by a unique cluster of families, and with the exception of gastro-intestinal illnesses each family is used to treat a unique cluster of illnesses. This indicates that plant selection and the illnesses they are used to treat is not random and furthermore appears to be based on the chemical quality of the plant as can be assessed by taste and smell.

CH'A		YA		SUP	
3 Fam. (Ast, Sol, Verb)	24 Fam.	4 Fam. (Ast, Eup, Iri, Poly)	22 Fam.	6 Fam. (Ast, Fab, Eup, Rub, Malp, Myrt)	25 Fam.
70%	30%	57%	43%	56%	44%

Table 4.10, Dominant families in each of three major taste categories.

Asteraceae	Solanaceae	Verbenaceae
Gastrointestinal 64	Gastrointestinal 30	Gastrointestinal 83
Respiratory 12	Wounds/Ulcers 30	Other 17
Other 24	Toothache/caries 20	

Table 4.11, Principal families considered to be *ch'a* and the primary illness categories each is used to treat. All figures expressed in percent of total collections.

Asteraceae	Euphorbiaceae	Iridaceae	Polygalaceae
Gastrointestinal 36	Gastrointestinal-14	Gastrointestinal-20	Gastrointestinal-20
Respiratory 16	Skin/wounds 57	Toothache 60	Respiratory 30
Toothache 27	Other 29	Other 20	Pain/inflam. 40

Table 4.12, Principal families considered to be *ya* and the primary illness categories each is used to treat. All figures in percent of total collections.

Asteraceae	Fabaceae	Euphorb.	Rubiaceae	Malpigiaceae	Mrytaceae
G-I 29	G-I 16	Eyes 33	G-I 22	G-I 20	G-I 25
Eyes 47	Resp. 33	Skin# 50	Eyes 33	Eyes 40	Resp. 38
Other 24	Skin* 27	Other 17	Resp. 33	Resp. 20	Eyes 25
	Other 24		Other 11	Menstr.-20	

Table 4.13, Principal families considered to be *sup* and the primary illness categories each is used to treat. All figures in percent of total collections. *includes several tongue related illnesses; #includes wounds

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Chapter 5

Selection Criteria for Plants

The evaluation of plants as medicines is a complex process involving detailed knowledge about the organoleptic (chemical) properties of plants in the context of cultural beliefs and practices about the nature, diagnosis and treatment of illness. Chapter Four examined aspects of the chemical evaluation knowledge and procedures. This chapter considers the interaction or use of this chemical knowledge within the range of beliefs and practices which can be said to constitute the medical system. This set of beliefs and practices, which intersect with many other areas of cultural belief and practice, are fundamental to the evaluation of plants as medicines. While there may be sampling for chemical content of the plants, the evaluation of use and value takes place within the cultural beliefs and practices of medicine. Even the fact that taste and odor are valued as important characteristics must be considered as a cultural priority about the nature of medicine. What this chapter does, then, is to attempt to explicate the cultural processes of medicinal plant selection and relate them to the biological processes discussed in the previous chapter, even though the distinction between the "cultural" and the "biological" is irrelevant to Tzeltal medical practice. Any distinction must be considered as a tool for analysis and illumination of the relevant processes, not a reflection of the reality in Cancuc.

There are several components to any discussion about the way in which people explore and evaluate the medicinal plant

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environment. To speak of components is not to imply that they are parts of a discrete model, but rather they serve as an analytic strategy that allows us to tease out the various processes by which people interact with their environment to identify medicinally valuable plants. The discussion can be divided into three sections. The first of these concerns the acquisition of knowledge or the process of learning about plants as medicines; how is it that people come to know that a particular plant is medicinal. The second part is an examination of how medicinal qualities and the understood curative "power" are derived. There exists here a complex interaction between culture, biology, perception and interpretation which determines how a plant is viewed as medicinal. The third component is the cultural expectation of a plant of a particular quality as it relates to the curing of illness. What is it about a medicinal plant that gives it the power to heal? How do plants affect the illnesses they are used to treat? As noted in the introduction, this is a study of the Tzeltal approach to things medicinal (as best as I can articulate it) and an attempt has been made not to compare, or evaluate these beliefs, practices, and expectations in light of Western biomedical beliefs and practices. Several proposals for future comparison (considering what might be gained), and how one might approach the questions are considered in the conclusion, Chapter Six.

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Learning Component

One learns, or becomes acquainted with, the value and use of medicinal plants by two primary pathways. While both are fairly straightforward and obvious at first sight, there is an important distinction between them. In the first method, one learns of plants

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from other people, usually from one's parents, but a range of persons are noted to be instructors. In this mode a person becomes acquainted with plants known to be medicinal, generally by having been introduced to them by another person. This represents the passing on of knowledge from one individual to the another, usually from older to younger.

The second method represents true innovation, where experienced healers will examine (and often experiment with) apparently novel plants for their medicinal value. In both cases, becoming acquainted with a plant is only one part of the total process of learning a plant's medicinal value. The other and arguably more important part, detailed below, involves a personal trial of the plant as medicine.

Table 5.1 details from whom knowledge of plant medicinal value was obtained.

Dreams/ancestors	Other persons	Self taught/by trial
16.3%	42.7%	41%

Table 5.1 These data are taken from the garden interview question #2 which explicitly asked how or where they learned this plant was a medicine, N=217.

These data indicate what informants stated was their first introduction to particular plants. Any given informant might have learned different plants in a variety of ways, or from a variety of people. As will be discussed below, everyone must try, or use, the plant before they will consider, or "know", it as a medicine. The table thus represents two interdigitating layers of the learning process. On one level a person becomes familiar with a plant in one way or another through the agency of other persons. This is, in spite of the

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numbers in the table, the dominant process by which people become familiar with medicinal plants. Those who state that they learned about the plant by trying it (*la jpas prueba*--'I have tried it.') appear to be bypassing the first stage of introduction. What is more likely the case is that these data represent a range of ways to answer the question posed in the interviews. For those who claim to have learned about the plant by themselves or by trial, they assumed the first part of plant introduction to be obvious and answered according to the perhaps more salient part of the learning process--the individual trial of each plant by each healer (see below). Nevertheless, there are a few individuals who apparently try novel plants or who try known plants for treatment of illnesses beyond the usual pattern of use. This is an important source of innovation and will be discussed later.

In most cases where the relationship of the person from whom the value of the plant was learned was stated, this person is almost without exception in some way related to the informant, as a parent, grandparent, in-law, uncle or aunt, pointing up an important aspect of knowledge transmission among the Tzeltal. The process is, for the most part simple and straight-forward, with the information being taught as any other activity might be, by example. If a child wants to learn more than can be learned from immediate family members, then they must identify a person with whom they can study. This does not appear to be a formal apprenticeship in any way, rather it usually involves the (usually) younger person living in proximity to the older person which permits participation in the healing enterprise. What and how much they learn then becomes a matter

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of individual motivation, intelligence and the knowledge possessed by the older person and their willingness to share.

Medicinal plant knowledge is stated by some, usually experienced, powerful, *jpoxtawanej* to be jealously guarded and is to be shared only among related individuals. My suspicion is that this is the ideal expectation of experienced healers rather than the behavioral norm. The degree of consensus on plant use, the relatively narrow range of plants used as medicines, the large number of people with at least some medicinal plant knowledge, and the unquestionable willingness on the part of many to share their knowledge with visiting anthropologists indicates that secretiveness is more ideal than real.

Another important element is the way in which relatedness is defined. Until relatively recently, Cancuc had a powerful, clan-based social structure (Guiteras-Holmes 1990) in which members of closely related clans could be expected to cooperate. While I have no data to directly substantiate it, I suspect that this clan-based cooperation would lead to wide currency in medicinal plant knowledge. In the few cases where the initial information was gotten from an unrelated person, the knowledge may have been gained "surreptitiously", by seeing someone harvesting large quantities of a plant and concluding that it could only be useful as a medicine and exploring that plant in more detail themselves. In other situations, the plant was given as treatment and recognized in an inadequately ground or cooked preparation. In this context the plant, its preparation and use are all readily known. It was reported to me that one can purchase medicinal plant knowledge on a plant by plant basis, but this is very

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expensive and no one could reasonably expect to become a healer if they did not have someone (a relative) from whom they could learn about the plants.[28]

The second major avenue to learning about or becoming acquainted with a plant as medicine is what might be termed "individual discovery". In its purest form this involves true innovation where people, usually experienced *jpoxtawanej*, sample plants for their chemical content, decide that the perceived qualities may have medicinal potential and try it as a medicine. This trial often occurs in a variety of contexts. The medicine may be used on a number of people or animals, often using several different preparation methods, or, depending on success, it may be used to treat several different illnesses over time.

The data suggest that this is an uncommon activity, restricted to the most experienced *jpoxtawanej*, and often in the context of illness which has not responded to usual treatments or in situations where the accustomed plants are not available. Another facet of the exploration of novel plants is the use of known plants for novel treatments--extending the usual use of the plant to include other illnesses. This extension is based on the cultural logic of healing (Chapter Three) such that a medicine that is used for one type of pain might be used to treat pain in a different part of the body, or a medicine that is used to treat intestinal parasites may be used to treat a skin ulcer thought to be also caused by "worms"[29]. While this was not common and the reported uses were most often outside the usual use patterns, this clearly represents an important point of innovation and learning. One informant discussed how during a long

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running illness, the primary symptom of which was headache, he tried a wide variety of plants, seeking a cure. A plant which he called *chikinburo wamal* (a name covering several Asteraceae) finally gave him relief. So, whenever anyone has severe headache this is the plant he prefers to use. He similarly tries to treat others with difficult or intractable illnesses--sampling a variety of plants which he believes will likely result in a cure. When one does eventually give the cure, he knows that this is a good plant and will use it again in the future.

Some individuals have learned some of their plants through dreams. There are several variations on this theme. The most common variant has the *jpoxtawanej* being asked to cure an illness that either they have not seen before or that has not yet responded to treatment. In worrying over how they might cure this person, the plant comes to them in a dream. The following day they seek out the plant and administer it, with success (if the treatment was not successful, the plant would not be considered a medicine).

The other major variant on the dream theme has the healer learning about healing, including plants, from having been presented with a set of books, often by a Ladino, in their dream(s). This dreaming usually takes place within the context of their learning, or having been "chosen" to be a healer (Vogt 1976; Metzger and Williams 1963). They received their knowledge, often reluctantly, by being given this set of books. Significantly, in nearly every case where the dreaming referred to a particular plant, that plant was a very common one readily known and recognized to anyone with an interest (e.g., *Solanum lanceolatum, Euphorbia graminea*). Given the

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inherent nature of, and the ready interpretability of dreams, there should be nothing surprising about people becoming familiar with plants as medicines through dreaming, whether the plants are common or not. Of perhaps greater importance is the obervation that all of the persons for whom dreaming represented an important avenue of learning were *jpik k'abal*, indicating that they learned the plants in the context of their having been chosen to be a healer. The power, authority and responsibility of healing is conferred upon them by the ancestors (*me'tik tatik*), God, or Ladinos (traditionally, all persons of superior authority and status). Anyone can learn the basics of plant medicine but a *jpik k'abal* has greater knowledge and skills because they have been elected to their position by the ancestors (or God).

Finally, for some individuals, the simple act of using a medicine for the first time, even a very common, widely known one, will constitute "learning it". I interpret this as indicating, especially for common plants, that there is no way to state definitively who first instructed one on the medicinal use of this plant. It is simply something that one grows up knowing as a member of this society. Alternatively, these informants are noting what is the more important aspect of the learning process--the individual trial of each plant by each healer.

This concept of the trial is fundamental to an understanding of the process by which plants are defined and evaluated as medicines. Regardless of where the knowledge about the plant originally came from or how one was introduced to a plant and its curative power/ability, practitioners will not consider it a medicine or use it

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as such until they themselves have had the opportunity to try it and are satisfied with the results. This is most obviously seen in statements to the effect of "I've heard that it is a medicine but I've never used it, so I don't know if it can cure or not". 41% of the responses to the questions #2 (from where did you learn this plant) and 38% for #22 (how is it possible to know that this is a medicine?) demonstrate that for a significant portion of the plants, informants learned "alone" or by having used the plant; "*la jpas prueba*"--"I have tried it". In many cases the two ideas occur together, "*jtukel la jnop pasel sok la jpas prueba yil sok te chamele*"--"alone I learned it and I tried it to see with illness" (i.e., tried it when afflicted with an illness). More importantly, even for those plants which were learned from other persons or which were passed down from the ancestors, it is only after the healer has had the opportunity to try the plant and see that the results meet their expectations that it will be considered a plant of any value and included in their collection of medicinal plants. Each informant at some point during the garden interviews noted that they learned a plant had medicinal qualities because they had tried it against particular illnesses and found that the plant met their expectations about how a plant should work. The trial can occur in a variety of contexts including using the plant on animals (usually pigs, mules, or horses), especially for wounds or skin ulcers, on oneself or a family member when afflicted with an illness, or occasionally on someone who came to them to be healed.

A relatively minor practice, in terms of incidence, but potentially important, in terms of knowledge generation, is the use of a plant known and used for one type of condition for other, often

related illness(es). If it works for one kind of condition it may be tried and/or used for a related kind of condition. This is easily seen in both the plant collection database and the garden interview database where plants will be used for related classes of illnesses--diarrhea, vomiting, and stomachache, or fever, cough, and "tuberculosis" (see also Berlin, et al. 1990; Berlin and Berlin, et al. in press) as well as related illnesses, e.g., *batz'il obal* (cough) and *jik'jik' obal* (whooping cough) where the common point is clearly cough, or *chay k'ajk'* and *paslam*, both kinds of suppurating skin conditions. The decision to try or use a plant on a different illness (or different kind or class of illness) appears to be based on two strategies. 1) There is a common feature about each of the illnesses that links them to the medicine. Pain, as in *k'ux ch'ujt* (stomachache) and *k'ux o'tanil* (upper gastrointestinal pain), a common etiology, e.g., *k'ux eal* (tooth decay) and *lukum* (intestinal parasites), both caused by *chan*, 'worms', similar appearance, or involvement of the same organ system are all criteria by which to try or use a plant on a different kind of condition. A plant may be well known for its ability to treat inflammation, but some individuals will use it to treat headache, stating that it is good for both conditions because it has the ability to cool/soothe hot kinds of illnesses, an unambiguously recognized feature of each illness. In this case it is the humoral nature of the illness and its treatment that provides explanation for apparantly disparate uses. Sometimes plants are used to treat apparently unrelated (classes of) illnesses (biomedically speaking), but which are, upon closer examination, ethnomedically linked, providing a logic behind the common usage. *Ch'ich' tza'nel* (bloody diarrhea) and

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k'in ch'ajaw (aphthous ulcers or herpes), or *k'ajk'* (fever) and *tzon kok* (coated tongue), or *k'ajk'* (fever) and *obal* (cough). In each case the ethnomedical linkage of the illness (see Chapter Three) would suggest that they could be treated with the same plant (or in the same treatment episode), even though they seem to very different by virtue of their bodily location, appearance, process and outcome. By extension, illnesses known to regularly co-occur with one another would logically be treated with the same plants and/or at the same time. Alternatively, or in tandem, there is often something about the plant as a medicine which links it to each of the illnesses. Thus in the case of *k'ux eal* and *lukum* noted above, both caused by 'worms', the plants used to treat them are all *ya* (piquent) in taste quality (*Achmella oppositifolia, Fleischmannia pratensis, Salmea scandens*). This is the primary characteristic of plants used to kill worms, considered to be the causative agent in each of these illnesses (see below). 2) The other form of transfer is from animal models to humans. Plant medicines are occasionally used to treat wounds on animals. If the cure is successful, it may be used on humans as well for the same kinds of conditions. I got no reports of detailed veterinary practices in relation to gastrointestinal, or respiratory illnesses. An example of this type of transfer can be seen in reverse in the following example. I was visiting an informant when I noticed a maggot infested wound on one of his horses (probably a saddle sore or bot fly exit wound). I mentioned this to one of his sons and asked what the usual treatment would be. He shrugged and said he didn't know of any plants to treat it and went about his business. A short while later he reappeared with a jar of insecticide (lindane)

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usually used for the treatment of lice and related conditions. He quickly upended the bottle over the wound, effectively filling it with the undiluted, concentrated poison. A poison that kills one type of organism (lice, fleas) is clearly viewed as equally effective on different kinds of organisms.

The selection, trial, or use of a plant as a medicine is not a deliberate, detailed strategy, but rather a response to illness. Other than the casual sampling of plants for their taste/odor there is no seeking out of plants as medicinal except in the context of illness. It is only when confronted with illness--a deviation from the cultural definition of normal--that any effort toward healing will take place. This may seem a self-evident point, but for healers in Cancuc it is fundamental. There is nothing special or magical about any given plant that makes it a medicine. It is only in the context of ill health and therapy that a plant may be considered or defined as a medicine. It is only because of its recognized ability to affect particular health conditions that it will be defined and used as a medicine. It is a member of the cultural category "medicine" because it meets expectations about what a medicine should do against particular, negatively valued, states of health. In the absence of this knowledge about a plant, it will not be considered a medicinal plant. Garden interview question #22 asks: "How does one know this is a medicine?" In response: "Because I myself tried it when I myself was afflicted with this illness, and I was cured." "I always use it and it cures." "One can only know if a plant is a medicine if one has the illness, only if it cures is it a medicine." Thus, it is only when one has experienced or seen the illness and its response to the medicine that

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one knows the plant is medicinal. It is the presence of illness and a change in the disease state in response to the medicinal use that allows one to claim or expect medicinal properties for a plant.

The significance of the trial is also evidenced in that a plant of a given quality is not necessarily a medicine. A bitter plant, even a very bitter plant is not considered a medicine just because it is bitter. Rather a bitter plant which when used, results in a culturally valued, positive change in health status will be considered medicinal. There are many bitter plants (for example) which are never used as medicines. As will be detailed below, change in state fairly unambiguously means improvement, usually symptomatic, of the condition under treatment. When asked if a plant with a similar quality can also be used to treat this or that condition the response will invariably be one of two possibilities. Informants will respond simply that they don't know if it can cure because they have not used it or they will respond that no, it cannot be used as medicine, because only those plants which we have tried work as medicines--it is these plants which have a demonstrated ability to cure. In the garden interviews a common response to the question about how does the quality have the power to cure (#7) or how does the medicine have the power to cure (#17) is simply "because it cures stomach pain", or "because the diarrhea stops", or "because it stops itching", etc. The medicine has been tried and found to have these results, indicating that it is a useful medicine. It is a plant of a particular organoleptic quality, used in the context of illness, which results in culturally valued change (improvement) in the status of

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the health condition that allows a plant to be defined/used as a medicine.

That illness abates in some way is unquestionably an expectation of medicinal plant use (and curing in general) in Cancuc. The biomedical relationship between the plant medicine (its pharmacological value) and the consequences for locally defined illness categories cannot be easily established in this or similar studies. Given that many (most?) common illness categories (fever, diarrhea, stomachache, cough) will likely self-resolve, it is very difficult to state unambiguously that there is a cause and effect relationship between improvement in health and use of plant medicines. But, the fact that most available plants are not used as medicines and that there is an unambiguous expectation that one will improve upon taking the medicine indicates that, culturally, there is a link between the plant and the outcome. In cases where this link is strong, the plant would seem a likely candidate for ethnopharmacological analysis (Heinrich, et al. 1992a).

Some healers occasionally sample plants in the course of their daily activity, or realize in one fashion or another that a plant has a particular organoleptic quality. One individual, when asked how he became familiar with a plant, noted that he had once used this particular plant to clean the work grime off of his hands before eating. While eating he noticed the very bitter taste to his fingers and went back to the plant (*Brickellia paniculata*) to see if that was the source. After discovering that it indeed was the source, he decided to try it as a medicine, using it to treat stomachahe (*k'ux ch'ujt*), for which he claimed that it worked, i.e., it relieved the pain.

Other people taste and/or smell plants for no other purpose than to learn their sensory quality. In most cases when we were collecting, this sampling did not lead to a collection of the plant. Rather the usual course of events was a discussion of the quality and if anyone knew it as a medicine or had used it such. As discussed above, the presence of a particular sensory quality does not necessarily define a plant as medicinal. Thus a plant's quality may be discovered accidentally or through intentional testing, and it will be noted as a possible medicine for a particular category of illness and may be tried accordingly. In this case the plant was bitter and highly aromatic and so he was of the opinion that it might possibly be useful for gastrointestinal illnesses as is common with bitter plants. Had it had a different quality, it would likely have been used for a different class of illness (see tables 5.4 and 5.5 at the end of the chapter). Having been assigned as a possible cure for conditions in this class it will be tried against an illness in that class and the results observed and noted.

A further, but infrequently reported, elaboration of the trial scheme is seen in a few cases, where there is an apparent effort to determine if the plant is toxic. This is most frequently seen in situations involving novel plants/medicines. The plant is tasted/sampled for adverse effects--to see if anything bad happens--"I tasted it to see if I would die" is a usual kind of statement in this context. Nausea, vomiting, dizziness, headache, etc. shortly after ingestion of the plant are noted as indications of poisonousness. But, they are likewise signs of a particularly powerful medicine. In those cases where informants reported severe, adverse reaction (all in the

garden interviews, and thus with known plants), they nevertheless used the plant as medicine, taking into account the assumed toxicity, based on their initial experience. As noted elsewhere, there is clear recognition of toxicity in some common medicinal plants (e.g., *Brugmansia candida*, *Polygonum punctatum*). This known toxicity is taken into account in usage patterns (e.g., largely external application) or in dosage or the use of a very small amount of the plant in initial preparation. The reaction from toxic principals in the plant is in distinction from the expected reaction upon usage of powerful medicines. In the first case, the reaction occurs in a healthy person, and thus is viewed as a toxic response to the plant. In the second case, the reaction is a result of the medicine attacking or struggling with the illness, and is an expected, indeed desired, proximate consequence of having used the medicine.

In general usage, there is no expectation that medicines will be necessarily benign. A common expectation of medicines is that they will initially make one feel worse. This is most commonly noted for medicines taken internally and for those liberally applied to the skin as plasters. The expectation is that one will initially feel worse, often with nausea, dizziness, desire to vomit, burning pain, itching and related kinds of negatively valued, unpleasant effects. This is noted especially to be the case for powerful medicines used against difficult or dangerous illnesses. This experience indicates very clearly that the medicine is struggling with or indeed killing the illness. That one should become faint, nauseated, etc. is to be expected and indeed is a desired, proximate outcome, indicating that while one may feel decidedly worse for a short while, there is every expectation that one

will indeed improve. An initial, immediate adverse reaction to the medicine provides the patient with evidence that he has taken a strong medicine which will shortly lead to a cure.

This is qualitatively different from the occasional "toxicity testing" noted above. This relatively uncommon testing for toxicity is generally done on the crude plant, sometimes in the course of routine sampling, but more often in the context of trying to identify medicines needed to treat an illness at hand. It is aimed at immediate reaction and a noxious response generally is not the expected or necessarily the desirable outcome. If the plant does produce a noxious reaction, it will be defined as toxic, providing important information about the plant, which will in turn affect what the plant is used for and how it is prepared and administered.

The more common pattern, at least in the context of collecting medicinal plants, was a casual sampling of plants while walking. It was not uncommon for informants regularly to pluck a leaf, smell it, taste it, then discard it. They reported that they were looking for plants that might be medicines based on their taste and odor. The organoleptic properties of the plant provided important clues as to possible medicinal use. Occasionally a very noxious plant was encountered and it generally would be rejected without fail. Noxiousness is not merely a strong flavor, which indicates possible medicinal properties, but rather a plant that resulted in some adverse bodily reaction such as severe nausea, extreme salivation, blistering of the skin, severe pain, etc. A strong flavor, very bitter, pungent, or sour would be an indication of possible medicinal value. In my tasting of the plants collected and in discussions with

informants after they had experienced a noxious plant, it is the immediate reaction to the raw plant that counts. In the case of the reaction to the prepared medicine, this is a known, expected, even desirable, consequence and therefore a valued part of the healing process. The key difference is context; for unknown plants which produced adverse reaction, this was an indication of toxicity, whereas for prepared medicines producing similar reactions, this was an indication of the plant's medicinal value.

In practice there is a clear recognition of toxicity of many medicines, reflected in small doses because "it is very strong" or "too much will make you sick", or "it is toxic"; in much smaller doses for children than for adults; in warnings about the consequences of taking too much, or statements to the effect "drink as much as you want, it's good for you, indicating lack of toxicity and putting in the framework of a "tonic", though that concept is more implicit than explicit[30]. Similarly, some plants are noted to be excellent for treating wounds and dermatological conditions, but will never be ingested or will be ingested in only the smallest quantities because it "is too strong", e.g., *Clematis grossa, C. dioica, Polygonum punctatum,* or *Solanum verbascifolium. Brugmansia candida* and *Cissampelos pareira*, both plants with known toxic potential, are given with great care. *Brugmansia* is generally used as an external application to control swelling, but is occasionally used for gastrointestinal conditions or fever where it is clearly understood that one can give only a very small amount to an adult and an even smaller amount to a child. Alternatively, the medicine will be made in a dilute fashion, using 1/4 or less of the leaf as opposed to the usual handful used

when applied externally. *Cissampelos* is universally used for gastrointestinal conditions, is very bitter and may be toxic. Generally it is prepared using just a piece of tuber, or 2-3 small pieces of the root and is administered in small doses, 1/2 cup (*olil vaso* ≈ 30ml), 2 spoonfuls (*cheb* [2] *cuchara*), very small cup (*jun tujtin vaso*).

A word of caution: There is, to my knowledge, nothing systematic about this testing process. It does not constitute a deliberate or verbalizable set of procedures that are followed for each plant by each healer before they will consider using a plant; there is no set of rules which dictate a method of testing plants. Rather, in a society based on first-hand empirical knowledge, whether it is the best locations for particular crops (Johnson 1974), the best mud for plastering walls, or selecting the best seeds for planting the following year (Gladwin 1980), it is simply the way in which one gains information. One learns through practice in everyday tasks, not through a formal education process. In a non-literate society which depends on the oral transmission of knowledge, there is renewal, strengthening and modification by practice of all information. It is a dynamic process inherent in the oral transmission of knowledge. This is an important point for innovation and variation of knowledge which I will discuss below.

A counter word of caution: Stating that there is nothing deliberate or systematic about the methods by which plants are evaluated for their medicinal properties, does not imply that there is no logic to the process. As is detailed elsewhere in respect to "trial and error" (Chapter Four), there must be an underlying cultural logic, a set of rules, which allow evaluation of medicines according to

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culturally valued qualities such as: useful, not useful, "good", "bad", desirable, undesirable, strong, not strong, etc. While there may be no codified set of procedures which can be easily articulated by informants, there is nevertheless a set of expectations which inform decisions about the value of medicinal plants and success of particular treatments.

The primary criterion for considering a medicine successful/useful is that it works; that it results in some positive change in the health condition of concern. Any discussion about the efficaciousness of a medicine must be considered within the cultural context of the expectations of curing (Etkin 1988a). Furthermore, any discussion of biomedical efficacy can be only discussed in the context of controlled clinical trials, an impossibility in this and most other ethnomedical or ethnopharmacological studies. We are left, unfortunately, to rely on what Brown (1987) felicitously refers to as "alkaloid mongering", using the chemical and pharmacological literature to attempt to identify if and how plants might be pharmacologically useful. There have been some notable exceptions to this of course: Berlin et al. (in press), Browner and Ortiz de Montellano (1986), Heinrich, et al. (1992b) where pharmacological testing and screening have been integrated with careful ethnomedical research. Heinrich, et al. (1992a) developed a methodology based on a proposal presented by Browner, et al (1988) to score plants for future pharmacological testing, based on their consistency of ethnomedical use.

In Cancuc, as in many other settings, the expectation of medicinal plant use is a change in state of the health condition being

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treated (Etkin 1988a; Browner 1985a; Ortiz de Montellano 1986). For the health conditions considered in this study (see Appendix B), that change in state is almost without exception a change for the better, an improvement in the way one feels. All of the conditions considered have a distinct and observable biological component, regardless of etiological expectations. Thus, even though many serious medical conditions are known to be caused by witchcraft and an important part of curing will be in the spiritual realm (the burning of candles, prayer, and ritual meals), the physical reality as an illness is, in most cases, easily observable and verifiable. To become better unambiguously means a diminution of pain, a lessening, or stopping of diarrhea, a cessation of itching, the scabbing over and decrease in infection of wounds, etc. There is, for the health conditions studied in this research, nothing mysterious about improvement--one feels better and once again is able to resume accustomed activities in a relatively unencumbered fashion.

This is easily seen by considering the answers to question #18 in the garden interview series which asked how the body feels upon taking the medicine. While there is a wide range of answers reflecting each informant's perception of the question and knowledge about illness, medicine, and bodily processes, a common theme runs throughout: "one feels better", or "the illness is calmed". While these are the predominant sentiments, abstracted from the wide range of answers, a closer examination reveals that the reason one feels better is because the medicine in some way affects the illness. Conditional and declarative sentences are common: "*Ya xbutz'anej k'inal te me ch'ab stiaw ketike*" ('One feels better if the tooth pain is

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calmed'); "*Ya xbutz'anej k'inal te me takej te tza'nele*" ('One feels better if the diarrhea dries up'); "*Ya xbutz'anej k'inal te me chikan ya xchik'inotik yu'un te k'alal lok' ta chamel*" ('One feels better (following) sweating when the illness comes out'); "*Ya xlamej te sak'al te obale sok ya xk'ixnaj, ya xlaj pisil te chamele, ya butz'anej k'inal*" ('Calms the itchiness of cough (by) warming and kills the entire illness and one feels better'). The outcome, though defined in ethnomedical (i.e., culturally conditioned) expectations of illness process, is nevertheless expressed in terms of improvement which are not likely significantly different from what anyone would expect, regardless of their cultural perspective on illness. Further, the link is clear that in many cases the expected outcome is derived as a result of therapy, a large part of which is medicinal plants. I would predict that, if we took the time to ask, this would be the dominant expectation in most medical systems regardless of etiological considerations, primary methods of treatment, or overall expectations on the course of particular illness episodes.

Assignation of Quality

Assigning, or perhaps more accurately, defining the quality of a plant as having medicinal properties is a complex blend of empirical observation, ethnomedical expectations, and biological understanding of disease processes. The English word "quality", as a general term, best expresses the concept of a plant's underlying usefulness as a medicine. Quality in this context reflects not only the organoleptic properties of a plant, but also intangibles like "hot" and "cold", which figure large for some plants/illnesses. My focus in this research was to understand the criteria by which a plant is thought to be able to

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cure, biologically speaking; in a sense its "power to heal". In consequence, interview questions were designed with this focus in mind. The spiritual and symbolic aspects were accomodated in more open-ended interviews, observation of healing activities, and in elaborations and discussions arising in the course of garden interviews. The primary question in Tzeltal (#6 on the garden interview form) which asked for a quality designation was "*Bin ya'el ta tuntesel, ya bal, sup bal, ch'a bal, sik bal*". In literal translation it is "How does it feel upon using, is it pungent, is it astringent, is it bitter, is it "cold"?", which best expresses the English/Spanish concept of "quality" or "sensation". The series of short prompts is necessary in Tzeltal to establish the domain, or intent, of the question; to give the informant a clue as to what the question intends. This was followed (#7) by the question "*Bin ut'il ay stulanil te yipe (calidad del #6).*" This translates to "Why does this quality have the power to heal"? (Literally: "How is it said [that] it is strong [or "has strength"] this power [or "force"]?") In the context of the entire interview these two questions (along with questions 17, 18, and 19) were the core questions designed to explore the underlying logic of plant selection.

Quality designation is generally based on empirical sampling of the plant, primarily taste and smell. This is obvious in the plant collections and the garden interviews where the vast majority (85% for both) are labeled by terms indicating the biological perception, based on chemical sensations experienced, of the plant: *ch'a* (bitter), *ya* (pungent), *paj* (sour), *sup* (astringent), etc. There is nothing mysterious about these designations, they simply reflect the results of chemosensory testing by taste and smell. But, to define a plant as

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ch'a carries with it more information than just its flavor. Inherent in the concept is information about illness categories for which the plant would serve as a useful medicine, which in turn informs on the likely preparation, administration and probably mode of action. The simple statement of "quality" is not merely a comment on taste or odor sensation, but a cascade of information about the plant as medicine. As noted above this designation of a quality is contextual; it carries the additional information only when the discussion is about the plant as medicine. A plant may be bitter and not used as a medicine. In this case, stating that the plant is bitter informs only on its taste, though this could be the starting point in the evaluation of the plant as medicine.

The nature of the Tzeltal language and how that impacts the reporting of perceived qualities deserves some discussion. Tzeltal, a productive language, allows speakers to combine basic terms (concepts) into compound word phrases yielding subtle shading in meaning and detailed reporting of sensation with an economy of language. Many plants are not simply bitter, pungent, or sour. They often possess a dominant sensation with overtones of others, or begin as one sensation and shade into another, or simply a variety of sensations are produced at once, all of which must be reported to provide an accurate description of the plant's qualities. As was discussed in the previous chapter, taste and odor are a complex combination of sensory input, involving pure taste, pure odor, and the pain and touch sensations detected and transmitted by the trigeminal nerve system. Though these are transmitted along three nerve pathways they are perceived holistically as unitary sensations

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by most individuals not trained to distinguish the difference (i.e., most of us). In everyday practice we do not consciously separate taste, odor, or pungency unless they are powerful and dominant (e.g., eating a lemon, sitting next to someone with too much perfume/cologne, or eating a very hot chili pepper). Informants, when asked to state a plant's quality, had to evaluate the plant if they were unfamiliar with it. In most cases, this was uncomplicated and involved a simple odor and taste procedure. But, as will be detailed below, ethnomedical factors affect the need to sample some plants, primarily because of their understood value as medicines. The most experienced *jpoxtawanej* knew the quality of most of the plants they collected without having to sample each one as encountered. Younger and/or less experienced healers often had to sample each plant and report their findings.

Thus a plant which has an unquestionable taste of bitterness will be reported as *ch'a* 'bitter' or if it is very bitter this may be modified to *lom ch'a, yon ch'a* or *ben ch'a* 'very bitter' (e.g., *Cissampelos pareira*). This may be combined with facial expressions, inflection and reaction to the sensation to indicate further that not only is it very bitter, but downright nasty and unpleasant in taste. Conversely, a plant may be reported as *ch'a chi'chi'tik* indicating that it is bitter and a little sweet-tasting (e.g., *Chromolaena collina*). In most cases this means that while it is unquestionably bitter, it has additional flavor characteristics which make it appear sweet or agreeable to the taste. Should a plant be bitter, but with an overtone of pungency it might be reported as *ch'ach'atik syaal*--medium bitter, but with a "bite" (*Fleischmanniopsis leucocephala*); or *ch'a*

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supsuptik, bitter with a definite astringency; or *supsuptik ch'aal* should the astringency be perceived as the dominant or primary sensation (*Pluchea odorata*). It is not uncommon for odor and taste concepts to be combined to form a single concept as in *yon jik'jik' syaal* which indicates that it has an extremely intense odor and pungent taste (*Polygala floribunda*). If two concepts are perceived equally they may be simply conjoined; *ch'a sok sup*, bitter and astringent (*Brugmansia candida*). In some cases additional information will be reported that has little to do with chemical sensation per se and more to do with the feelings produced from having taken the medicine. The root of *Cissampelos pareira*, a widely recognized and used medicine for gastrointestinal complaints, has an extremely bitter flavor. It is usually reported as *ch'a* or *lom ch'a*, but some informants reported *ch'a xlebebet*, bitter and it burns (or warms), or *xinxintik xabet* indicating that it was a disagreeable flavor which is perceived to cause discomfort upon consumption. The combinations are as varied as the plants to be sampled and informants to report on the sensations, but each statement reflects that person's perception of the plant. While there is variation, it is probably best to consider it "variations on a theme". It is generally a matter of interpretation of the sensations received, in many cases it is not easy to state definitively that one sensation is dominant over another, so it is often a matter of making a "judgement call" in stating one's perception. Nevertheless, seldom will there be radical differences in stated quality. It would be unusual for one person to state a plant as being bitter, while another would define the plant as sour.[31]

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Acknowledging that there are "variations on a theme" in labeling chemical perceptions, it is also important not to obscure a certain amount of inter-informant variation in reporting of qualities that does not arise merely from differences in interpretation. This variation arises from two sources, the plant and the perceiver. There are distinct differences between plant populations (and between plants in a single population) based on environmental conditions, genetics, age of the plant, part sampled, etc. The root of *Acacia angustissima* is the part generally used and is universally reported to be *sup* (astringent), but some informants use the leaves and these are unambiguously reported to be *ch'a* (bitter). Two specimens of *Achmella oppositifolia*, collected by the same informant, on the same day, in the same general area are reported as *ya* and *ch'a* by the informant. My notes confirm that each was radically different in taste sensation, one being described as "fiery hot!", the other as "medium bitter". Closely related species may also vary considerably in sensation. *Calea ternifolia* is generally regarded as *ch'a*, *C. trichotoma* is generally noted to be less bitter, *ch'ach'atik*, while *C. urticifolia* is *lom ch'a*!, very bitter. The status of the person doing the sampling will also affect their perception depending on their nutritional state, being hungover, expectations of what the plant ought to be, and interpretation of ambiguous sensations. This last is particularly important because many of the plants do not have a clear, unambiguous taste or odor and so there is much room for variable reporting. As an example consider *Pluchea odorata*, one of the garden plants which was recognized by five informants, each of whom gave a variable description of its quality: 1) *ch'a, supsuptik*

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ch'aal, 2) *yon ch'a*, 3) *ch'a*, 4) *ch'ach'atik supil*, and 5) *sup*. It is clear that each of them perceived the same plant in slightly different ways, but conceptually very similarly. For all of the informants there were two elements which dominated, bitterness and astringency. Why this variation in perception exists is essentially unknowable and represents a common problem in taste and odor research (Engen 1991; Miller and Bartoshuk 1991:213).

The other major category of designation is determined in response to the perceived status of the illness and is derived from a humoral theory of opposites. While the majority of quality designations are based on chemical sensation, largely mediated through taste and smell, or tactile sensations (*sak'*--it itches, *ya*--trigeminal nerve stimulations of pain), the designation of a medicine as warm (*k'ixin*)[32] or cold (*sik*) is largely based on the perceived hot/cold status of the illness. It is the ethnomedical concept of the illness as "hot" or "cold" which determines whether the medicine used to treat it, which must be the humoral opposite, will be hot or cold rather than anything inherent and verifiable in the plant (Messer 1981; Tedlock 1987). This point has been repeatedly demonstrated in Mexico and Central America (Foster 1979:181; Logan 1973:390-1).

An illness may be seen as having been caused by the blood being too hot (*k'ux jolol* [headache], *ch'ich' ni'* [bloody nose]) and needing to be cooled in order to stop the pain or the bleeding; or it may be seen as a cough which has become cold, making it worse, and so needing to be warmed in order "come out" (*jik'jik' obal*, ['whopping cough'] *sak obal* ['tuberculosis']); or the womb or body needing to be

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warmed to drive out the (cold) air which is causing difficulty or pain (*sik ta ch'ujtik ta antz* [menstrual/fertility difficulties], *jul bak' sik* ['arthritis]'). The hot/cold aspect of illnesses and how this relates to other aspects of health are discussed more fully in Chapter Three.

Table 5.2, using the pile sort data and the results from the hot/cold test (see Chapter Two), indicates that the hot/cold status of illness is fairly unambiguous; there is a substantial degree of consensus on most of the 58 illnesses about which I asked. It can be seen that 40/58 (69%) of the illness terms had an agreement among informants (n=13) of >75% as to the status of particular illnesses as hot or cold, and 53/58 (91%) had an inter-informant agreement of >62%. This degree of consensus is somewhat higher than has been reported in the literature to date (Foster 1979; Weller 1983). The hot/cold status of plants, as derived from the hot/cold test, is less clear (Chapter Two). Only 10/24 plants (42%) used in the garden interviews were relatively ambiguously noted to be hot or cold.[33] This test was designed to determine if there was a clear hot/cold designation for <u>plants</u>. There does not appear to be. But, if the data are examined <u>as though</u> the question was about the hot/cold status of the illnesses cured by those plants, rather than about the plants themeselves, then the data are more consistent with those of the pile sorts. These numbers are presented in columns three and five in Table 5.2. The consistency is striking. In nearly all cases there is substantial agreement between the two tests. This indicates that the driving force for defining a medicinal plant as hot or cold is based primarily on the illness for which it is being used and not on anything inherent in the plant. There are exceptions, discussed

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elsewhere, in that plants which are *ya* or which have succulent leaves, etc. may be noted as hot or cold respectively, regardless of the illnesses for which they are used.

Illness	Sikil (cold) Chamel	Hot/cold test results	K'ajk' (hot) Chamel	Hot/cold test results
1 jul bak sik'	77	100		
2 tza'nel	92	82		
3 cha'lam tzotz			62	75
4 batz'il obal		66	54	
5 belbel on			77	
6 bik tal tza'nel	85	66		
7 bujk'			85	100
8 cha' nujkul			77	100
9 ch'ich' tza'nel			54	67
10 mak sitil			77	
11 chakal			100	100
12 xoch		80	62	
13 chixal yak' wakax			92	100
14 chay k'ajk'			100	100
15 sik k'ajk'			54	50
16 chixal yak' mis			100	
17 tokal ta sitik			69	
18 chin			92	100
19 k'ajk'et chin			100	
20 k'ux baketaltik	77			
21 sak obal	85	86		
22 chul chan			69	
23 echen			69	50
24 ejsel	54			
25 ixim chakal			100	100
26 ja' ch'ujt	92	100		
27 jik'jik' obal	85	60		
28 k'ajk'al obal			69	
29 k'ael			77	66
30 k'ajk'			100	50
31 k'in ch'ajaw		100	92	
32 k'ajk'et k'in ch'ajaw			100	
33 k'ux ch'ujtubel	85	78		
34 k'ux jolobel			92	75
35 k'ux o'tanil	69	60		
36 k'ux sitil			85	100
37 lukum	77			
38 muk'ul chin			92	
39 muk'ul chuel			92	
40 nujkul ch'ujt	85			

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41 obal tza'nel	62			
42 paslam			92	50
43 pumel	100	100		
44 sak nok'			85	
45 sal		100	62	
46 sep chin			77	
47 sijt'el			69	100
48 sijt'ubel	77			
49 simal obal			62	
50 sin ak'al tza'nel	62	100		
51 sit chay			54	
52 sit mut			85	
53 tuk'ul ch'ujt			100	
54 tumin k'in ch'ajaw			92	
55 tzajal chuel			92	
56 tzajal paslam			100	
57 tzon kok		100	92	
58 xenel	69	75		

Table 5.2. Columns two and four present data on the hot/cold status of illnesses as derived from the pile sort data, presented as % of informant agreement. Columns three and five are interpretations of the results from the hot/cold test conducted with the garden interview plants. See text for additional discussion.

While nearly all illnesses can be clearly stated to be hot or cold, this will not necessarily determine the quality of the medicine needed to achieve a cure. In Cancuc the humoral component of health and illness is clearly in evidence but does not appear to be a major organizing principle for diagnosis, etiology, or therapy, also noted by Weller (1983) and Tedlock (1987) in Guatemala, and Young (1980) in Central Mexico. Others have found that humoral classification of illness is a major organizing feature for diagnosis and treatment (Foster 1979; Logan 1973; Messer 1981). Rather, in Cancuc it appears that although most illnesses can be easily classified as hot or cold, this designation comes into play only under fairly restricted circumstances. The concepts of hot/cold imbalance or exposure to excesses of temperature, while in evidence, are not

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major etiologic phenomena, though they do figure in some illnesses (see Chapter Three).

It is not absolutely clear, despite much discussion in the literature, what factors lead to a designation of an illness as hot or cold, and which of these factors will in turn determine or affect the perceived quality of the medicine used to treat it (see Messer 1981; Mathews 1983; Tedlock 1987; Weller 1983 for reviews). It is generally accepted that while there appear to be patterns, locally and internationally (Anderson 1987; Manderson 1987), there is considerable variation within the same region across time (Foster 1979), from one segment of society to another (e.g., healers vs. laypersons), and between societies (Messer 1981; Weller 1983).

In Cancuc many illnesses, especially those considered to be *k'ajk'* (hot), are so considered because they are in fact hot, they produce heat. Of the various conditions in the plant collection database which unambiguously need to be cured with *sik* (cold) plants, 50% of them are heat producing in some way, including burns (*k'ajk'el*), inflammatory skin ailments (*paslam, bujk', chay k'ajk'*), and inflammation as a general condition (*sijt'el*). An additional 25% of illnesses treated with cold plants may be thought of as what would be in English burning or stinging pain, or severe itching and so could be easily considered to be "heat producing" conditions. This includes predominantly skin rashes of various descriptions (*chin*) and several of the eye ailments (*tokal, sit mut, chul chan*). Thus, from the plant collections database 75% of the plants whose only designation is *sik* are used to treat heat producing conditions.

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The pile sort data clearly demonstrate this pattern as well. Of the 28/58 health conditions considered to be hot (>75% informant agreement), 19 (68%) produce or result from inflammation or what might be characterized as burning pain or severe itching. Of the remaining 9 conditions, 6 are characterized by sharp or intense pain (eye conditions and headache). Two of the conditions are considered as diseases of the tongue and are universally recognized as serious. These are ethnomedically affiliated with diarrhea and fever (probably representing various stages of, probably severe, dehydration), which could easily be perceived as hot (see Table 5.2 for details).

Illnesses designated as cold are not as empirically obvious, nor are they nearly as numerous. Of the 58 health conditions considered in the pile sort exercise, only 12 (>75% informant agreement) are clearly noted as cold (Table 5.2). In the plant collection database the difference is more striking yet. Of the 987 plant/illness collections, there are only 12 that are labeled as *k'ixin*, and thus, following the logic outlined here, useful for cold kinds of illnesses, whereas there are 127 plants which are labeled as *sik* and thus useful for hot kinds of illnesses. *Sik* health conditions are generally thought to be due to the intrusion of (cold) air (*ik'*) as in *sik ik', sik ta ch'ujtik, alal jel*[34], or the body/illness in some way becoming cold, thus exacerbating (*sak obal, jik'jik' obal*), or causing illness (*jul bak sik'*, most gastrointestinal problems [*pumel, tza'nel*], and generalized edema [*sijt'ubel*]). Of the 12 health conditions considered as cold in the pile sort data, 7 are gastrointestinal, 2 are respiratory, 2 represent

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arthritis or related kinds of conditions, while the last is generalized edema.

It is important to make clear this distinction between those illnesses which are unambiguously defined as cold or hot and those which need to be treated with hot or cold medicines. An illness can be readily and consistently categorized as hot or cold (Table 5.2), but almost never be treated with a hot or cold medicine (e.g., most gastrointestinal conditions), while other groups or kinds of illnesses will also be clearly hot or cold in their designation and the treatment will be largely based on humoral treatment with plants of the opposite quality (e.g., most skin ailments). The distinction appears to center on ethnomedical beliefs about what needs to happen to the illness in order to achieve a cure. This is in part an issue of etiology and in part one of understanding of disease processes. Ultimately, it is the ethnomedical belief system which drives the designation of a plant medicine as hot or cold in relation to the illnesses to be treated. This concept is discussed in much more detail in Chapter Three which explores the ethnomedical system in relation to healing with medicinal plants and Table 5.4 which examines each medicinal quality and how it operates to control illness (see also illness definitions in Appendix B and quality definitions in Appendix D).

Unlike other medicinal plant qualities which are generally thought to calm or overpower the illness, plants with a hot or cold designation are thought to warm (*k'ixnaj*) or cool (*siketes*) the illness in accordance with a humoral theory of opposites. If an illness is understood to be "hot" (*k'ajk'*) it must be treated with a plant which is understood to be "cold" (*sik*) which will cool the illness, bringing

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relief from pain and discomfort and curing the ailment. The opposite holds true as well. An illness defined as "cold" (*sik*) must be treated with a medicine which is "warm" (*k'ixin*). There is some difference in expectations between these two qualities and the illnesses they are used to treat, discussed in Table 5.4.

As noted above, the pile sort data indicate very clearly that most illnesses can easily be assigned to a hot or cold category, but that by no means indicates that the treatment must necessarily be its opposite. Most gastrointestinal illnesses are unambiguously understood to be cold illnesses, but there are very few instances in either the plant collection database or in the garden interviews where the primary form of treatment is hot. Rather some other expectation comes into play in relation to how gastrointestinal illness ought to be managed. Conversely arthritis (*jul bak' sik*) and female reproductive issues (*sik ta ch'ujtik ta antz, ste'el spat ta antz, alaljel*) are almost without exception treated with warming plants, the idea being to warm or expel the cold air causing the difficulty. The same could be said of the major respiratory conditions (*sak obal, jik'jik' obal*) which are widely thought to be cold. The cure or the role of the medicine is to warm the cough, to loosen it and allow it to come out of (be expelled from) the body.

One can taste or smell a plant and determine that it is bitter, sour, or astringent, but there is nothing inherent in a plant or medicine which will allow one to state unequivocally that it is hot or cold. Nevertheless there is an empirical component to some aspects of medicines stated to be hot or cold. Those defined as cold are the more ambiguous in that it became apparent during plant collections

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that many of the plants were from cool places or had something about them that, at least from my perspective, made them seem possibly "cool". Many of the plants regularly considered to be *sik* grow in cool, moist, shady places (*Stellaria, Pilea, Begonia*), while others have thick, fleshy, succulent leaves and stems which yield a large amount of liquid when crushed (*Begonia, Bomarea, Bryophyllum, Peperomia, Tripogandra, Commelina*, various orchids). Anderson (1987:331) notes similar characteristics regarding cooling foods in Chinese medicine and cuisine. These observations were seldom reported to me as <u>reasons</u> why the plants were cool or that they cured because they had these properties or grew in these places. On only two occasions were these conditions reported to me as contributing to the plant's status as a cold medicine. In one instance the plant concerned was a *Piper* sp. which was noted to be colder (*más fria*) because it is more succulent (*"porque es aguada"*). Most of the pipers have a pungent taste/odor to them and are usually regarded as *ya* (which would usually be designated as 'hot'), but this one, which was succulent and growing on a shaded wall, was considered to be cooler. The other example simply consisted of an informant picking a leaf of *Commelina*, holding it to my cheek and pointing out that it was *sik*, one could feel its coolness against the skin, even though it was a warm, sunny day and the plant was growing in an open field.

Finally there are cases where a chemically based quality is stated, but the "power to heal" is considered to come from the medicine being able to warm or cool the illness. This is most clearly demonstrated in the case of *Hibiscus uncinellus* which is used to treat

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jik'jik' obal. A wide range of qualities is noted, *chi', yayatik, paj, bilil,* but in the majority of cases the reason it can cure is because it warms the illness, warms the cough, allowing it to come out, to be expelled. In this and similar cases there will be a definite sensation of warmth upon taking the medicine. The most common admixtures to this medicine are cloves (*Eugenia caryophyllata*), allspice (*Pimenta officinalis*), or occasionally cinnamon (*Cinnamomum zeylanicum*), honey or raw sugar (*panela*). Cloves, cinnamon or allspice will all produce a sense of warmth through stimulation of the trigeminal nerve system.

In a related vein there are instances where the assigned qualities are due to a combination of chemical sensations, what occurs to the illness during the course of the healing process, and ethnomedical expectations about the outcome of medicinal use. An ideal example may be found in *Ranunculus petiolaris* (*nitan k'ajk' wamal*). It is used predominantly for suppurating skin conditions (*chay k'ajk', paslam, sal*) and inflammation (*sijt'el*) (secondarily for gastrointestinal conditions) and is often noted to have several qualities, *ya, sak', sup, sik.* The chemosensorily derived quality, *ya,* is unambiguous, all parts of this plant, especially the roots and seeds, are very pungent in flavor, thus there is no question about its chemical quality. *Sak'* and *sup* are qualities derived from observation about what the medicine does when it is being used. It is *sak'* because when it is applied to the skin it hurts or itches still more, while the *sup* designation arises from the fact that as the skin conditions begin to heal, the pustules begin to dry up and form scabs. A common expectation of astringent plants is that they cause the

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illness to dry up, be it skin conditions or diarrhea. The designation as *sik* results from being the humoral opposite of clearly *k'ajk'* health conditions and possibly from the relief one gets from the burning pain and itching of the inflamed skin.

Table 5.4 contains a discussion of each of the main quality terms collected, an English gloss, how each quality is generally understood to affect illness, and how the body feels when one takes a medicine of this quality.

Power to Heal

The third part of the discussion is concerned with how a medicine has the power or ability to heal. What is it about a plant that makes it useful as medicine? Why this particular plant and not some other? How do plant medicines affect the illnesses they are used to treat? A medicine is used because within the cultural context of healing it will result in a beneficial change in negatively valued states of health. A plant medicine is able to cure because it has the power or strength to change the illness. This change may be a matter of overpowering or dominating the illness, resulting in a diminution of (or relief from) symptoms, or a change in state within the humoral framework in which the hot or cold nature of the illness is modified in line with normal expectations. Details about the role of each quality (bitter, astringent, etc.) appear in Table 5.4. This table explores the way in which each of the identified medicinal plant qualities serves to cure illness. Table 5.5 is similar in intent but approaches the question from a different perspective. Each of the plants in the medicinal plant garden is considered in turn with a discussion of what each plant treats and how it works as a medicine.

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Together these two tables provide a detailed outline on the way in which plant medicines serve to cure illness. The following discussion is a general consideration of why plants have the power to heal; what is it about plants that allows them to be defined as medicines.

The "power" or ability of a plant to heal is both inherent to, and derived externally from, the plant. Foremost, it has a quality which is useful in treating illness (*ya*, *ch'a*, *paj*, etc.). That quality (or qualities, in some cases) is useful because it in some way affects the disease in a fashion beneficial to the ill person. This in part defines it as a medicine--because it works. It is defined, considered, and used as a medicine because it is effective, because it results in a culturally expected and acceptable change in the state of health of the individual being treated. As discussed above, in many cases, this change for the better is just that, relief of the presenting signs and symptoms of ill health. The quality is effective because it is stronger than the illness. This strength allows it to overpower the illness in the struggle which ensues upon taking or using the medicine. In the garden interviews there were three question which elicited data on this theme, each addressing the issue from a slightly different angle (questions #s 7, 17, and 19). The data fall into three variations of this central idea of the medicine overpowering or dominating the illness. The first variant is a straightforward statement that the medicine or quality is stronger or overpowers the illness. This in turn may be expressed in several ways. In the most forceful, the illness is killed or stopped by the medicine, while other variations have to do with calming, quieting, or soothing the illness, but in all cases the image is clear; one of the medicine in some way affecting

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the illness to the benefit of the patient. A second variant states that the quality or the medicine is strong or has much strength. While not explicitly stated by these informants that the medicine is stronger than the illness, I interpret this second response, in light of the first , as a shorthand method of saying "it is stronger than the illness". The final variant is a statement that the medicine has quality x, y, or z (*ja' ay ch'a* --it is bitter). In light of the other statements, this indicates that the presence of the quality is what gives the medicine the ability to cure, that which gives it the ability to affect the illness.

Many people report feeling worse upon taking the medicine, indeed they expect to feel worse because this is the primary indication that the medicine is working, that it has engaged the illness in a struggle of domination. Expectations vary depending on the nature of the illness, but in general an immediate, negative, change in state indicates that the medicine has begun fighting the illness. This is often indicated by pain, either an increase in pain or the presence of pain where there was none previously. If suffering from diarrhea, stomach pain would be anticipated, or if not pain, then movement, described as jumping or churning, indicating that the struggle has begun. Skin ailments will hurt even more, stinging and burning with the application of the medicine. This is something that one must endure, recognizing that relief will follow shortly and that in the long run, the illness will be overcome and one will improve (feel better). As the medicine overcomes the illness relief from pain will ensue, but in the short term pain will be the predominate sensation.

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The action of medicines within the humoral framework differ from this general model. The expectation of hot/cold medicines when applied to illness of the opposite category is that the illness will be altered, implicitly, more toward the neutral, bringing relief. Cold medicines are expected to bring relief, more or less immediately, serving to calm or cool the pain/heat of the conditions. Warming medicines serve to warm up the illness, usually allowing for its expulsion (e.g., coughs), or for a restoration of appropriate functioning (e.g., female reproductive problems).

The idea of struggle between illness and medicine, or of the medicine overpowering the illness is fundamental to an understanding of the way in which a medicine works. The medicine overpowers or dominates in the struggle to overcome the illness. This expectation also provides the rationale for changing medicines or medicinal approaches. If the patient fails to improve, this is an indication that the medicine was weaker than the illness and another medicine or form of treatment is required. The medicine (or its quality) affects the illness in some fundamental way, to change it such that it no longer poses a threat to the ill person. The change anticipated depends on the nature of the illness, as can be seen in tables 5.4 and 5.5. It may be that the desired aim is the cessation of pain or itching or it may be that the illness is in some way killed or stopped by the medicine. In other cases the medicine is considered to kill the "worms" (*chanul*) which cause illness. As noted in Chapter Three, these worms may be visible or invisible, usually the latter. The *chanul* are causative agents in a wide range of illnesses from diarrheas to eye problems to skin ailments, tooth decay and

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abscesses and contrast with *lukum* which are usually visible intestinal parasites. The domination of illness results in a change or containment of the illness, sometimes allowing for its expulsion. It is frequently said that the medicine does something to the illness and allows it to "come out" (Etkin 1988a).

The perceived strength of a plant as medicine is in part determined by the relative intensity of the quality such that a very bitter, pungent, or astringent plant will be seen as more powerful than one less intense. This is borne out by the results from the triad tests, Table 5.3, where the question was a simple "which is the strongest?". The design of the test and analysis is such that the numbers represent the percentage for which each term was stated to be the most powerful out of all the times that a particular quality was a choice in any given triad. For example, *ch'a*, (bitter) is considered the most powerful 71% of the time, across all informants, when matched against all other qualities.

Ch'a, ya (pungent), and *sup* (astringent) are clearly considered to be stronger than other plant qualities. As was discussed in Chapter Four (Table 4.9), this correlates closely with the frequency of plants of these qualities used as medicines.

Quality	Triad results	Quality	Triad results
ch'a	71	bilil	27
sup	50	xyuk et yik'	25
ya	50	xuch'	24
jik'jik' yik'	37	xojet	20
paj	33	sik	18
tzij yik'	32	sak'	16
k'ixin	30		

Table 5.3, Triad results on quality terms. Percent of affirmative answers when compared against all other quality terms.

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The garden interviews indicate that not only are these qualities considered to be stronger, but because they are stronger they result in more effective medicines, medicines which are better able to cure one of illness. The most bitter (astringent, pungent) part of the plant will be used "because that makes the best medicine"; a very powerfully flavored medicine will be given in small doses because "it is real strong", whereas a less strongly flavored medicine might be given liberally; strongly flavored plants/medicines will be noted to kill or stop illness as opposed to properties of calming or cooling exhibited by plants of less intense sensations.

A plant with more than one perceivable quality is generally considered to produce a superior medicine to a plant which consists of only a single quality, unless, as discussed above, that quality is in some way notable or the plant is known to produce a strong (toxic) reaction. Likewise, medicines resulting from a mixture of ingredients, especially of different qualities, (which may [or may not] in turn manifest both of the constituent qualities). The primary reason for combining ingredients is to "make the medicine stronger" and enhance its healing properties. In the case, for example, of *Piper jacquemontianum*, universally recognized as *ya*, it is defined as *lom ya* (very piquant) when combined with *tan* (slaked lime). In its use for skin conditions, this makes it a superior medicine because the very piquant nature will be more effective for killing the *chan* responsible for these conditions, allowing them to scab up and heal more rapidly. *Pluchea odorata*, used to treat fever, is considered by some informants to be *sup* (astringent) which when combined with

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Mimosa albida, another *sup* plant, is not just more astringent (e.g., *lom sup*), but becomes *mero tulan yip* (truly very strong).

Finally, a medicine which is known to cure several illnesses, regardless of its quality designation, is more powerful than one which only cures one or two.

For those healers who are *jpik k'abal*[35]--in Cancuc, this is generally considered to be those who know how to pray (which entails the full panoply of ritual, burning candles, incense, and the drinking of liquor)--the plants as entities or medicine may be considered to play a relatively minor role in the ultimate success of healing efforts. The power to heal ultimately comes from God and is made available through the efforts of the *jpik k'abal*. The healer will invest power in the plant through prayer, but ultimately this power derives from God. These informants have no difficulty in stating how a plant works on a proximate level, that it overpowers the illness, or calms/cools the pain, or dries up the diarrhea, and these are thought to result from the inherent empirical qualities of the plant. Nevertheless, ultimate power and strength is stated as coming from God, that it is only with God's benediction that a plant can be expected to heal. From the perspective of these healers, the reason they have a high degree of success in curing is as much because of their access to this benediction, their ability to pray and receive this additional blessing/help/strength, as it is to their extensive knowledge of plants and experience in diagnosing illness.

Table 5.4: Medicinal Plant Qualities

The following series of tables is designed to present a basic summation of each of the medicinal plant qualities. It is important to

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note that these are descriptive terms that may be used in a variety of contexts. As discussed in more detail elsewhere, when applied to plants which may be used as medicines, these terms carry with them (or imply) a certain amount of information besides just the taste/odor/texture of the plant. Knowing what the plants' qualities are informs one about general classes of illness for which this plant would be appropriate and following from this information about preparation, administration and expected outcome. Knowing that a plant is bitter is much more than simply knowing that it has this particular organoleptic property, it is information that describes this plant as a medicine; it tells one that it is probably useful for gastrointestinal problems, that it would probably be boiled and the resulting tea drunk, that it will probably cause the stomach to ache still more, but that in a day or two the original pain will subside and the diarrhea will stop.

Data are drawn from the plant collections and garden interview databases, and my fieldnotes. Each section will follow a similar format. First will be a true table, the first column of which is a listing of the major illness categories for which medicines are generally used; the second column represents the number of plant/illness combinations in the plant collection database whose sole designation was the quality under consideration, e.g., *sup*, *ch'a*, etc. Often when plants were collected, several uses would be noted for each one. In order to facilitate analysis I separated each illness term into a separate record in a database. Thus there may be several entries for *Brugmansia candida* which have the same collection number, but which occur with the illness headache in one record and

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inflammation in another; each illness/plant pair constitutes a single, unique record. For clarity I considered in this analysis only those plants which were labeled with a single quality term. Many plants have secondary terms attached to them, but to include them here would be confusing and would not provide any particular additional information. The variable nature of plant qualities and their perception was discussed in Chapter Four, and the perception of plants with variable qualities when used as medicines was discussed above. The fourth column contains the data from the garden interview database. These data represent the number of times that plants designated as having the quality under consideration was mentioned as being useful for treating that class of illness. Columns three and five are the percent of total for each database. For example the third row, "gastrointestinal" the 17 plant collections in column two represent 15.2% of the total collections of *sup* plants (column three), while in column five 52% of the illnesses matched with plants designated as *sup* were used to treat gastrointestinal illnesses.

Following this true table is a discussion of the quality, including representative species and how the sensation produced is perceived and valued. This in turn is followed by a discussion on how the plant heals, what it does to the illness, etc. The less common qualties are considered in a general way, without the use of the "true table". Data are often limited for these simply because they were uncommon, and did not appear in the garden interviews from which come much of the data on power to heal, etc.

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Health conditions	Plant collections	% of total in collections	Garden interviews	% of total garden interviews
inflammation/wounds/skin	12	10.7		
blood conditions	6	5.4		
gastrointestinal	17	15.2	11	52
oral/dental	8	7.1		
eyes	24	21.4	4	19
fever	7	6.3	1	4.7
headache	6	5.4		
respiratory	14	12.5	4	19
other	16	14.3	1	4.7

Table 5.4.1, SUP. Only those conditions for which sup was the only quality listed are included (n=112, plant collections, n=21 garden interviews). Data are from the plant collection and garden interview databases.

Of 987 illness/plant pairs in the plant collection database there were 112 (11% of total collections) in which the plant was considered *sup*. An additional 83 (8.4%) had *sup* as one of two or more qualities given for the plant. Representative species from the plant collections which typify this sensation include *Byrsonima crassifolia*, *Calliandra houstoniana*, *Clethra suaveolens*, *Eugenia* spp., *Euphorbia* spp., *Gnaphalium* spp., *Psidium* spp., *Rondeletia* spp., and *Trema micrantha*. Generally the quality designation refers to the part of the plant used, but when part of the plant, usually the fruit, is widely known and used, that may be the designated as the quality, regardless of the status of the part actually used as medicine. *Byrsonima* treats a variety of health conditions and the bark is always used in these preparations. This shrubby tree also produces a small yellow fruit which when ripe is *chi'* (sweet), but is generally not used in medicinal preparations. Even though the fruit is seldom used as medicine, an occasional designation for this plant as medicine is *chi'*; the same occurs sometimes with *Psidium* spp. and *Prunus serotina*.

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In the garden interview database there are 41 instances in which a plant is mentioned as *sup*, 18 of which are only *sup*, covering 11 plants, of which *Acacia angustissima* could be viewed as the "type specimen" in that it is unambiguously designated as sup by most informants (8/10).

As is the case with all of the qualities, different plants produce different kinds of sensations within the domain of *sup*. Upon tasting astringent plants, ranging, in this case, from the unquestionably astringent (*Byrsonima, Eugenia, Psidium*), producing the distinct sensation of "drying" or "puckery" feeling, like eating an unripe persimmon, through to others which presented a variety of sensations within a single plant (e.g., *Eugenia origaniodes*). At first tasting this plant gives the impression of intense aroma in the mouth, followed by an uncomfortably strong astringency and pungency. Another aspect to this range of sensations is the distinction between what might be termed a "chemical" astringency caused by the chemical makeup of the plant, and a "physical" astringency resulting from the physical makeup of the plant part. In most cases the sensation of astringency resulting from physical characteristics results from leaf hairs which produce a reaction similar to astringency, but which is probably more tactile than chemical, though both will likely be detected through the trigeminal nerve pathways.

Astringent plants are used to treat a range of conditions, principally gastrointestinal, though a number of eye problems, respiratory ailments, and skin/oral illnesses are also included. In most cases (11/16) the part used is the root and/or bark. This is not

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surprising in that generally tannins, which are the most commonly associated plant compounds with astringent properties, are found in higher concentrations in roots and bark, as opposed to faster growing leaves and flowers. It has the power to heal because it is stronger than the illness, is able to dominate. While this is the most common consideration for why a plant with this quality has the power to heal, the most common mechanism by which it cures is its ability to "dry up" or "draw together" the illnesses. This applies across illness types including diarrhea where it dries the diarrhea, stopping the flow, to respiratory illnesses where it draws together the cough which is "walking through the body" allowing for its expulsion, or eye conditions, which upon being brought together may be removed from the eye, either through natural processes or through the actual physical removal with a small stick or piece of cloth, to skin ailments where it dries up the infection, wound, or sores allowing them to scab and heal.

Of the 8 admixtures (added to the 16 *sup* only plants in the garden interviews), 5 are *sup*, 2 are *ch'a* and 1 is *ya*. The resulting medicines are qualitatively stronger than either of the constituent ingredients. *Sup* and *sup* become *ben sup* or *tulan supil* or *mero tulan yip*; *sup* and *ch'a* become *mero ch'a tulanil*. This last could be interpreted to indicate that *ch'a* is the stronger or dominant quality because in admixtures which combine bitter and non-bitter components, the resulting medicine is usually bitter. As is discussed elsewhere the use of admixtures is a complex phenomenon the value of which is in some way to improve the medicine by making it more palatable, stronger, or more effective.

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Health conditions	Plant collections	% of total in collections	Garden interviews	% of total garden interviews
inflammation/wounds/skin	19	8.6	7	6.8
blood conditions				
gastrointestinal	120	54.3	80	77.7
oral/dental	4	1.8	2	1.9
eyes	6	2.7	1	.97
fever	8	3.6	3	2.9
headache	12	5.4		
respiratory	17	7.8	5	4.8
arthritis/body pain	6	2.7	4	3.9
other	29 (9=chawaj)	13 (4.1)	1	.97

Table 5.4.2, CH'A. Only those conditions for which ch'a was the only quality listed are included (n=221, plant collections, n=103 garden interviews). Data are from the plant collection and garden interview databases.

Ch'a is the most widely represented plant quality in the plant collections database with 221/987 (22%) of the plant/illness pairs being labeled as bitter with no other quality designation, though many are modified ([*lom ch'a*] 'very bitter', [*tebuk ch;a*] 'slightly bitter', etc. If we include those plants which are labeled as bitter and some other quality, the number is much larger: 335 (34%) plant/illness pairs, accounting for one third of the illnesses treated with plants. Representative species from the plant collections include *Agertina* spp., *Boconia* spp., *Brickellia* spp., *Calea* spp., *Piptothrix* spp., *Solanum* spp., *Stevia* spp. Note that with the exception of *Solanum* spp., all of the plants in this list are members of the family Asteraceae. The Asteraceae is one of the largest and most widespread families; consequently the argument could be advanced that they are heavily represented simply because of their ubiquity. But, two factors argue against this facile argument. On the one hand, the majority of the Asteraceae represented have a clear and unambiguous designation of *ch'a* (43%) or *ya* (14%). (This does

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not include all of the plants which are labeled by some combination of the two qualities.) 57% or more of plants represented by just two qualities would suggest that not just any Asteraceae will do; only those which meet the cultural requirement of "medicine" are acceptable. The other point against this argument is that other large, widespread families (Solanaceae, Orchidaceae, Fabaceae) are not used to a degree comparable to Asteraceae. The Asteraceae represent 23% of the collections, whereas Solanaceae and Orchidaceae represent only 3.7%, .9%, and 7.2%, respectively. Similarly, those that are used, are used because of signal characteristics (orchids--*sik* [*bilil*], Solanaceae--*ch'a*, Fabaceae--*sup* and *xin*).

In the garden interview database there are 103 illness/plant pairs in which *ch'a* is stated as the only quality. Considering only the plants, there were 58 instances in which a plant was labeled as bitter, including 17/25 plants included in the interview series, with three species consistently labeled as bitter: *Cissampelos pareira*, *Verbena litoralis*, *Cordia spinescens*. Each of these is unequivocally bitter, with the root being the primary part used on the vine *Cissampelos*, and the leaves on the herb *Verbena* and the shrub *Cordia*.

It is obvious from an examination of Table 5.4.2 that bitter plants are the overwhelming choice of treatment for gastrointestinal illnesses and are not particularly valued, though used, for other illnesses. While not obvious in the table, nearly all of the plants designated as very bitter (*lom ch'a*) are used for gastrointestinal conditions, while those plants not considered particularly bitter (*ch'ach'atik*, *tebuk ch'a*) are used for a wider variety of conditions,

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relatively few of which are gastrointestinal. The pattern is less marked for plants simply stated to be bitter (*ch'a*), but here too, the predominate use is for gastrointestinal illnesses, see below.

As discussed in Chapter Four, there is a wide range of terms in Tzeltal which can be applied to plants to designate their flavor/quality/sensation. This range of terms is reflective of the highly variable nature of bitter sensations produced by plant chemicals. The range includes the intensely bitter *Verbena litoralis*, or *Cissampelos pareira* which is unpleasantly bitter, through to plants like *Calea* spp., and *Chromolaena* spp. which have definitely pleasant, aromatic overtones, while still being very bitter to the taste. Others are not particularly bitter upon initial tasting, but leave an unpleasant bitter aftertaste.

As noted above, bitter plants are used to treat a wide range of conditions, but the majority are gastrointestinal illnesses including several types of diarrhea, parasites, stomachache, and upper gastric pain. In general, bitter plants have the power to heal because they are bitter and the bitterness (or the bitter plant) is strong; it is stronger than the illness and is thus able to overpower, kill, or stop the illness. Though one may feel worse upon taking the medicine (indeed, would expect to), the expectation is that the diarrhea will be stopped, the pain will be calmed, and in general one feels better. The medicine works, on the proximate level, by drying up the diarrhea, killing intestinal parasites, stopping (or drying) the pus associated with skin conditions (e.g., scabies) allowing healing, while at the same time calming the pain and, in the case of some plants, cleansing the stomach and intestines.

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The variety of admixtures (mentioned in the garden interviews) are all plants with important bitter components, with two exceptions: *Psidium* sp. is without question, astringent (though still used for diarrhea), and salt (*chi'*, 'sweet'), used for treatment of *chin* (scabies and other rashes). In most cases the resulting medicine was still more bitter (*ben ch'a, mero ch'a, yon bayel ch'a*) and/or stronger (*yon tulan ch'aal, tulan yip*).

Health conditions	Plant collections	% of total in collections	Garden interviews	% of total garden interviews
inflammation/wounds/skin	22	17.6	27	45.7
blood conditions				
gastrointestinal	26	20.8	9	15.3
oral/dental	19	15.2	8	13.5
eyes	16	12.8	1	1.7
fever	4	3.2	2	3.4
headache	7	5.6	3	5.1
respiratory	10	8.0	6	10.2
arthritis/body pain	8	6.4	2	3.4
other	13	10.6	1	1.7

Table 5.4.3, YA. Only those conditions for which ya was the only quality listed are included (n=125, plant collections, n=59 garden interviews). Data are from the plant collection and garden interview databases.

Ya plants are not as frequently used as *ch'a* plants, though they are still widely represented in the databases. In the plant collection database there are 124 (12.6%) plant/illness pairs in which *ya* is the sole quality, while there are 226 (22.9%) in which *ya* is considered to be part of a more complex flavor/odor. Unlike most other qualities *ya* can be used to designate an odor quality as readily as it can be used to designate a taste quality, though taste is the usual referent. This is due in large part to the volatile nature of many compounds labeled as *ya*. An alternative way to view this is that many plants

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labeled as *ya* are so labeled because they have a volatile component. Although the plant is tasted, the volatile component may be detected in the nasal passages as "hot" or "spicy". This is in addition to sensations produced in the mouth. Items from the taste/odor experiment clearly labeled as *ya* included ginger (fresh and dried), Chinese mustard, and garlic. "Tiger balm" is an example of an odor labeled as ya.

Representative species from the plant collection database include *Achmella oppositifolia*, *Erigeron karwinskianus*, *Polygala* spp., and *Sisyrinchium* spp. *Erigeron* and *Achmella*, both composites, occasionally also have a bitter component to them, though the piquant aspect is clearly the dominant sensation. *Polygala* (Polygalaceae) and *Sisyrinchium* (Liliaceae) both have sharp, clear hotness, much in the same sense as raw ginger does.

In the garden interview database 54 plant/illness pairs had *ya* as one of the qualities, the majority (40) having *ya* as the only quality. A surprising number of the garden plants were clearly *ya* in quality, including *Clematis grossa*, *Piper jacquemontianum*, *Polygala floribunda*, *Salmea scandens*, *Solanum lanceolatum*, and *Ranunculus petiolaris*.

While the pattern in Table 5.4.3 is not as strong or as obvious as with bitter plants, it is still clear that there are clear preferences for the use of piquant plants. A consideration of the ethnomedical expectations of the medicines makes the pattern clearer still. As with most other qualities, the overall mechanism by which *ya* plants cure illness is to overpower, kill, dominate the illness resulting in a calming, cooling, healing. The specific, proximate, mechanism by

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which the medicine works largely explains the pattern seen in Table 5.4.3. As discussed in Chapter Three *chan* and *lukum* are important etiological agents which may be implicated in a wide range of illnesses. *Ya* plants kill the causative worm, allowing the wound to heal. In this case, many of the skin conditions treated with *ya* plants are severe, resistant to healing and prone to spreading (*chay k'ajk'*, *paslam*, *sal*) and *chan* are commonly associated with these kinds of conditions. It is the same with most of the oral/dental conditions, especially *chan eal* 'tooth decay'. Many of the gastrointestinal illnesses are *lukum* 'parasites' which are killed by the medicine, allowing the parasites to be passed in the feces, a sure indication of successful treatment. Some informants suggested that severe coughs (e.g., *sak obal*) were caused by *chan* which would therefore be cured by *ya* plants.

Admixtures generally serve to make the medicine more *ya*, common examples include *tan*, slaked lime, cloves, allspice, or black pepper.

Health conditions	Plant collections	% of total in collections	Garden interviews	% of total garden interviews
inflammation/wounds/skin	33	55	16	47
blood conditions			1	2.9
gastrointestinal	6	10	2	5.9
oral/dental				
eyes	11	18.3	1	2.9
fever	1	1.6	3	8.8
headache	2	3.3	2	5.9
respiratory			3	8.8
arthritis/body pain				
other	7	11.7	7	20.6

Table 5.4.4, SIK. Only those conditions for which sik was the only quality listed are included (n=60, plant collections, n=34 garden interviews). Data are from the plant collection and garden interview databases.

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There are 60 plant/illness pairs in the plant collections database which have *sik* ('cold') as their sole designation. The designation as a *sik* plant is a complex blending of cultural expectation and biology and was explored in Chapter Three and so will be only briefly summarized here. Unlike most other medicinal qualities, there is no aggregation of plants widely recognized as *sik*. The primary reason for this has to do with the way in which plants are defined as *sik*. Several species which seem to typify one aspect of the concept of *sik* include: *Begonia heracleifolia*, *Bomarea hirtella*, *Bryophyllum pinnatum*. Another component of this definitional process include: *Lobielia laxiflora*, *Parathesis chiapensis*, *Stellaria* spp., and *Brugmansia candida* and *Phyllanthus niruri* from the garden interviews.

As can be seen in Table 5.4.4, there is a very clear clustering of uses around inflammatory conditions, wounds, and skin problems. An examination of Table 3.2 reveals that these are by and large all considered to be "hot" conditions which therefore must be treated with cold plants. Many of the illnesses in other categories in Table 5.4.4 are also defined as, or are, hot illnesses. For example in the "other" row in the garden interviews column almost the entire category consists of *ch'e'* (6/7) which is universally recognized as a hot illness, first and foremost; likewise eye conditions in the plant collections column.

Many of the plants (or parts) used to treat these illnesses are succulent and could be regarded as cooling, e.g., *Begonia*, *Bomarea*, or *Byrophyllum*, or grow in cool, moist, shady places, e.g., *Stellaria*. For other plants the association is not so clear: *Lobelia*, *Parathesis*,

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Brugmansia, *Phyllanthus*. In some cases the *sik* definition may result from the analgesic nature of the plants used. This seems highly likely in the case of *Brugmansia* and possible with *Phyllanthus*, given their preparation, application techniques and chemical makeup.

The medicines work by calming/cooling the illness. This is in marked contrast to most other plant medicines where the usual outcome is that the illness is stopped/killed/overpowered. Given that most of the conditions trreated with *sik* plants have a clear component of inflammation, burning, or itching pain, etc., this is an important expectation. Likewise, there is a clear expectation that swelling and/or inflammation will diminish, decrease. This is most notable with *Brugmansia candida*, nearly universally used for swelling and inflammation.

The use of admixtures is relatively uncommon with *sik* plants. In some cases, the admixtures are succulent plants, Arthrostema, Bryophyllum, and the resulting medicine is *yon sik*, *mero sik*, or *ben sik*, all indications of increased "coldness" (or strength/ability). In one case, the admixture is salt which is used with *Brugmansia* for suppurating skin conditions.

The following discussions of the remaining qualities will not be as fully developed as have the foregoing because of their relative infrequency. Having not encountered them often, especially in the garden interviews, I have limited data on them and can present them only in outline form.

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Health conditions	Plant collections	% of total in collections	Garden interviews	% of total garden interviews
inflammation/wounds/skin	11	18		
blood conditions				
gastrointestinal	17	27.9		
oral/dental	1	1.6		
eyes	3	4.9		
fever	5	8.2		
headache	6	9.8		
respiratory	3	4.9	1	33
arthritis/body pain	3	4.9		
other	12	19.7	2	67

Table 5.4.5, XIN. Only those conditions for which xin was the only quality listed are included (n=62, plant collections, n=3 garden interviews). Data are from the plant collection and garden interview databases.

Xin is a quality assigned to 62 illness/plant pairs in the plant collection database. Like *sik* there are no widely recognized plants designated as *xin*, though the plants do tend to cluster in the plant family Fabaceae (30%). Representative species include *Castilleja arvensis*, *Crotalaria* spp., and *Borreria laevis*. There are only three plants mentioned as only *xin* in the garden interviews, each of them only once: *Brickellia paniculata*, *Phyllanthus niruri*, and *Brugmansia candida*, though there are three other plants mentioned as *xin* in combination with some other taste/odor characteristic: *Eryngium ghiesbreghtii* (*xin ch'ach'atik*), *Erigeron karwinskianus* (*xinxintik ch'aal*), and *Cissampelos pariera* (*xinxintik xabet*).

There is no easy way to describe the taste sensation of *xin* except to say that it is disagreeable or bad without any other obvious characteristic. See Chapter Four for a detailed discussion of this quality.

Xin plants cure because they are disagreeable, serving to stop, burn, or kill the force of the illness, though the bad taste associated with *xin* plants usually makes them unpleasant medicines.

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Health conditions	Plant collections	% of total in collections	Garden interviews	% of total garden interviews
inflammation/wounds/skin	9	37.7		
blood conditions				
gastrointestinal			2	16.7
oral/dental	8	33.3	9	75
eyes	1	4.2		
fever	2	8.3		
headache	2	8.3		
respiratory	2	8.3	1	8.3
arthritis/body pain				
other				

Table 5.4.6, PAJ. Only those conditions for which paj was the only quality listed are included (n=24, plant collections, n=12, garden interviews). Data are from the plant collection and garden interview databases.

Paj (sour) plants are relatively uncommon in the environment, but those which are common, are unmistakably so: *Arthrostema* spp., *Begonia* spp *Citrus limonia*, (lime) and *Rhus terebithifolia*. In the garden interviews all mentions of sour plants refer to a single plant: *Arthrostema ciliatum*.

Sour plants are mostly sour in the same sense that lemon is sour, though clearly there is variation in intensity and other flavor/sensations can influence the overall effect. *Arthrostema ciliatum* is a common plant, occasionally used to relieve thirst when walking or working. It is intensely sour, though like lemon, not unpleasant to the taste. Once one becomes accustomed to the sourness, it is actually a rather tasty plant. The Begonias tend to be less sour and slightly astringent. The fruit of *Rhus terebithifolia* is the only part genuinely sour and is the desired part to use, but if it is not available, as it generally isn't much of the year, then the leaves are sometimes substituted though they are not particularly *paj*. The

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more common route is to seek out other sour plants like *Arthrostema*.

The uses of sour plants fall obviously and clearly into two categories: inflammatory skin conditions and oral problems. In the latter it is conditions like *tzon kok* and *k'in ch'ajaw* which are treated by the application of the medicine which removes the white coating of *tzon kok* and dries up and heals the ulcers of *k'in ch'ajaw*. In the case of inflammatory skin conditions, there appears to be some overlap with *sik*, in that several of the plants labeled as *sik* in one context are labeled as *paj* (a "true" taste) in this case (*Begonia*, *Bomarea*). Interestingly, in this case the mechanism by which they heal is to overpower or kill the illness, unlike *sik* plants which cool and calm the illness.

Admixtures are relatively few, but the most common is with lard (*lew*) which is unambiguously recognized as sik, but also helps keep the medicine in contact with the sore in the mouth.

Health conditions	Plant collections	% of total in collections	Garden interviews	% of total garden interviews
inflammation/wounds/skin	1	3.3		
blood conditions				
gastrointestinal	10	33		
oral/dental				
eyes	2	6.7		
fever	4	13		
headache				
respiratory	10	33		
arthritis/body pain				
other	3	10		

Table 5.4.7, CHI'. Only those conditions for which chi' was the only quality listed are included (n=30, plant collections, n=0 garden interviews). Data are from the plant collection and garden interview databases.

When applied to plants *chi'* means simply sweet, and generally it is the sweet of sugar or honey, though at times a neutral, vaguely pleasant taste will be labeled sweet as well. Sometimes salt is an admixture, at which point, the resulting medicine may be referred to as *chi'*. See Chapter Four for a full discussion of these phenomena.

Chi' is another interesting quality which can be interpreted from a variety of perspectives. Of the 30 illness/plant pairs in the plant collection database (there are none in the garden interviews) it can be seen that the majority fall into two categories, but that tells only one part of the story. Representative species include *Cirsium horridulum*, *Monnina xalapensis*, and *Prunus serotina*. *Cirsium* is a thistle with tremendous stiff spines which, if you can get a taste of it, is indeed moderately sweet. But, it is used almost exclusively to treat *ch'ixal yak' mis* and *ch'ixal yak' wakax*, both conditions marked by hard raised areas on the tongue which are generally ethnomedically grouped with gastrointestinal illnesses. Additionally, the leaves are long, strap shaped, slightly wider at the distal end. The only reasonable interpretation is that this represents one of the few cases where a medicine is used according to a "Doctrine of Signatures" philosophy, though I never got the sense that it was explicit. The other important plant for treating these and some other tongue conditions is *Plantago australis* which is named dog tongue plant (*yak' tz'i' wamal*), is tongue shaped and has small raised hair follicles, giving it a decidedly tongue-like appearance. This covers 3/10 of the gastrointestinal illnesses in Table 5.4.7. A similar case of doctrine of signatures in this same category is the use of *Salvia rubignosa* to treat *cha'lam tzotz*, characterized by stiff, short head

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hairs, similar in appearence to those on this *Salvia*. Finally, it should be noted that all of the remaining gastrointestinal illnesses (6/10) are treated with plants considered to be only slightly sweet, suggesting that some sweetness is not a particularly useful quality for treatment of this class of illness.

As noted above some plants are labeled according to the characteristics of the dominant feature of the plant, usually the fruit. Such is the case with *Monnina xalapensis*, *Sambucus mexicana*, and *Prunus serotina*, all of which produce abundant small fruits which when very ripe, are quite sweet. In about one-half of the cases, the fruit is the part used as medicine, but in the remainder, some other part is used which will undoubtedly have a different quality. This is especially the case with respiratory conditions which in general seem to be treated with naturally sweet plant medicines or which have added to them sugar or honey to make them sweet.

The use of sweet plants/medicines to treat fever appears to be because of the affiliation of fever with cough. With one exception, all of the fever medicines listed as sweet are the three plants listed in the previous paragraph which are the most frequently used to treat coughs of one type or another.

Bilil

There are 6 illness/plant pairs in the plant collection database where the sole quality is bilil which is probably best glossed as gelatinous (like okra sap), slippery (like high clay mud) or slimy (like mucus or chicken droppings), depending on context. The most common plant labeled as *bilil* is *Anoda cristata* (Malvaceae, like

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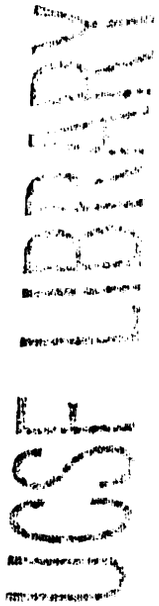
okra); when chewed the leaves become slightly gelatinous and slimy. It is ordinarily mashed up and applied to swellings (*sijt'el*).

Jik'jik'

Jik'jik' is represented by 13 illness/plant pairs in the plant collections database which do not sort into any pattern concerning their use. *Jik'jik'* is generally any plant or odor which is sharp and intense; the usual example given to describe the sensation is that produced upon smelling roasting or burning chili peppers. It is an odor which, pleasant or not, will cause one to draw back instinctively and perhaps "catch one's breath", hence the onomatopoeic name for the odor. It may cause one to involuntarily draw back in surprise, though strong, "sweet", intense smells may also be considered *Jik'jik'*. Representative plants are *Apium leptophyllum*, *Nama dichotomum*, and *Cymbopogon citratus* ('lemon grass').

K'ixin

K'ixin ('warm') medicine is used to treat 'cold' illnesses, of which there are relatively few in Cancuc, especially if considered in contrast to 'hot' illnesses described above. Generally cold illnesses are related to 'air' and its intrusion into the body, sleeping on cold ground, or as described in Chapter Three, the turning cold of particular illnesses, causing them to change into a more severe condition (e.g., respiratory). The role of *k'ixin* medicines is explicitly to warm up the affected person, thus driving out the cold and illness. In contrast to the numerous collections of *sik* medicines, there are only ten in the plant collections database and there is no pattern present in species or usage. Some of the illnesses treated include



childbirth (*alal jel*), female reproductive problems (*sik ta ch'ujtik ta antz*), whooping cough (*jik'jik' obal*) and diarrhea (*sin ak'al tza'nel*).

There is some overlap between *ya* medicines and those defined as *k'ixin* because some ya medicines can make one feel warm. In general though, they are distinct. Warming medicines are often combinations of various ingredients in addition to the plant: cloves, honey, raw sugar (*panela*), allspice; all of which tend to give one a warming sense upon ingestion. There are several instances in the garden interviews where a plant had one quality, but that quality converted to *k'ixin* or *ya* with the addition of some of the above ingredients. This is best seen in *Hibiscus uncinellus* which in the garden interviews is used almost exclusively as a treatment for *jik'jik' obal* (whooping cough), an unquestionably cold illness. In question #6 which asks about the quality of the plant, there was a range of answers including *ch'a*, *chi'*, *paj*, etc. But with the usual addition of some of the above ingredients the resulting medicine had the quality *ya* or *k'ixin*, demonstrating as well the overlapping nature of these two qualities.

K'ojoj

K'ojoj or *k'oj yik'* is an uncommon odor, most clearly typified by *Petevaria alliacea* which has an unpleasant, skunk-like odor. It is also described as being like something burned, especially a tostada. It is the odor of something deeply toasted, just before it begins to smoke and smell "burned". Of the nine plant/illness pairs in the plant collection database, eight are for *jul bak sik* ('arthritis') with one exception for *xiwel* ('fright').

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Xojet

Xojet is generally a very pleasant, "sweet-smelling" odor but without the sharp, piercing aspect of *jik'jik'*. Sometimes *xojet* is used in the sense of something which smells "nice" or desirable. There seems to be a certain degree of overlap between *xojet* and *xyuk'et yik'*. Representative species include *Tagetes filifolia*, and *Lippia alba*; in the taste/odor experiment cinnamon oil, cocoa, spearmint oil, tea spice, and Tiger Balm were all described as *xojet* by one or two informants. There was no pattern to the uses, being used for childbirth, diarrhea, fever and *cha'lam tzotz*.

Xyuk'et yik'

Xyuk'et yik' is generally an odor which is strong, pleasant and can be detected at a distance (like ripe mangos in the market). In reference to medicinal plants, it is usually a plant that smells strongly and pleasantly when one brushes against it or walks through it. Usual examples include *Tagetes filifolia*, *Chenopodium amboisioides* (epazote), *Satureja brownei*. Each of these plants has a distinctive, unique odor (relative to the others), but all have one feature in common. They produce an intense odor that surrounds one when they are bruised (i.e., by walking on or through them). Of the nine illness/plant pairs in the plant collections database, four are for respiratory conditions and the remaining five are spread through a variety of other conditions.

Tzij yik'

Tzij yik' is a very uncommon medicinal plant characteristic, being represented by only four collections: *Thalictrum guatemalense*, *Brugmansia candida*, *Scoparia dulcis*, *Pluchea odorata*. The illnesses

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for which they are used all have a large spiritual component: *xiwel* ('fright'), *jul bak sik* (arthritis), *kexton* (?), *ste'el spat antztik* (menstruation and related issues) suggesting the possibility that these medicines may be "adjuncts" to the larger role of prayer and ritual (for these particular types of illnesses). Interestingly though, the *Brugmansia* is used to treat *xiwel* and is mashed with water and bathed on the frightened person, often a child, offering possible soporific effects.

Sak'

Sak' is the adjective 'itch' and the verb 'to scrape' (or 'scratch'?) and describes what these plants do as much as what they are for. There are ten illness/plant pairs in the plant collection database, largely consisting of skin conditions (*chay k'ajk'*, *sijt'el*), but also some others that provide insight into how the quality is perceived. *Anoda cristata* is used in cases of inadequate milk, but curiously the only thing that is done is to place the seed capsule (shaped something like a bowler hat) over the woman's nipple. Given the shape and size of the seed capsule it would "just fit" over a nipple, but not, given its hard woodiness and sharp edges, without causing some discomfort ('scratchiness'?). Likewise, *Desmodium aparines* has short stiff protrusions ('hairs') on the stems that cause one to itch when handling this plant. The stem is used to scrape the eye in the process of removing the offending object/covering. *Sak'* also refers, as in the case above to the sensation produced upon use or tasting. *Crusea calocephala* produces a scratchiness to the tongue when sampled; the glochids of *Opuntia* sp. are guaranteed to cause itchiness if not handled with extreme care.

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Xuch'

Xuch' is simply sticky or gummy; when applied to medicines it usually means something sticky that dries and produces a layer of dried sap over the affected area. It is always used in the treatment of wounds (*echen*) or scabies (*chin*) (eight illness/plant pairs). In my experience the "type" examples were two species of *Ficus*: (*F pertusa* and *F. aurea*); each of these produced copious quantities of white, milky sap when cut which was then applied to the wound or rash, often directly from the cut branch. When I tried it, it resulted in a tenacious, waterproof covering over the affected part. *Euphorbia graminea* and *Chamaesyce hyssopifolia* are similar, but the resulting covering is less durable and needs to be renewed frequently.

Table 5.5: Garden Plants

This table presents a basic model of each of the plants used in the garden interviews; what they are generally used for, how they work to cure illness, what they do to the illness, how they make the body feel, etc. The plants are presented in numerical order as they were presented to informants. The ordering indicates nothing more than the relation of the plant within the garden. While most plants have a range of uses only the most commonly mentioned will be included.

1) ***Acacia angustissima***, *me' ja'*, was known by 11/16 informants with complete uniformity of naming. Of the 17 uses presented, 8 were for gastrointestinal illnesses and 4 were for eye conditions. (note: Two of the remaining conditions are defined as diseases of the

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tongue (*ch'ixal yak' mis*), are ethnomedically included with gastrointestinal conditions and probably result from dehydration due to diarrhea and fever, or from sores in the mouth, *k'in ch'ajaw*.) The remaining three conditions are *obal* ('cough'), *ch'ich' ni'* ('bloody nose'), and *sijt'el* ('inflammation'). The part most frequently used is the root (*yisim*) and/or bark (*pat*), both of which have the quality of *sup* (astringent). These parts are used explicitly because they are astringent (probably from tannins); it is the astringency which gives the strength to heal. Two of the three informants who reported the quality as *ch'a* ('bitter') used the leaves as opposed to the root, though their uses were consistent. This indicates that knowledge is based on individual experience, not "received wisdom". The power to heal is derived from the presence and strength of the astringency and the ability of this quality to overpower or control the illness. The *chan* ('worms') are killed, diarrhea is stopped, pain is calmed, vision is cleared, the inflammation recedes.

2) ***Ranunculus petiolaris***, known by 9/16 informants, most of whom used the name *nitan k'ajk' wamal*, or *k'anal nich wamal*. Of the twelve uses noted, seven are for suppurating skin ailments and/or edema (*chay k'ajk', paslam, sijt'ubel*), four are gastrointestinal uses (*tza'nel, pumel, k'ux o'tanil*), and the remaining is for toothache (*k'ux eal*). 5/9 informants used the root, two used the leaves and two used the whole plant. All parts of the plant are *ya*, though the most intense are the seeds and roots. It cures by the strength of its pungency (*ya*) by overpowering, killing/stopping, or calming (a.k.a. cooling) the illness. Several informants commented on the fact that

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when this medicine is applied (to skin or mouth) there is a great deal of pain which one must tolerate for a little while, then the medicine must be removed or it will cause the skin to peel. In one case (*pumel*) the pungency serves to warm up the illness allowing it to be expelled; in others even though the medicine is *ya* which is stronger than the illness, the ultimate outcome is that of "cooling of the body" (*sikil te winkiletike*) or relief from burning pain and inflammation. As discussed above under *sik*, and in Chapter Three, there are some cases where the perceived hot/cold status of the illness drives the quality of the medicine; in other situations, the relief from burning pain is spoken of in terms of "cooling" the illness or the body. The plant is labeled and used primarily because it is *ya*, but the result of that use is *sik*, 'cooling'.

3) ***Salvia karwinskii*** was recognized by nearly one-half of the informants (7/16) and is known by three names or their variants, *woch'ol ok wamal, muk'ul tzabal tzunun, or tzajal nich wamal.* Of eleven noted uses, fever (3/11, *k'ajk'*), gastrointestinal (4/11, *xenel, tza'nel*), and respiratory conditions (3/11, *sik k'ajk', obal, jik'jik' obal*) predominate. The part used is the leaves and it cures by virtue of the strength of its bitterness (*ch'a*) which stops/kills the strength of the illness, calms the pain and/or causes the illness to "flee" the body whereupon the affected person feels better. One informant uses the flowers to treat *jik'jik' obal* (pertussis); the flowers are *xojet ta uch'el* (good to drink), but has the power to heal because it is *k'ixin* ('warming') to an illness universally known to be *sik* ('cold').

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4) ***Solanum lanceolatum***, *tujkulum ch'ix*, was known by the majority of informants (12/16) and is used most frequently for inflammation, wounds and infections (7/17, *sijt'el, k'ael, k'ajk'al chin, echen,*), toothache/decay (4/17, *k'ux eal*), inflammatory eye conditions (2/17, *cha'nukul*) with the balance being used for gastrointestinal problems and fever (4/17, *k'ux ch'ujt, tza'nel, k'ajk'*). The important summary point about most of these conditions is that they are marked by intense pain and inflammation, which is interesting, given the analgesic/anti-inflammatory nature of several member of this genus.

Quality designation varies, in part in response to the part used, and in part because it has a complex flavor/odor profile that would allow assignation to several different categories. The leaf is consistently defined as *ya* (*ch'a* in one case) and is used in the majority of cases (5/7) for inflammatory skin conditions and wounds, while the root is much more variable, being defined (in descending order) as *sup, ch'a, ya, sik/xin* and is used equally consistently for the remaining conditions (gastrointestinal, eye and toothache). One informant explicitly stated that she uses different parts for different conditions: roots ground, mixed with salt and packed against affected tooth, while the leaves are ground and put on the infected skin conditions. The reason why the particular part was used is nearly always because it has superior strength. The plant (or its attendent part) has the ability to cure because it has these strong qualities which calm/cure the ill person by overpowering/stopping the illness, drying up the pus (of skin conditions), killing the *chanul* ('worms'), which cause the eye, skin and gastorintestinal conditions. This is

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often stated as an if/then statement: if the illness is stopped or calmed, then one feels better.

Several informants noted clearly that only small amounts of this could be used when applied to the eyes or consumed because it is very powerful and too much would cause damage or make one sicker. One informant reported on the way his father used this medicine. He would take the leaves, heat them briefly, apply them firmly to arthritic areas then, with a thorn from the plant, he would lightly prick the skin through the overlying leaf. This would be repeated until some relief was achieved. There is a tradition of pricking/bleeding during the healing process in Cancuc, but with this plant (the same has been reported for *Brugmansia*) it seems possible that this activity would increase the "transdermal" absorption of anti-inflammatory or analgesic chemicals.

5) ***Brugmansia candida***, universally known as *kampana*, was known by all 15 informants and is used most frequently to treat inflammation and sprains (12/22, *sijt'el, betz'el*) with fever (*k'ajk'*) and fever and chills (*sik' k'ajk'*) (5/22), and serious suppurating skin conditions (4/22, *paslam, bujk, chay k'ajk'*) accounting for the rest (1/22, headache). In all cases the leaf is the part used, and as would be predicted with these particular health conditions the majority (10/14) stated its quality to be *sik* with the balance stating *ch'a, sup,* or *xin*. It has the power to heal largely because the "coldness" of the medicine is strong which cools, calms the illness permitting the inflammation to recede and/or the blood to be cooled which relieves headache.

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Brugmansia is generally applied externally, but when taken internally there is clear recognition of toxicity. Only very small amounts of the leaves are used and/or very small amounts of the resulting medicine is taken. The usual preparation methods involved either crushing the plant and packing the pulp on the affected part, or alternatively taking the large leaves (25 cm), placing them very briefly in the fire, only enough to wilt them, then immediately placing them on the affected part and pressing them on very firmly. This procedure is repeated several times with new leaves until pain relief has been achieved, and it may be done several times a day for a couple of days.

6) ***Cordia spinescens***

Recognized by 8/15 informants under a variety of names, the most common being variations on *xijch' wamal* (6/8). Other names include *bakal it wamal, ch'aal wamal.* Of 15 uses noted 12/15 are for gastrointestinal (*ja' ch'ujt, ch'ich' tza'nel, k'ux ch;ujt*), two for eye conditions (*cha'nukul*) and one toothache (*k'ux eal*). Most people considered the plant as *ch'a* with two individuals viewing it as *sup.* It stops the force of the illness (diarrhea, stomach pain), calming the illness allowing one to feel better. Most use the leaves, but one informant uses the root because the "blood" of the plant stays, is resident in the roots. He also mixes this with *Psidium sp.*, a very astringent plant. His rationale for mixing them was that since both are used for diarrhea, both are strong, one bitter, one astringent, together they might be better yet, so he tried them together and was satisfied with the results.

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7) ***Chromolaena collina***, variously known as *ton ch'a te', sakil nich wamal*, and *ch'aal wamal*, this plant was not widely known (5/15). Of eleven recorded illnesses the vast majority (9) were gastrointestinal (*tza'nel, sin ak'al tza'nel, ch'ich' tza'nel, k'ux ch'ujt*), and two are "dizziness" (*chawaj*). With one exception all informants agree that it is *ch'a* to one degree or another. One informant defines it as *ya, chi'chi'tik*. It has the power to heal because of the strength of the qualities which serve to dry up the stomach and calm the pain allowing one to feel better. One informant noted the plant to be *ch'a*, yet said that it is good for cooling the head (which is "hot" when one has *chawaj*) because it provides a cooling feeling "like alcohol". Another informant noted that this plant is real bitter, so much so that when consumed (for diarrhea) there is excessive salivation and one can feel the bitterness in the stomach--this is its strength and indicates that it is struggling with the illness.

8) ***Fuchsia microphylla***, noted as *tzajal nich wamal* by 4/6 individuals who knew it (*tzajal pajte' wamal, k'ox bal te'* wamal were the other two names). There is no preponderant type of conditions treated; of nine uses, 3 were for gastrointestinal (*k'ux ch'ujt, tza'nel*), one respiratory (*obal*), two arthritis (*jul bak sik*), and one each for eye (*k'ux sitil*), headache (*k'ux jolol*) and "low energy" (*ajk' k'inal*). Similarly, there was a wide range of opinions on its quality: *ch'a, ya, sik, sup*, each of which was noted to be strong allowing them to stop or kill the illnesses. In the case of cough, the medicine "peels down" the cough (allows it to come out). In this context the medicine was

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reported as *tok'tok'tik*, meaning to pull out or uproot. It was described as a sensation deep in the sinuses. A fever will rise up when the medicine is taken; one must stay home wrapped up as one is in a very dangeous state while the medicine is struggling with the illness. Nearly everyone noted, regardless of use, that this plant puts one in some discomfort upon using it. It is a rather innocuous plant with no strong taste/odor, so it is interesting that it appears to cause such discomfort. In discussing whether there are additional plants which can cure diarrhea one informant noted that *pech'pech'ak* (*Sisyrhincium sp.*) is good for *mak tza'il* (intestinal blockage). This plant has a clear ginger-like flavor which he said makes one want to drink a lot, but that one should only drink a little because within minutes one needs to go to the bathroom with forceful diarrhea and violent vomiting, thus getting rid of everything that is affecting the stomach. Reports of such purgings are rare.

9) ***Piper jacquemontianum***, was universally recognized (by 9/15 informants) as *mumonol te'*, though there were variations (*tzajal, ijk'al, yaxal*--red, black and blue respectively). Of 17 reported uses, all are skin conditions of one type or another, most serious (*sal, xoch', sijt'el, k'ael*). A variety of qualities was noted, but it is clearly *ya* (6/9) with reports of *ch'a, sik, sup.* Interestingly 6/9 informants mixed *tan* (cal, slaked lime) with the plant for external applications which yielded a medicine of remarkable pungency (*lom ya*) which was very strong, killing the worms causing the illnesses and calming/cooling the pain and swelling.

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10) ***Bidens aurea***, known by only five informants was named *kulentu wamal* by two and *tusus* by three. Of nine recorded uses, four were for gastrointestinal (*tza'nel, xenel, cha'lam tzotz*), two were for fever (*k'ajk'*), and there were one each for headache (*k'ux jolobel*), respiratory (*sik k'ajk'*), and wounds (*echen*). Its quality was divided, three informants noted it to be *sik*, while one noted *ch'a yayatik xintik*, and two others noted *tzij yik'* (one of whom also said *sik*). One very knowledgeable informant who indicated *sik* as the quality said he didn't know it by any other quality, only that it was *sik* because it cured *k'ajk'* health conditions (*k'ux jolobel, cha'lam tzotz*). Another informant knows the plant has medicinal properties because it is *tzij yik'* but uses it because it is *sik*. Depending on the quality designation, the illness is cooled, calming one, or the force of the medicine kill/stops the illness, whereupon one feels better.

11) ***Phyllanthus niruri***, known by 11/15 informants all of whom called it *kuchkuch ijtz'in*. Of 14 uses, nine are for *ch'e'*, which I have glossed as 'colic', but which may be a "culture-bound syndrome" of some type. The remaining five are all categorically "hot" illnesses (*k'ajk', cha'lam tzotz, k'ux jolol*). With two exceptions (*ya, xin*), all informants identified this medicine as *sik* which serves to cool/calm the (over) heated child/blood who "never stops crying". Generally the medicine is prepared by grinding/macerating the plant in water which is then used to bathe the head of the child, thus bringing relief.

A couple of informants also used the plant as a diagnostic tool as well as a curative. Several branchlets were placed between the

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baby's back and the shawl in which it is carried. If these wilt rapidly, it is a sure sign of *ch'e'*.

12) ***Erigeron karwinkianus*** was not widely known (6/15), most of whom referred to it as *sakil nich wamal* (also *kulento chico* or *chicle wamal*, which is a reference to its minty taste, like chewing gum, Chicle in Spanish). Of the nine recorded uses, five were gastrointestinal (*k'ux ch'ujt, tza'nel*), three respiratory (*sak obal, obal*), one fever (*k'ajk'*). This plant serves as a very graphic example of the way in which particular qualities are assigned to particular illnesses. There is considerable variation among plants on the flavor of this plant. Sometimes it is bitter with a spicy, minty overtone; at other times the spicy, minty aspect is definitely the dominant sensation. Thus, it is often labeled *ch'a*, and just as often *ya*, both of them an accurate measure of the sensation perceived. None of the informants sampled this particular plant, so they were operating from memory. Of the three informants who said that this plant was good for treating gastrointestinal illnesses, all said the plant was bitter (*ch'a*). Of the three who said it was good for respiratory illnesses, all said it was pungent (*ya*). In a case like this where the quality could "go either way", it clearly went in the direction dictated by ethnomedical expectations.

It serves to cure one of illness by overwhelming the illness with its superior strength, or in the case of cough it kills the worm (*chanul*) that causes the "itch" of cough, calming and allowing normal breathing.

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13) ***Euphorbia graminea***, recognized by 7/15 informants by nearly as many names: *k'an chu' wamal, mak'al wamal, sakil nich wamal, pojow wamal, buluk sit wamal.* Of ten uses, four are skin/inflammation (*chin, sijt'el*), two are fever (*k'ajk'*), one respiratory (*k'ajk'al obal*), one gastrointestinal (*xenel*) and two eye conditions (*sak nok, k'ux sitil*). Continuing with the inconsistencies this plant is evaluated as *sup, ch'a, ya, and sik.* It stops the illness by virtue of whichever quality it has and provides relief.

14) ***Cissampelos pareira***, recognized universally as *patex chinin ak'* by all 15 informants, is used entirely for gastrointestinal illnesses (n=22), including *tza'nel, xenel, sin ak'al tza'nel, lukum, k'ux o'tanil,* and *k'ux ch'ujt.* Everyone uses the root/tuber, which with two exceptions (*ya, xinxintik*) is regarded in varying degrees as *ch'a.* It has the power to cure because it is very bitter, it has the quality of bitterness, a very strong quality which gives the medicine the strength to kill the parasites, dry up the diarrhea, and calm/cool the pain of the stomach which allows one to feel better.

One informant learned this plant from his father, then learned the admixtures from a teacher in the lowlands. The admixtures (epazote *Chenopodium ambroisiodes* and *jocote*, pitch pine) allow it to cure more types of *lukum* than this plant alone. The resulting mixture is *ch'a xlebebet* which he described as being like mint chewing gum; one can feel it deep in the nose, mouth and nasal passages, presumably because of the turpentine nature of the pitch pine and the highly aromatic nature of the epazote.

15) ***Polygala floribunda***, known by 8/15 informants, all of whom used some variant of *pum wamal* to identify it. Of eleven uses, four are for gastrointestinal (*cha'lam tzotz, k'ux o'tanil*), one respiratory (*sak obal*), two headache (*k'ux jolol*), and one each for toothache (*k'ux eal*), "arthritis" (*sakil jul bak sik*), inflammation (*sijt'el*), and "dandruff" (*sak ta joltik*). It is universally known as *ya*, powerfully so, several people noting that if not used carefully/correctly it will cause the skin to peel, whether of the head, gums or other parts. There are two interesting points about the way in which this cures. Most people simply said it has the ability to cure because it is *ya*, not because it necessarily does anything to the illness; it is *ya*, therefore it cures. The other point of interest is in relation to the way in which it is said to cure *cha'lam tzotz*; of the three informants who noted it as useful for this conditions, each had a different reason for its effectiveness. One informant noted that plastered on the head, it allowed for the short hairs characteristic of the illness to break, thus facilitating their removal. Another individual said that the diarrhea in which the food passes through unchanged gets better, while the third noted that the fever goes down. Each of three informants highlighted one of the main defining criteria for this illness, presumably in accordance with their perceptions of the most serious aspects of it, though the person who said it breaks the short hairs did note that it makes the child feel better because the gastrointestinal problems get better.

Final note: this plant was formerly (and occasionally still is) used as a shampoo. It is a very good shampoo, leaving ones hair very clean and the scalp, pleasantly invigorated. Several informants

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noted that in the days when this was the only option for cleaning the hair, no one had dandruff; it is only with the advent of commercial shampoo and soap that people began suffering from dandruff. The cure then is to use this older method from the days when no one had dandruff.

16) ***Hibiscus uncinellus*** is fairly widely recognized (10/15) as *ch'ix jol ak'* , with one exception (*tzajal nich wamal*). Likewise it is almost unanimously (8/10) used for the treatment of *jik'jik' obal* (pertussis, and other severe coughs). The other two uses were bloody nose (*lok ch'ich' sni'*) and fever and chills (*sik k'ajk'*). This medicine is largely considered to work within the humoral system of therapy, this illness is unquestionably perceived as *sik* (cold) and this medicine is warming. A wide range of qualities are noted, largely depending on the part used: flowers are *chi'* or *xojet*, while leaves are *yayatik, bilil,* or *paj*. The use of admixtures is very common, including allspice, cloves, honey, raw sugar and in some cases other plants. In a couple of cases the resulting medicine becomes *k'ixin*--warming, in other cases becoming *xojet*, pleasant, nice (to drink). In nearly all cases where it is used to treat *jik'jik' obal* it does so because it warms, causes the illness to be warmed, allowing one to cough more freely.

17) ***Clematis grossa*** was recognized by only 6/15 informants, all of whom named it *ich'il ak'* and with only two execeptions it is used for serious skin conditions (*paslam, chay k'ajk', sal, chin*) (7/9); the two exceptions were *k'ux joloj* (headache) and *k'ux eal* (toothache). With one exception (*ch'a*) everyone considered the plant to be *ya* which is

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consistent with the way in which these illnesses are generally treated. It cures by virtue of the strength of the medicine which overpowers the illness, drying up the *chin*, cooling the pain and swelling of inflammation, and calms the irritation of the illness. Like other strongly *ya* plants, this one is said to hurt a lot (more) when applied and to cause the condition to dry up, scab up and ultimately fall off.

18) ***Alloispermum integrefolium***, used by 10/15 informants, all of whom called it *koxox chij*. This substantial consistency of naming possibly results from the fact that this is a common *milpa* plant and is widely used as fresh greens, eaten with midmorning *matz*. It is mildly bitter (*ch'ach'atik*), though one each reported *sup*, or *chi'*, and is most commonly used (7/16) for gastrointestinal conditions (*tza'nel, xenel, k'ux ch'ujt, k'ux o'tanil*), hiccups (*juk'ubajel*) (3/16), what appears to be reflux (*k'ajk'al nuk'*) (4/16), and one use each for headache (*k'ux jolol*) and "dizziness" (*chawaj*). The bitterness and (implicit coldness) serve to stop the force of the illness and cool the discomfort (especially of hiccups and reflux, both hot conditions); this relieves one of pain and one will improve and feel better.

19) ***Salmea scandens*** was known by slightly over one half (9/15) of informants and is widely recognized for its *ya* quality, though some thought there were elements of *ch'a* or *sup* to it as well. There was little consistency in naming: *ch'a ak'* (modified as *tzajal*, or *ch'aba* in two cases) was the most common (3 informants); others named it *tzajal wamal*, or *ijk'al wamal, ijk'al pat wamal, ijk'al ton ch'a te*, or

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yaal wamal. In each case the name is purely descriptive of perceived color (*ijk'al*--black, *tzajal*--red), or something about its flavor (*ya, ch'a*), or its growth habit; *ak'*--vine. It is used for a wide range of conditions, including respiratory, 3/17, (*obal, sak obal*), gastrointestinal, 3/17, (*k'ux o'tanil, lukum*), toothache, 4/17 (*k'ux eal*), body pain/arthritis, 2/17 (*k'ux baketaltik*), skin conditions, 2/17, (*sal, xoch'*), headache, 2/17 (*k'ux jolol*), and 'lack of energy', 1/17 (*xwayet k'inal*). It cures because the strength of the medicine is greater than that of the illness, thus permitting it to overcome the illness, making one feel better.

The use of this plant appears in some cases to result from a transfer of knowledge from one domain to another. Several men noted this plant as good for killing fish--armloads are taken to the upstream end of an empounded stream, crushed and pounded in the water, the fish float to the surface for easy harvest. The logic of medicinal use is that if it can kill fish, then it can kill *lukum*, or *chan*, and is used accordingly. A couple of people described the sensation of numbness that results from use for toothache.

20) ***Pluchea odorata*** is recognized by very few informants (5/15) by variants of several names: *ton ch'a te', ch'aal wamal, sitit wamal.* It is a bitter plant used almost exclusively for gastrointestinal conditions, 7/10 (*tza'nel, xenel, lukum k'ux ch'ujt*), and one each for fever (*k'ajk'*), wounds (*echen*), and "dizziness" (*chawaj*). It is strong because it is very bitter which overcomes the strength of the illness, making one feel better because the illness has left. This particular plant, with one informant, illustrates the nature and importance of

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trying plants to "test" their efficacy. The following is a quote from my fieldnotes about our discussion on this plant and how he came to use it.

Plant #20, *tzajal ton ch'a te'* (Pluchea odorata) is used to treat *lukum, ben k'ux ch'ujtik* (bad/strong stomachache), *mero chawaj* and *tza'nel.* He said he learned to use this plant when he was affected by *tza'nel* and used this plant. I asked why he chose this plant as opposed to some other. His response was that he knows most of the (medicinal) plants because he is always trying plants for their flavor/quality. Because this plant is *ch'a* he tried it for *tza'nel* (because one uses *ch'a* plants for diarrhea). It worked the first time and the second time for him as well as when he used it to treat other people as well. Thus if it worked for one gastrointestinal condition then it ought to work for others as well, especially in the case of a plant like this that is very bitter. One would try this (or any other) if the plant that you would ordinarily use was not available. In this way uses are extended from one illness to another.

21) ***Eryngium ghiesbreghtii*** was not widely recognized (6/15) and is known by several different names: *bujk' wamal, chujchuj paj te', yak' tz'i' wamal, ch'oj chak wamal.* It is similarly used for a considerably wide range of conditions and is noted as having several qualities. Of seven health conditions noted, it is mentioned twice for "female reproductive" issues (*sik ta ch'ujtik ta antz*), twice for gastrointestinal issues (*pumel, k'ux ch'ujt*), twice for inflammation and wounds (*sijt'el, echen*), and once for fever (*k'ajk'*). Each informant gave a different description of its quality: *yon bayel sikil, supsuptik ch'aal, k'ixin, xabet tebuk, ya tebuk, xin.* This serves as an illustrative example of the way in which the humoral theory can drive the quality designation of the plant. In this case, the first informant noted that the plant was good for *echen* and *sijt'el,* both hot conditions, therefore the plant must be *sik.* The two informants who noted it to be good for female reproductive problems, clearly *sik*

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conditions, noted the plant to be *k'ixin*. The power to heal likewise is ambivalent: "it warms"; "there is strength to coldness".

22) ***Brickellia paniculata*** was recognized by 8/15 informants and is known generally by some variation on *sitit*, or *ton ch'a te'*. Of the thirteen uses noted, most (8) were for gastrointestinal complaints (*xenel, tza'nel, k'ux ch'ujt*), with one each for fever (*k'ajk'*), "witchcraft" (*welil lok'el choj*), headache (*k'ux jolol*), sprain (*betz'el*), and mensruation (*steel spat antz*). This plant too was labeled with several qualities, though in this case I think the variation is based on the variable nature of the plant. The plant was labeled as *ch'a, sup, xin*, or *ya*, often combination, indicating that the plant indeed had all of these qualities and how one attends to them influences the reporting on them. These strong qualities serve to make one feel better, calm the illness by overpowering, stopping, killing the illness.

23) ***Arthrostema ciliatum*** was recognized by 10/15 informants unanimously as *paj te'* and likewise is unambiguously labeled as *paj-* -sour. It has an intense sour taste, not unlike lemon, but a little more sharp. Of 16 uses it is used almost entirely to treat a wide range of tongue/mouth conditions (14/16), *k'in ch'ajaw, tzon kok, ch'ixal yak' mis* (*wakax*), with the other two conditions overlapping in that they are probably considered respiratory conditions, but like the others are related to fever in the broad sense (*majben ta ko'tanik, sk'aal ta ko'tanitk*). In all cases the stem is the part used, though some people use the leaves as well. There are three general mechanisms by which the sourness of this medicine works: it

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kills/stops the illness in the usual fashion, it cools/calms the fever, and it removes the illness from the tongue/mouth. In each case one feels better after using the medicine because the fever goes down, one can eat again, or one simply feels better. Two of the more common application procedures are clearly directed at removing the signs of illness from the mouth. In one case the ground plant is mixed with lard then applied to the lesions in the mouth, thus keeping the medicine in contact with the affected parts. Alternatively the medicine is applied frequently throughout the day until the condition begin to resolve. For *tzon kok* which is a coating on the tongue, the usual application method is to wipe it on liberally, then in a short while, wipe the tongue, inside of the mouth in order to clear out the illness, remove it.

24) ***Cuphea pinetorum*** was recognized by only 6/15 informants and was generally named in reference to the perceived flower color: *tzajal nich wamal, yaxal nich wamal*, or alternatively: *tzajal tok'ay, k'isis wamal.* Of the ten health conditions it was used for, seven were respiratory (*jik'jik' obal, sik k'ajk', sak obal, obal*), one was fever (*k'ajk'*) and two were gastrointestinal (*k'ux o'tanil, tza'nel*). It was noted as having a range of qualities, reflecting perhaps its relative lack of distinctive flavor/odor: *yayatik, k'ixintik, chi'chi'tik ch'aal, sikiket ta uch'el, ch'ach'atik, sup*). It cures by calming, cooling or eliminating the illness, and one feels better.

25) ***Verbena litoralis*** was recognized by nearly everyone, 14/15, is known by all by the same name, *yakan k'ulub wamal*, and is used

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almost exclusively for gastrointestinal conditions (25/27), including *k'ux o'tanil, ja' ch'ujt, ch'ich' tza'nel, sin ak'al tza'nel, xenel.* The other two uses were for "anger" (*ilim baj*) and respiratory (*sik k'ajk'*). It is sharply and immediately bitter with all informants stating so, with two informants noting that it has *sup* as a secondary quality. This plant points up the significance of the taste qualities in illness treatment because nearly everyone noted that it is the bitterness of the plant which does something to the illness, in most cases stops/kills it so one feels better.

Chapter 6

Conclusion

This chapter has four objectives. First will be a brief review of the significant findings of this research; a discussion on how the Tzeltal Maya of Cancuc, Chiapas select and evaluate plants as medicines. Following this will be a discussion of the theoretical significance and practical implications of this research for several fields. The third objective will be a short foray into some "informed speculation" about chemical sensation in human history. I will discuss the current work in relation to other well-informed speculation and suggest some alternative formulations, or modifications to theories and speculations already in circulation. Given the nature of the field the second and third objectives are largely intertwined with one another. Finally, I will suggest several questions which emerge from this research and how they can further address the question of medicinal (or food) plant selection in particular, and chemosensation in general.

Research Results

It is generally accepted that toxic secondary metabolites in plants evolved primarily in response to insect herbivores. While insects have provided the greatest selection pressure, many of the evolved chemicals have a wide range of biological activity, affecting many diverse taxa, including humans. Through a broad spectrum of biological mechanisms (metabolic detoxification), and cultural manipulation of plant resources (processing to detoxify and make palatable, domestication) human populations have learned to avoid

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or manage plant toxins in the food supply (Johns 1990a), yet recognize their value as medicines.

While there is undoubtedly variation in chemical content within and between populations of particular species, it can be assumed that the presence of pharmacologically active (toxic) phytochemicals will vary in quantity depending on a variety of forces and life history circumstances, but across time and space these plant chemicals generally will be present in detectable quantities. Data presented in Table 4.1 indicate that the parts of plants used is quite consistent, regardless of the health conditions being treated suggesting a recognition of chemical concentration in particular plant parts.

Human chemosensation operates via three largely interdependent modalities. While each modality, taste, odor, and detection of irritation, appear to be independent of one another with respect to receptor cells, nerve pathways and neural processing in the brain, chemicals are, except in extreme cases, perceived holistically. It is this holistic perception and the cultural expectations and interpretations of these stimuli that ultimately affect or determine behavior in response to detection of environmental chemicals.

There has been considerable debate in taste research as to whether there are only four primary tastes (sweet, salty, sour, bitter), more than four central tastes, or whether there are indeed "primaries" at all. The alternative conclusion to primary taste sensations is to consider taste perception as a continuum on which the "basic four" represent particularly physiologically significant

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salient points. Data from this study are better accommodated by a continuum model than by one which posits only four primary tastes. In an ecological context in which people must contend with "real world" chemical stimuli, the so-called primaries will be only part of a much wider categorization of tastes. In Tzeltal, astringent (*sup*), pungent (*ya*), and what is best glossed as "disagreeable" (*xin*) also represent major chemosensory, "taste" categories.

Furthermore, Tzeltal naming of plant flavors reflects the complex nature of environmental chemicals. While bitter, sour, sweet, and salty (seldom) plant tastes do exist as dominant sensations, they are as frequently constituted of a range or combination of sensations.

Though not without dissent, there has been general agreement that there are basic categories of tastes. No such unanimity exists in trying to categorize odors. Many schemes have been developed; none have withstood empirical testing. Generally, in Western language and culture, odors are described by analogy to some other culturally appropriate or known odor (It smells like...; It is musky, skunky, lemony...). In Tzeltal, categorization does not depend on an odor being identified as being like some other, presumably related, substance. Rather there is a range of conceptual classes (cognitive categories) which capture most significant odors, whether common or novel.

Ultimately, classification according to categories is less important than categorization according to perceived or expected value: good to eat, bad to eat (toxic, bad flavor/odor), good for medicine (effective), bad for medicine (worthless). These are

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essentially hedonic evaluations (good/bad) made in an ecological/adaptive context in interaction with cultural expectations of the consequences of use of tastes/odors of a particular nature.

Classification systems in Tzeltal are developed based on experiential criteria, representing the organization of the stimuli encountered in the environment. The discussion in Chapter Four highlights an important methodological/theoretical issue on the perception, categorization and interpretation of environmental stimuli. Practitioners in the field of psychophysics have done most of the research on taste and odor classification. For them the interesting and important questions revolve around the neurological and cognitive correlates of individual stimuli (whether of taste or odor); how are particular stimuli recognized, processed and categorized at the receptor/cognitive level? The question is more general when considered from an anthropological perspective: How do these processes play out in the context of human cultural and biological adaptation to their environment, broadly conceived? How (and why) does culture influence the experience and categorization of taste and odor stimuli and how, in turn, does that affect (and effect) behavior? As sociocultural beings, nearly all external sensations (biological) will be analyzed, interpreted and acted upon based on social and cultural constraints and expectations (Howes 1991). This is an important area of research, as yet little explored (Johns 1990; Engen 1991). I will return to this point in the last section and make some specific suggestions about how this research might be pursued.

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It is significant that the Tzeltal do not make an evaluative distinction between sweet and salt; both are *chi'*. There is no confusion between the two tastes: salt is salt and sweet is sweet, no one would tell you that soda pop is salty or that bacon is sweet. But, when presented with sugar and salt and asked to state their qualities, the unanimous statement for each will be *chi'*. Although it cannot be tested in this research I would hypothesize that because these are both physiologically necessary, desirable, and important substances which may be, at times, in short supply, they are both evaluated as "sweet", in the sense of good, desirable, necessary. Implied in this is not just as a reflection of "taste", but additionally an evaluative (hedonic) statement concerning the "value" of these substances. This point too highlights the significance of the interaction between individual biology, culture and environment.

The "informant consensus" model (Trotter and Logan 1986) implicitly underlies much ethnopharmacolgical research. The basic assumption holds that plants frequently and consistently used (across informants, and/or time and space) have a greater likelihood of exhibiting beneficial (i.e., pharmacological) effects. This has been well demonstrated in a number of studies and is particularly useful if the aim of the research is to identify "useful species" as candidates for pharmacological study. But this leaves open the question as to why so many plants do not fit within a consensus model. An examination of the underlying logic by which plants are identified as useful--the "ethno" half of ethnopharmacological studies yields important insights.

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It was clearly demonstrated in this study that there are common chemosensory features which link the many disparate species used to treat particular kinds of health conditions. Furthermore examination of the ethnomedical expectations of medicinal plants often reveals a relationship between the chemosensory quality of a plant and its anticipated activity against particular classes of illness.

These data support the informant consensus model, but also explain the underlying cultural criteria and expectations of plants chosen to treat particular kinds of illnesses. Additionally, the many plants about which consensus is weak or lacking can be understood if the perspective of the criteria used to define plants as medicines is the starting point for the research program. The rational for this process was developed in Chapter Four and each quality and its role in healing was explored in Chapter Five.

Likewise, it was shown that not only are plants of certain qualities consistently used to treat particular classes of illness, but that the chemosensory qualities deemed the most powerful (*ch'a*, *ya*, *sup*) will be used against the illnesses viewed as the most severe.

There is some possibility that there is a relationship between the organoleptic properties of the plants and their medicinal (pharmacological) value. This relationship cannot be explicitly tested with the available data, but some insight is gained by an examination of the plant chemosensory qualities, the primary families represented and the illnesses they are used to treat (Tables 4.10-4.13). The bulk of plants with particular organoleptic properties are concentrated in relatively few families, members of which tend to be

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directed toward the treatment of specific classes of illness and which are noted to contain many species rich in biologically active secondary compounds. Specific proposals for this work will be presented in the last section.

Chapter Five addressed the processes by which plants become defined as medicines. For the purpose of discussion, these processes may be thought of in three stages, recognizing that no such division exists in Tzeltal practice. Each of these "components", 1) learning about plants as medicines, 2) defining the quality of a plant as medicine, and 3) knowledge of the power to heal occur or exist simultaneously in medical practice.

Medicinal plant knowledge, like any other cultural domain, must be learned. There are two interdigitating parts to the learning process. A young person (or anyone learning a plant for the first time) must first become aware that particular plants have medicinal properties. They may get this knowledge from a variety of persons, though in most cases it is from older relatives, and on occasion from observations of plants given in the context of healing

Alternatively they may first become aware of the plant's importance from dreams. Plants first encountered in dreams are often, though not always, common, widely recognized plants. Receiving knowledge of medicinal plants in dreams always occurs in the context of the healer trying without success to cure someone. Either they don't know a plant for a particular illness, or those which they have tried have failed to effect a cure. Dreamed plants come at a time of crisis and provide alternatives to known therapy.

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These various methods constitute the person's first introduction to individual plants as medicines, though it is only one aspect of the process of becoming familiar with a plant as medicine. Knowing that a plant is a medicine only occurs after the person (healer) him/herself has used the medicine in the context of illness treatment and found that it works in a culturally appropriate fashion; that it relieves illness and suffering in accordance with their expectations of what that medicine should do when applied against particular kinds of illnesses. It is only after a person has tried a plant medicine and been satisfied with the results that he/she will consider it a medicine and use it in the future. This process applies just as strongly to well-known, common medicinal plants as to uncommon or newly discovered plants. ("I've heard it is a medicine, but I don't know it, I've never used it.") The concept of a trial (*la prueba*) is fundamental in considering plants as medicines. This can be seen in the fact that most plants are not medicines. There are many bitter, pungent, astringent, and sour plants which are seldom, if ever, used as medicines. It is only plants which have certain (chemical) qualities which when used according to culturally defined methods result in acceptable changes in health status that are defined and consistently used as medicines.

I have referred to this process throughout as a trial. Given my discussion of "trial and error" in Chapter Four, it is important to note that my use of "trial" here precisely illustrates the point: any consideration of the value or use of a plant as medicine (or any other cultural category) necessarily relies on sociocultural processes to

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provide meaning and definition to the results of any "trial" (or "error", for that matter).

Any plant when first learned as medicine will be encountered in the context of illness. Seldom will people encounter a plant-as-medicine without also learning the illnesses for which it is most appropriate, preparation and administration methods, where and when to locate it, harvest periods, alternative plants, etc. When someone tries a plant, it will always be against this general background of knowledge and expectations about how plants of this quality (e.g., taste) will feel upon consumption and what will be the anticipated results. Plants which consistently fail to meet these expectations fail to gain acceptance by individual healers and so remain outside their general use patterns. If the plant does not meet expectations of many healers, then it is a "marginal" medicine, known and used by a few individuals but not widely accepted and used.

Novel uses for known or new plants are, on occasion, incorporated into the pharmacopoeia by experienced healers who try new plants for their organoleptic properties, then use them to treat illnesses they think are appropriately treated with this type of plant. Secondarily, some people will extend the use of known plants to illness for which this plant is not commonly used (or for which it has not been previously used). In most cases this use of new plants and the extension of uses follows cultural conventions about the relationship among illnesses and expectations about what kinds of organoleptic properties are appropriate to address various classes of illness.

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Consideration of cultural expectations about medicinal plants intersects many interrelated aspects of the medical system. Two particularly salient aspects in this discussion center on the expectations of medicinal plant use. When a plant is consumed or applied there is an expectation that pain and discomfort will follow immediately. This is an important sign that the medicine has engaged the illness in a struggle, that it is working to overpower the illness. A second, but clearly related, aspect is that one expects to feel better following medicinal use (within the whole context of healing). For the most part there is nothing mysterious about feeling better: it is the alleviation of the presenting signs and symptoms and a return to accustomed activities and routines as before the illness manifested. Clearly in many cases this is not possible and does not occur; this generalization holds in any therapeutic regime. The nature of improvement is an intricate dance between individual motivations (of both the healer and patient), cultural expectations, and the biological nature of the illness. While there is unquestionably an element in which illness, and wellness, are culturally and socially constructed, improvement in the realm of medicinal plant use is generally uncomplicated and means a diminution of pain, lessening of swelling, healing of wounds, cessation of diarrhea, lowering of fever, relief from cough, etc., etc.

The determination and designation of plant quality, in effect its power to heal, is based on chemosensory evaluation of the plant, the response of the body to these qualities, generally in the context of ill health, and the cultural expectations and interpretations of those sensations and responses. A plant is noted to have a particular

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taste/odor sensation (bitter, sour, astringent) upon sampling and/or based on prior knowledge. This quality, when stated in the context of medicine, carries with it more than just a statement of its "taste". Included, implicitly, is information about its probable use as a medicine, what kinds of illnesses will likely or most appropriately be treated, in turn how will the plant be prepared and administered as medicine, how will one feel upon consumption (application), and an anticipation of the outcome from the use of the medicine. Unquestionably bitter plants like *Cornutia grandifolia* or *Calea ternifolia*, the first a tree, the second a small shrub, if presented to a healer who does not know them, will likely suggest that they would be good for treatment of gastrointestinal illnesses, which in turn means that they would probably be boiled to make an infusion, to be drunk by the patient 2-3 times/day. Even if the healer did not know the plants, if he/she were told that these plants were medicines and asked to state their uses based on taste, this pattern of use would be the likely response. The same applies for other qualities: A pungent (ya) plant like *Achmella oppositifolia* or *Salmea scandens* would likely be suggested as useful for treatment of health conditions caused by *chan* or *lukum* which are readily killed by pungent medicines. But here the preparation will be different. Instead of boiling, the usual preparation is to mash the most piquant part(s) and pack it around or on the affected part, or in the case of intestinal parasites (*lukum*), to ask that it be drunk.

While it is relatively uncommon, the designation of plants within the humoral system of "hot" or "cold" is nevertheless salient in the context of some illnesses. Illnesses are fairly easily categorized

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as hot or cold but plants are not at all clearly labeled. The consistency and strength of illness definitions within the hot/cold paradigm essentially drives the definition of plants as the opposite characteristic. For some classes of illness, the corresponding plant used to treat it will almost invariably be labeled by its humoral opposite, depending on the status of the illness. Some illnesses must be treated by a medicine of the opposite quality. This is especially the case with "cold" plants and "hot" illnesses.

The power to heal of a plant is really a consideration of the way in which medicines serve to make one feel better. The ability of a plant to heal derives largely from its taste and odor properties and to a lesser extent (or less commonly) from its status in a humoral system. Regardless of its chemosensory properties, a plant is ultimately judged as a good medicine (defined as a medicine) by the effect it has on the body and the illness resident in the body. There is a clear recognition that for good (powerful/effective) medicines there will be an immediate change in state, usually for the worse: pain will increase, there will be uncommon activity in the stomach, nausea, etc. This indicates that the illness has been engaged in a struggle by the medicine. Following this shortly will be the beginning of symptom relief.

The reason for taking a medicine (i.e., engaging in therapy of which medicinal plants are a part) is to be rid of negatively valued states of health--illness. It is this expectation and the culturally interpreted results from previous use of this medicine that ultimately defines a plant as a medicine. Because a medicine has resulted (in a culturally acceptable manner) in relief from suffering,

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it is considered and used as a medicine. If in the course of use a plant does not meet the cultural expectations and anticipated results of good therapy, then it is unlikely to remain as a central part of the pharmacopoeia. The degree to which these cultural expectations correlate with pharmacological activity is yet to be determined and constitutes an important area for future research.

Theoretical Considerations

Several theoretical points have already been addressed in the above discussion. They will not be elaborated further in this section except to the degree that they are relevant to the present discussion. While the preceding and the following three sections are presented as discrete, the division is largely arbitrary and I will refer back and forth to various concepts and ideas as I proceed through the next three sections.

The ability of humans to recognize physiologically, and organize cognitively, different kinds of stimuli goes a long way in explaining how and why people can use taste and odor to evaluate plants as useful, dangerous, good, etc. The distinction between physiological recognition and cognitive comprehension is important. Humans, like most generalist food consumers, are capable of distinguishing between various taste and odor sensations. Some of these elicit a positive response (sweet) and others a negative response (bitter, pungent). While sweet and sour stimuli may "cross-adapt", i.e., a strong sensation will prevent detection of another, similar sensation, the same does not occur with bitter (Miller and Bartoshuk 1991) and other aversive taste and odor stimuli (Engen 1991). Presumably this

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is an adaptive mechanism: "Poisons are not all chemically similar. A detection system for poisons ought to have the capacity to respond to diverse structures and multiple bitter receptor mechanisms provide this capacity" (Garcia and Hankins 1974). Similarly, stimulation of the trigeminal system (nasal or oral) will result in strong physiological reaction to the stimulus, presumably to prevent ingestion of the aversive substance (Silver and Finger 1991), and the response will be largely similar each time.

Paul Rozin has demonstrated clearly that humans can overcome powerful aversive responses to some items and convert them (by definition) to highly desired food items, (e.g., chilies, ginger, black pepper, also alcohol and tobacco, see Rozin [1982b, 1990] for thorough discussions of his ideas). He follows the conventional (and I believe, fundamentally correct) assumption about the role of the mouth (and implicitly the nose) in accepting nutrients into, while rejecting toxins from, the body. He goes on to develop a model of individual learning (socialization), cultural expectations, and perhaps biological adaptive advantage as reasons why human populations worldwide have come not only to like chilies, but to crave them, to consider a meal incomplete without them, even though they are highly aversive because of their pungency. I would extend his basic argument by suggesting that people evaluate medicinal plants by a different set of criteria than used for foods. While chilies, for example, are biologically aversive, they come to be preferred food items--they are liked. Most medicines (at least in Cancuc) also have aversive flavors, many of them powerfully so, there are few neutral or "good" tasting medicines. In Cancuc, the <u>most</u> aversive qualities

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are deemed to be the best medicines. This derives from the cultural expectations of medicine and illness interaction. The idea of struggle and domination would seem to indicate that the more powerful the reaction, the better the medicine. Thus, medicines are valued because they are bad, because they taste bad and are naturally aversive. This differs significantly from the gradual reversal of aversion that comes with coming to like chilies (tobacco, coffee, etc.). The medicines are still not liked, they are still aversive, but they are preferred, or valued more highly than the less potent ones because they meet cultural (and perhaps biological) expectations of what a good, powerful medicine should be like. There is no "conversion of aversion to a liking" (Rozin 1987:199). In the case of medicine, aversive flavors are still highly aversive and disliked, often intensely so, but they are highly valued for their medicinal properties (the perceived or actual ability to affect health). I should note that this is in a society which relishes chilies, where a meal is considered deficient if it does not include chilies. A household is poor indeed if they don't have or can't afford chilies.

An extension of this is seen in the fact that it is the most aversive plants (bitter, pungent, astringent) that are deemed to make the best medicines. Those which would be the least desirable and indeed would be innately rejected as dangerous, are the most highly valued as medicines. The natural aversive reactions (nausea, pain) are viewed as positive signs that the medicine is a good one, that it has engaged the illness and will ultimately result in a beneficial outcome.

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One could then posit a question about how food choice, selection, and evaluation (Johns 1990; Rozin 1987) differ from medicinal plant choice, selection, and evaluation. The intensity (i.e., daily) of food interaction would seem to favor, in general, the most desirable and/or nutritionally valuable foods (economics and availability being equal), while at the same time reducing exposure to aversive and/or toxic substances. Medicinal substances on the other hand, because of their relatively infrequent ingestion (only when sick) can be (are) evaluated on different criteria. That which is not good to eat may good to treat. In some sense people can afford to ingest/apply (potentially) toxic substances as medicines whereas they cannot so afford to with foods. If (and it is a big if at this point) there is a beneficial outcome to this consumption of toxic materials, then that behavior and/or those substances will be valued even though they are naturally aversive and produce strong negative reactions in their consumers. This strong aversion would normally condition against future use, yet these are the most highly regarded substances as medicines.

We can continue this theoretical speculation briefly by considering a possible model to explain how these normally aversive qualities might become valued as powerful medicines. Humans as consumers of plants are in a different position *vis a vis* plant secondary compounds because of the complexity of potential interactions and the ability to substantially alter the chemical content of the plants in their favor (Johns 1990). While most insects must rely on physiological detoxification, sequestration, etc. to cope with plant toxins, mammals can often rely on learning to

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discriminate among toxic plants or the toxic parts of particular plants. Humans can take this process one step further, not only learning what parts of which plants to avoid, but recognizing and developing alternate uses (medicine, fish and arrow poisons) for those same toxic compounds.

People are clearly aware of the chemical nature of plants and animals in their environment. Acutely toxic plants are easily identified, the results are immediate, obvious and easily related to the offending organism. Several routes of learning may be imagined: children presumably can be counted on to put toxic plants with which they are not familiar in their mouths and the results noted by adults. The search for food is often posited as the primary way in which people become knowledgeable about the chemical constituents of plants. This undoubtedly is part of the process, but I am hard pressed to give it too much credence for two reasons. Most populations, even those moving into new areas have a stereotyped set of plants upon which they rely for the vast bulk of their food; even gathering/hunting groups who must necessarily be intimately aware of their plant resources do not exploit the majority of edible plants about which they have knowledge. The very conservative nature of people's diets is driven to a large extent by the natural neophobia we, and all other omnivores, possess. There is little impetus to try something new if there is no strong, driving need, though famine could provide this need, but not reliably. The third mode of learning about environmental chemicals is intentional sampling in the context of medicinal plants. As outlined in Chapter Five, some individuals actively seek out new possible plants which

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might be useful as medicines. This is a cultural context in which it "makes sense" to learn about new plants. While famine may "drive" people to seek new plants and thus learn about their chemical constituents, I find it more useful to think in terms of people actively seeking out new knowledge with the express intent of finding new medicines. In a sense the selection pressure (cultural and biological) against identifying plant chemicals is both too great and too small in the case of food plants. Too great in the sense that when food is severely scarce, the issue is to identify quickly the most edible plants and to exploit them to their maximum. Too small in the sense that when food supply is adequate, there is little motivation to seek out new variety. Illness on the other hand is regular and constant in any given population. It represents a frequent point of crisis which must be dealt with so that members can return to accustomed activities quickly. There is a constant motivation to seek out new medicines, whereas the same does not appear to be the case with food plants.

Humans are smart. Given that some plants are acutely toxic, humans would clearly have knowledge of the effects of consumption. Similarly, given human intelligence, it is also not difficult to conceive that they could/would recognize a positive outcome in health (whether culturally defined or biologically determined) from plant use (Johns 1990). What follows are some thoughts on how this process might occur.

"Odors are pleasant because they have pleasant associations" (Engen 1991:2). Odors and tastes are given meaning as good, bad, useful, etc., by humans who associate them with particular contexts and situations (Holley 1991:332ff). Engen (1991:7) discusses the

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phenomena of odor memory where once one gets an odor "memorized" it will not be easily forgotten. Similarly, recognition of odors is very powerful in memory whereas naming of odors is not (Engen 1982:107). This is opposed to other types of memory where subsequent events can crowd out earlier events. In the case of significant odor memories, they are not easily dislodged. He argues: "An odor is integrated into the mental representation of an experience; it has no identifiable attributes of its own, but exists as an inherent part of a unitary, holistic perceptual event" (ibid.).

The most powerful example of this is food aversion. Flavor aversion is a very powerful response on the part of animals and humans. From an adaptive perspective, when combined with neophobia, it becomes an important protective mechanism against environmental toxins (bitter) and spoiled food (sour, rank) (Bernstein 1991). Aversions can be learned even after a delay of hours or days between when the toxic or aversive substance was consumed and when signs of illness were manifested. Furthermore, and importantly for the following discussion, a novel substance is a more powerful conditioner than familiar odors/tastes (Garb and Stunkard 1974). Once an aversion has been learned, the associated odor and/or taste is a very powerful reminder of the precipitating event.

But, odors do not cause illness, stimulation of the olfactory receptors does not make one feel nauseated, for example, but rather the association with previous experience--the memory--causes one to become nauseated.

The parts of this model have to do with the way in which people become aware of environmental chemicals (discussed above)

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and how this perception of these sensations is evaluated on the cultural and biological level. I have discussed at considerable length the way in which the people of Cancuc think about plant chemicals. What I propose here is a more general model that does not necessarily apply to any one group. Much of what this section covers has been considered in much greater depth by Tim Johns (1990). What I propose here is different in some respects, but shares many features. In any event, I acknowledge his considerable effort and its influence on my own thinking.

Very briefly, the parts of the model are as follows:

1) There is a strong reaction to odors (and tastes) based on previous experience. Often they are liked/disliked according to the context in which they were experienced (Engen 1982).

2) Odors (and associated tastes) are well remembered, even though they often cannot be named (Engen, Kuisma, and Eimas 1973; Engen and Ross 1973). Whole odors are better remembered than single, pure odors (Desor and Beauchamp 1974).

3) Many plant chemicals are highly aversive (unpleasant).

4) In Cancuc there is an expectation that one will feel bad (worse) upon taking or using the medicine. This result (feeling bad) may identify (i.e., allow for recognition, based on physiological response, detection) toxic and/or medicinal plants with pharmacological properties. Further evaluation and elaboration becomes an activity which takes place within the cultural expectation of ill health, curing and the outcome of medicinal use and the social practice of medicine.

5) If a person's health improves upon consumption of the medicine, then there is feedback which indicates that the plant-as-medicine is

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good (medically), even though the natural reaction is to reject it on the basis of its flavor and/or proximate effects.

Culture (and attendant learning) reinterprets negative biological phenomena to be highly valued sensations and responses. Aversion reactions when coupled with significant improvement in health may serve to cement knowledge about medicinal plants at both the biological (physiological and psychological) and cultural (learning and knowledge transmission) levels. In consequence, as noted earlier, a medicine may be intensely disliked on the individual level (in part because of aversion reactions), but be highly valued at the cultural level because of its recognized or known ability to cure specific ailments.

An important point about this process is that the improvement in health need not be the direct result of medicinal plant consumption. The process can work even in the absence of pharmacological consequences from the plant. Some plants will become incorporated and regularly used even though they have little or no actual effects on health.

An extension of this argument suggests that the natural aversive reactions (resistance to bitter/sour/rancid/pungent substances) have been converted culturally into a powerful mechanism for sampling the environment. This serves not only to alert people to dangerous non-food items, but alternatively to dangerous, powerful medicines.

The skill people bring to the memory of odors (and affiliated tastes) can be seen by considering the Japanese practice of Kôdô, the Cult of Incense in which the aim is to identify the one unknown odor

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(incense) out of ten (Takagi 1989). As in many Buddhist traditions, the idea is to focus one's mind and concentration skills. At the outset three different incenses are passed around the group. These are the "*tameshi*" ('initial contacts') and are to be memorized. Three duplicates of these three incenses serve as the ground out of which one must identify the "guest" odor (*kyaku*). In various schools, the practice of Kôdô is to increase one's concentrative and comtemplative skills through a competitive game to see who can best recognize the odors.

What is important about this from my perspective is that with training, exposure, and experience one can learn to distinguish subtle differences between odors. The same would be the case among perfumers who must also recognize and distinguish a variety of odors. It seems perfectly reasonable to argue that an aware healer could distinguish one medicinal plant from the next based on its flavor/odor profile. The odor/taste dimension become an additional criterion by which to identify and differentiate medicines or plants as medicines.

The relationship between organoleptic properties and the evaluation of medicinal plants is probably a widespread phenomenon (Johns 1990; Heinrich, et al. 1992a) and the very strong possibility that there may be a link between these evaluative criteria and the pharmacological activity of the plants can possibly facilitate or improve the search for beneficial medicinal plants which can be incorporated into local primary health care (PHC) schemes. Although the bulk of most current ethnopharmacological work is to develop new leads for pharmaceuticals in the developed worlds (Cox 1990;

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Farnsworth 1990; Waller 1993) and PHC has never received the attention and funding necessary to develop and maintain it (Judith Justice, personal communication), the need for identifying, recording and making available knowledge about locally known and accessible plants has not diminished. Western pharmaceuticals are increasingly available to peoples in developing countries, but seldom in medical context in which they were developed and intended for use (Etkin, Ross, and Muazzamu 1990; Whyte 1992) and generally at greatly inflated prices if Cancuc is any example. Anthropological and pharmacological assay methodologies exist to make quick, efficient evaluations of local medicinal plant knowledge. Furthermore, there in an emerging ethic which demands that this knowledge be shared with the host communities, not "mined" for the benefit of the few (e.g., The Declaration of Belém).

We are faced with something of a paradox in the late 20th century. Medicinal plants represent a tradition of knowledge and practice spanning centuries, if not millennia (Cox 1990). It has been widely demonstrated that there is probably medicinal value to many medicinal plants, especially if considered within the cultural context in which their use evolved. At this point in world history, the primary reason why many people still rely on medicinal plants is lack of access to adequate, modern health care (including clean water, sewers, trained medical practitioners). It is largely an issue of economic development. The paradox enters in that in the willy nilly rush to develop, many communities, of which Cancuc serves as an excellent example, are losing their traditional knowledge and the plants upon which that is based, while at the same time not gaining

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access to alternative or adequate forms of health care. The loss of plants and knowledge is two-fold. On the one hand, land pressure has eliminated or made inaccessible huge numbers of medicinal plants. Plants are pushed to extinction or are simply unavailable because of distance, etc. The other major issue centers on changing priorities. If children are in school, they do not have the extended opportunities to learn about medicinal plants from their parents. Of equal importance, they don't have any interest in learning about plants, "that's old fashioned".

While there is this precipitous loss of plants and knowledge, there is not a corresponding increase in access to or knowledge of other options. I cannot address the probable health consequences of this paradoxical situation, but I am pessimistic that the balance will not be favorable in the foreseeable future.

Utilizing an anthropologically sophisticated methodology which elicits the underlying cultural logic of plant use in combination with increasingly sophisticated, inexpensive (relatively speaking) and efficient pharmacological assays conducted under explicit agreements on the partition of the data, will permit rapid assessment and sharing of medicinal plant knowledge.

Future Research

The degree to which aversive tastes (and odors) really correlate to toxic (medicinal) principles has, to my knowledge, not been tested or documented. This makes it difficult to argue that aversive (bitter, pungent, etc.) plant chemicals are favored (selected) because of their associated biological activity. It is reasonable to argue on purely cultural grounds that particular plants are preferred

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simply because they are bitter and that pharmacological consequences are irrelevant or accidental. I am disinclined to accept such an argument because I believe that humans are more purposeful and directed in their adaptation to environmental constraints and options and that cultural knowledge (as understood and acted upon by individuals) is guided by the outcome of experience.

There are metaphorical associations which are well established in which some characteristic of the plant is ethnomedically defined as useful for treatment of particular kinds of ailments (Etkin 1990a:151). Many of these examples fall within a Doctrine of Signatures kind of medical philosophy. There has been some consideration of the possible therapeutic effects/consequences of these practices (Browner 1985a; Browner and Ortiz de Montellano 1986) which suggests that in at least some cases there are beneficial pharmacological consequences to these approaches. What the present study affords is the opportunity to examine explicitly the relationship between chemical selection of plants as medicines (by taste and odor), the cultural logic of their uses, and the potential impact on human health.

Many classes of physiologically active chemical have distinctive tastes and odors (T. Johns, personal communication). The basic strategy for such a study would be to consider, for a few select species, the relationship among the organoleptic properties of specific plants medicines, how these chemicals are associated with, or related to, pharmacological principles and how these chemicals likely

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manifest themselves in the human body when used in accordance with ethnomedical practices and expectations.

A study of this type would be conducted in three parts. 1) Using a database of medicinal plants, identify a set of plants, each of which is consistently used to treat the same kinds of illnesses (gastrointestinal, respiratory, skin, etc.). Ideally greater specificity could be attained by seeking consensus on single named illness categories (e.g., specific kinds of diarrhea). 2) The plants would be subjected to a literature search to identify those with pharmacological potential. 3) This subset of plants then needs to be examined to determine bitter or pungent principles, aromatic compounds, etc. that might have unique and salient organoleptic properties. Ideally these classes of chemicals would be compared to those with biological activity. Are the pharmacologically active chemicals related or co-occurring with the organoleptically significant chemicals? If there is a relationship such that we can predict pharmacological activity based on taste and odor properties, then we have a powerful explanatory insight with important ecological and evolutionary implications.

If it should be borne out that the organoleptic properties of plants offer some further insight into the cultural logic of healing then the next, more remote, step is to think about the cultural and biological process that fostered the development of such sophisticated knowledge in the absence of "science" in the European tradition. Such an exercise could be used to highlight clearly the relationship between biological and cultural evolution in human society.

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While it is clear that human society categorizes the natural environment in predictable ways, whether it is plants and animals (see Berlin 1992 for review) or parts of the environment for "special purposes" (Balée and Daly 1990), there has as yet been very little cross-cultural research which examines the perception and categorization of taste and odor. The overarching question guiding this type of research is how are taste and odor utilized to mediate and interpret the environment. How does this organization, interpretation, and categorization influence behavior? There has been some research on cross-cultural perception of tastes and odors (see Doty [1986] and Johns [in press], for reviews) and there have been attempts at integrating much of the disparate data from an "ecological", or at least holistic perspective (Engen 1982, 1991). But, with the exception of Johns' excellent volume (1990), there has been almost no research which took as its program an explicitly systematic cross-cultural, comparative look at chemosensation and its role in human adaptation.

There is little question that we rely heavily as a species on vision. The role of vision as a fundamental force in primate evolution has been much discussed (Cartmill 1974) and is indisputable. But, the neglect of olfaction and gustation is unfortunate. The edibility of a given food item, especially novel ones, cannot be determined solely by visual inspection--it is only accomplished by detailed chemosensory examination. It is a truism in taste and odor research that taste and odor are the "guardians of the gut", ultimately determining what is ingested into the body. What has been neglected is a consideration of the way in which

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chemosensation interacts with other senses, especially vision and tactile, to evaluate environmental resources as valuable, dangerous, or useful in one domain of activity but not in another.

The research presented here as well as that of several other researchers (Johns 1990; O'Mahony and Muhideen 1977; O'Mahony and Tang 1980) has demonstrated beyond doubt that society and culture exert a profound influence on perception and categorization. Moreover these different perceptions, cognitive styles and categorization approaches will likely affect behavior and social interaction (Kuipers 1984).

Any research program needs to be cross-cultural and analyzed within an ecological perspective. While there are some genetic differences in taste and smell, (e.g., PTC [phenylthiocarbamate]), they are uncommon and while they cannot be neglected, I expect that they will be relatively unimportant in the grand scheme of things. It appears safe to suggest that all populations are endowed with roughly the same capacities regarding taste and odor detection and discrimination. The greatest need at this point is not research directed at biological differences in the ability to smell or taste particular substances at various concentrations, though the possibility needs to be kept in mind. Rather, the need now is research which measures not just what people taste and smell, but how they think about it and act upon that which they learn. The cultural and social guides, expectations and constraints on the organization (categorization) of perceptual experience may be highly significant. At a slightly greater analytical remove, attention needs to be directed toward the evolutionary processes (both biological and

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cultural) and consequences of human interactions with the chemical world.

Methodologically, the research needs to be diverse. Straight-forward psychophysical research is inadequate because it fails to capture the cultural and cognitive context in which perception takes place. What is needed is a methodological strategy which takes advantage of the number-crunching validity and reliability of psychophysical data while at the same time utilizing structured and semi-structured interview techniques characteristic of anthropology, providing the fundamentally important contextual data.

A different aspect of environmental classification pertains to the relative use of various life-forms in medicinal preparations. Heinrich and Barrera (in press) consider the relative contribution of various life-form taxa to the pharmacopoeia. Their operating hypothesis is that the most common, readily available plants should be the most heavily represented among plants used by the lowland Mixe in Oaxaca, Mexico. Like others before them (Alcorn 1981b; Moerman 1989), they did not find this to be the case; trees, shrubs, and vines were as well represented as weedy or common herbs. This argues that commonness and ready availability are not important selection criteria.

Their findings could be extended by considering the concept of apparancy (Kingsbury 1983). Apparancy argues that common or highly visible (by a variety of definitions) plants or parts will suffer more predation than uncommon plants or parts. The other half of the argument suggests that apparent plants/parts should have higher concentrations of toxic/protective chemicals. The concept of

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apparancy has an interesting potential in medicinal ethnobotany. If human populations are indeed capable of identifying pharmacologically active plants, then there should be a correlation of the life-form of the plant, the pharmacologically active chemicals found and the illnesses being treated. Thus the use of annual plants (unapparent) should take advantage of the usually (theoretically) highly toxic chemicals elaborated only in response to attack, whereas in perennial shrubs, trees and vines the parts used should a) be those parts where chemicals are concentrated, and b) take advantage of those secondary metabolites stored in those parts (via preparation and administration procedures).

As an example consider the Tzeltal use of branch tips, a fairly common practice. This is an unapparent part of the larger perennial plant by virtue of its short duration temporally, but nevertheless critical phase of plant development. We could therefore expect certain kinds of chemicals to be present in the new leaves which would have certain pharmacological effects. We would have different expectations of roots, bark or fruit use. In each case human use should take advantage of particular chemical configurations evolved in response to herbivore (insect) pressure. If humans do indeed select their medicinal plants in response, at some level, to pharmacological outcome, then it seems reasonable to suggest that parts will be specified because of their chemical content. The data presented in Table 4.1 indicate the possibility of such a relationship.

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FOOTNOTES

[1] The Spanish term 'municipio' is roughly equivalent to a large county in the U.S. In Chiapas the present pattern of settlement is of the municipal seat ('cabecera') where the secular government is situated and the main church for the community. While increasing numbers of people are settling in and near the municipal seat, the bulk of the population lives in small scattered hamlets known as parajes which are located throughout the municipality.

[2] Cancuc was the point of origin of the only widespread Indian rebellion until that which began on Janurary 1, 1994 when a large band of Indians from around the highlands occupied six towns, including San Cristóbal de las Casas and Ocosingo, the two largest towns in the highlands. There demands were simple and straightforward, electoral reform, improvements in education, infrastructure, economic opportunites, and a cessation of usurpation of Indian lands by local ranchers and coffee producers. As of this writing, negotiations are proceeding and many of their demands are being met--at least on paper.

[3] The PROCOMITH ethnomedical database was derived from a series of ethnomedical interviews conducted in each of the towns included in the initial study. These consisted of texts collected by the municipal coordinators following an interview guide. These interviews resulted in ethnomedical texts which provided detailed descriptions on the signs, symptoms and course of the illnesses.

[4] Use of the word "God" in this context is generic. The Tzeltal have a complex relationship with the supernatural. In discussions about etiology and illness they will often use the word God (rios), though it rapidly becomes obvious that this is not the single, all-powerful God of the Christian tradition. I will not discuss these spiritual aspects further as they have been thoroughly explored in a variety of other contexts (e.g. Gossen 1974; Nash 1970; Tedlock 1982; Vogt 1976).

[5] Several informants told me that the number and size of the candles were closely related to the perceived severity of the illness being treated. Candles of this size are very expensive and the large number implies a large monetary outlay, suggesting that her illness (and the witchcraft which caused it) were grave and required considerable attention.

[6] Prayers vary from community to community and from healer to healer, but in general they are addressed to all of the relevant saints, spirits and sacred places in the region (Guiteras-Holmes 1990:220). The purpose of the prayer depends in large measure on the nature of the illness and its perceived etiology. The effort may be to restore the patient's lost or captured soul, or to turn the bewitchment away from the ill person. See Vogt 1976 and Tedlock 1982 for extended discussions of prayer in Mayan society.

[7] The feeling of the pulse is fundamental to diagnosis of most illnesses in Mayan society. In Cancuc the healer "listens to the blood" in order to "hear what it says about the illness". While the taking of the pulse in diagnosis is common in Mayan society throughout Mesoamerica, there is considerable variation in interaction between healer and patient, what is to be learned and the way in which the healer serves as a medium. See Metzger and Williams 1963; Fabrega and Silver 1973; Tedlock 1982 for detailed discussions of the role of the pulse in diagnosis among the Maya.

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[8] The evangelical groups appear to be no more tolerant of variation in Cancuc (and Chiapas) than they are in the U.S. Members of the local evangelical church are not permitted even to pass near the central square during ("pagan") festivals and were actively discouraged from utilizing traditional medical practitioners. Most people in the evangelical church had very little knowledge of medicinal plants, not so much because of proscription against plants per se, but because of their association with old, evil practices. In consequence potentially useful healthcare options were proscribed. It bears noting as well that most of the owners of the private clinics were members of the evangelical church.

[9] The praying over the medicine "to give it the strength to heal" was frequently mentioned as a necessary component to the preparation of medicine. The purpose was variously explained as seeking the benediction of God who gave the plants to humans for use as medicines (or who instructed humans on which plants were useful as medicines), or enlisting the help of God (or San Juan) in the treatment. With this one exception, this was universal in all of the healing sessions in which I participated.

[10] Other factors are also increasing the attention to, and awareness of the value of, plants as medicines. The local "ethnomedical revival" is largely based on the value of medicinal plants. Multicommunity meetings (congressos) to discuss traditional medicinal practices largely focus on medicinal plants. There was considerable discussion within the community about the establishment of a medicinal plant garden and an increasing "commoditization" of medicinal plants. This last took a number of forms. Researchers like myself wanting to talk to people about medicinal plants and paying them for their time increases awareness of the value of the plants. There are groups in Chiapas who will buy bags of medicinal plants (e.g. OMIECH) brought in from the countryside. Finally there are individuals who explicitly charge for plant-based treatments. These are usually men who have returned from extended stays in other parts of the country. They are locally considered charlatans because they don't know how to pray and because they charge exorbitant fees for what has been considered a duty on the part of traditional healers.

[11] This is not to say that there are no symbolic aspects to plant use in healing. No well tended family altar would be correct without fresh, or at least green, pine boughs. These would definitely be replaced before a major healing was to take place. Tobacco (*may*) is widely employed for its magical properties, and no healing of any consequence would be complete without sugar cane alcohol and incense, both plant products with immensely important symbolic meaning.

[12] *Chin* as a general term may refer to just about any rash, though it is usually modified if it refers to specific types of rash. Scabies appears to be the most general gloss for *chin*.

[13] In surrounding communities this type of illness is usually referred to as *ak'bil chamel* from the verb *ak'*, to place or to give. Alternatively *ak' chamel* was defined as to cause harm or one who can send or cause illness in others. While the verb use remains the same in Cancuc, being a victim of witchcraft or conditions thought to arise via witchcraft are referred to as *'abil chamel'*. I have no explanation for the linguistic variation. Informants mostly shrugged and said something to the effect of "well, I don't know, that's the way we say it here..." Guiteras-Holmes (1990) and Villa Rojas (1990) who worked in Cancuc and Oxchuc, respectively, in the early 1940s both transcribed the word as *ag chamel*. The

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degree to which this indicates a different pronounciation vs. different transcription is difficult to assess.

[14] There does not appear to be a clear distinction between *smantal ta rios* and *batz'il chamel* in many peoples' minds. Many informants had difficulty during the pile sort exercise deciding whether particular illnesses belonged in one of these two categories if it was clearly not *abil chamel*. There were often mutterings about them being the same and the pile sort data would seem to bear this out. The majority of conditions not defined as *abil chamel* were often evenly sorted between the other two categories.

[15] *O'tanil* is usually translated or glossed as 'heart', but in the Tzeltal ethnomedical scheme of things is a more complex phenomenon, referring to a region in which a variety of things occur. Thus *k'ux o'tanil* refers, in most cases, to upper gastric pain, while *ma xk'ax ik' ta wo'tan* means that the child (usually) is having difficulty breathing, 'the air isn't passing to the *o'tan*. In the case of coughs of the nature described here, the reference is to the upper airways and lungs.

[16] What is reported here is that which we encountered while working in the area. There are several programs which we were assured by state health authorities existed in Cancuc but which we never encountered in over a year and a half in town working on a variety of health related research. I will not discuss those resources which were officially in Cancuc but for which there was no evidence of their existence.

[17] This particular health worker was, in my experience, a rare individual. He was first of all dedicted to public health and put tremendous effort into trying to improve public health standards at the most basic level: latrines, protecting wells from animals, improving record keeping on the vaccination program, providing instruction on basic hygiene and household medical basics, etc. He also was a very insightful individual who realized the tremendous cultural gap between the people of Cancuc and the larger society he represented. He was painfully aware of the difficulties this presented in making even the most basic changes. He was equally pained by bureaucratic incompetence, official (local and state) corruption which made his efforts much more difficult and ultimately less effective. For example he had responsibility for parts of 3 communities covering an area of probably 300 km.2, all of which he had to reach by public transport and foot, while his supervisor had access to a late model Jeep station wagon and seldom left the city.

[18] The Instituto Méxicano de Seguridad Social (IMSS) has established rural medical centers throughout Mexico. In comparison with other countries I believe they are relatively successful in their mission of providing basic medical care to the rural populations, but their success on the local level is highly variable and seems to depend on local administrative dedication and the quality and interest of the pasantes who staff the clinics on an annual basis.

[19] It is difficult to judge the number of people who would be classified as traditional healers. Because it is an ascribed status, there is a range of interest, skill and knowledge among the various healers. If we restrict the discussion to just those who are *jpik k'abal*, it is probably safe to say that their numbers are relatively few. In an effort to identify possible informants, I asked two collaborators to make a list of everyone they could think of who might have medicinal plant knowledge. The resulting list contained 35 names, out of a local population of approximately 5000. This can be taken as only the roughest of estimates because of the nature in which the list was generated.

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[20] People are acknowledged for their medical skills by having a following. This applies equally to the *jpoxtawanej* as well as to the proprietors of the private dispensaries. In Spanish it would be noted as "el tiene gente", lit. 'he has people', or he has a clientele, a following. The person's skills are known and people request his/her services.

[21] The combination of odor, texture, etc. and taste (chemical sensation) is generally referred to as "flavor" with "taste" generally being used to refer to the chemical sensations, usually glossed as bitter, sour, sweet and salty.

[22] I wonder if at least part of the issue here is that we seldom need to attend to odors except as good or bad (spoiled food, air pollution, the desirability of someone's perfume). Because we in Western industrial society are so far removed from the natural world and most of what we encounter has been processed and reodorized, most of us pay scant attention to odor except when we are struck either by the intensity or the pleasantness (or lack thereof) of an odor (food, smoke, diesel fumes). Much the same could be said for flavor.

[23] The fact that the ability to smell the test substance must be suppressed in order to study "taste" in isolation speaks to the integrated nature of chemosensory evaluation. The same issue applies to irritative substances which cannot be used in taste or odor research for risk of "confounding" the results.

[24] Cain (1978:204) suggests that Linnaeus' system is the earliest extant scheme by someone who had sufficiently broad olfactory experience to develop a classification system that could comprehend the vast array of possible odors. Aristotle proposed a five stage system which was identical to that of his taste terms, while his much more prolific student, Theophrastus, developed a scheme of seven distinct classes, which unfortunately has not survived in his available writings.

[25] The only time that anyone said an odor was like something else was during the taste/odor experiment when I asked informants to tell me what the specific (foreign) odors might be used to treat. Som people needed to relate the novel odors to known plants in order to assign them usage, e.g., spearmint oil was likened to *chicle wamal* (*Mentha sp.*), useful for treating *tiel tz'i'* ('dog bite', by extension, rabies). It was likened to a known plant, not to describe the odor, but to assign it to a category of medicine.

[26] The exceptions are easily explained by reference to either the plant or the illness. In the case of *Prunella vulgaris*, the plant has relatively little flavor of note, while the illness it is usually used to treat, *cha'lam tzotz*, is a complex "syndrome" (see chapter 3) which manifests in a variety of ways, including diarrhea. In the ethnomedical classification it is most clearly grouped with gastro-intestinal illnesses, but because of the multiple components of the illness it is perceived differently by different individuals. It is generally considered a hot illness (though here too there is variation), while others direct their attention to the short head hairs and their removal, and some focus on the gastro-intestinal aspects of the illness. Each of these illness categories generally rely on plants of particular qualities: *sik* for the hot condition, *ch'a* for gastro-intestinal, and *ya* to remove of the short hairs. Since *P. vulgaris* has an ambiguous flavor, it gets assigned a variety of qualities, reflecting the possibility that in some cases, the quality term applied to a plant may be the result of the illness being treated. This is consistently so with hot/cold plants, and very occasionally the case with the chemical

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qualities. Considering all plants used to treat *cha'lam tzotz*, they are consistent with the usual pattern, bitter plants generally applied to gastro-intestinal issues, pungent plants being used to remove the short hairs, and *sik* plants for the heat producing nature of the illness. *Salmea scandens* is much more straightforward. It has a strongly pungent flavor but with an unquestionable degree of bitterness and so can easily be categorized either way. But more importantly, this plant is most frequently used to treat intestinal parasites (*lukum*), which ethnomedically are thought to be killed by the use of *ya* plants. In this case it could well be true because this plant is also known as a very effective fish poison.

27 The variation between these two tables, 4.7 and 4.8, can be in part explained by differences in method. The first table represents data from the plant collections where informants collected plants known to them as encountered in walking through the community. The second table represents data collected on the plants in the medicinal plant garden which was a much more constrained environment in which informants either knew the plants or not. It should be noted in this connection that in table 4.8, *paj* and *xin* are represented by very few informant statements, resulting from few plants considered to have these qualities.

28 I suspect that this method of learning plants may be a relatively new innovation reflecting Cancuqueros' increasing involvement in the larger national cash economy. There are a number of other indications that medicinal plants are becoming monitized, ranging from individual healers explicitly charging, up front, for their services to regional organizations (e.g. OMIECH) who are willing to purchase medicinal plants in large quantities.

29 *Lukum* and *chan* can both be glossed as "worms", but there is a distinction between them. *Lukum*, in the context of health, generally refers to intestinal parasites (Spanish: *parásitos*) and can generally, at one time or another, be seen, usually in the feces. They are understood to be both an illness (*lukum*), or occasionally the causative agent as in *k'ux ch'ujt* where the pain is said to arise because of the presence of parasites. *Chan* are more ambivalently understood, in that they are usually considered as proximate etiologic agents, but which are not usually visible. Several illnesses are explicitly seen to be caused by *chanul* (*chan eal*, tooth decay), while others are stated to be caused by *chanul* though not explicitly noted in the name of the illness. This is the case for a number of difficult skin conditions (*paslam*, *k'ael*) and become apparent in response to questions 17 & 19 in the garden interviews where it was stated that the medicine worked because it killed the *chanul* (*smiil be yip ta chanul*).

30 Unlike Asian medicine where tonics are a very important part of medicine and curing (e.g. van Esterik 1988), there is no clear category of medicine explicitly understood to be tonic or something taken regularly to make one feel better, give one strength, boost ones stamina, etc. While there are medicines to treat each of these kinds of conditions, they occur as illness categories rather than as a general state of health that can be maintained and manipulated through the regular ingestion of some plant substance. They are illnesses which need to be treated, not a state of health to be maintained or avoided/prevented by regular use of a particular preparation. There are only three instances in my fieldnotes where a medicine was described in such a way that it could be considered as a tonic: *Euphorbia graminea*, *Erigeron karwinskianus*, and *Arthrostema ciliata*. In each case the concept was to take as much or as often as desired until one felt better. They were taken because one felt a little bad, taken for usually minor illness (*mayuk yip k'inal*, 'no energy'; *batz'il obal*, 'true cough' ["cough due to cold"]; *tzon kok*,

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'coated tongue', usually associated with fever), or after one had been treated for more serious illness as something of a restorative.

31 The one significant exception to this general rule is that some informants will define a plant as bitter (*ch'a*) if they view it to be a particularly powerful medicine. If asked to verify the taste (because they are at variance with everyone else) the usual response will be something to the effect of *ch'a sok paj* (bitter and sour), thus preserving their statement about its quality as a powerful medicine, while at the same time "correcting" themselves as to its "true" taste quality. The relative strength of the various qualities was discussed in chapter 4 and in table 5.3 below.

32 Semantically, there appears to be a difference between the concepts expressed by *k'ixin* and *k'ajk'*. *K'ixin* means "to warm" (*k'ixnaj*), something which causes one to become warm(ed). *K'ajk'* means hot, something which produces or gives off heat. The sun, a fire, or a fever are all *k'ajk'*. If one is walking on a bright sunny day, the sun is *k'ajk'*, but one takes off one's sweater because one has become *k'ixin*--warmed. One takes a *k'ixin* medicine to overcome or counteract a *sik*--cold--illness or one sits next to a fire or moves into the sun to become *k'ixin*--warmed. *Ay sk'aalel* would indicate that "I have a fever", but *Ay k'ixnal* indicates that "I am hot", if said, for example, while taking off one's sweater midmorning.

33 This "hot/cold test" was conducted with only five informants and so can only be taken as suggestive of a likely pattern rather than a definitive statement. "Relatively unambiguous" means 4/5 informants agreed on the quality of the plant. If 5/5 is the requirement the number of plants clearly defined as hot or cold drops to one.

34 Strictly speaking this is childbirth, but often when there is difficulty not associated with witchcraft, then the entrance of air (which is inherently cold as a agent of illness) will be the likely etiology.

35 As discussed in Chapter 3, *pik k'abal*, literally, to feel the arm, or as stated by the Tzeltal "to listen to the blood" is pronounced in Cancuc as *pik'abal*.

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APPENDICES

Appendix A: Data collection forms used in this research.

1) Plant Collection form.

Numero de colección_____ Informante_____
Fecha_____ Localidad_____
Altura en pie_____ Vegetación_____

¿Nombre de la planta?_____
(Binti spiil ini _____ini?)
¿Qúe cura esta planta?_____
(Bin chamelil ya xpoxtay ini wamal ini.)

¿Qúe parte se usa?_____
(Ba'ay ya xtuun, yisim bal, yabenal bal?)
¿Qúe cantidad se usa (de yabenal, yisim, etc.)?_____
(Jich smiil ta tuntesel te (yabenal, yisim, etc.)
¿Qúe calidad tiene esta planta?_____
(Bin ya'el ta tuntesel)

¿Qué enfermedades se puede curar con plantas de esta calidad?____

¿Tiene otras calidades esta planta?_____

Hay otras ingredientes que se mezcla con esta planta_____
(Ay bal skap [Ay bal sok tak ta tuntesel te wamale?])
¿Qúe cantitidad de estos se usa?_____
(Jich smiil ta tuntesel te_____)

¿Qué parte de estos ingredientes se usa?_____
(Binti ya xtuun maka yisim, yabenal, snich)

¿Qué calidades tienen estos ingredientes?_____
(Bin ya'el ta tuntesel)

¿Como es la fuerza cuando se mezcla?_____
(O ¿como se cambia la medicina cuando se mezcla? **Bin ya'el yip te k'alal ya skap sbayike.)**

¿Cómo se prepara?_____
(Bin ut'il ta pasel?)
¿Cómo se usa?_____
(Bin ut'il ya tuun testik?)

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¿Qúe cantidad se toma or se usa?_____
(Jich smiil ta kuch'tike o_____)
¿Cuántas veces?_____
(Jayeb welta y jayeb k'a'al?)
¿Cómo siente el cuerpo cuando se tome esta medicina?_____
(Bin ya'el te winkiletik k'alal ya kuch'tik ini pox ini.)

Descripción breve de la planta_____

2) Garden Interview form

PREGUNTAS PARA LAS ENTREVISTAS JARDINES

Nombre del informante (o iniciales)_____Fecha_____

Numero de la planta_____Nombre de la planta según el informante_____

1) Bin chamelil ya xpoxtay ini wamal ini_____
(¿Cúales enfermedades son tratadas con esta planta (medicina)?)

2) Bint'il la a'na' sba te me pox ini wamal ini_____
(¿Cómo aprendió que esta planta es medicina?)
_____

3) Binti ya xtuun ini wamal ini, yisim bal , yabenal, snich_____
(¿Qúe parte se usa?)

4) Bi stuuk janax ya xtuun ini (parte del #3) ini_____
(¿Por qué esta parte?)

5) Jich smiil ta tuntesel_____
(¿Cuánto de esta planta se usa?)

6) Bin ya'el ta tuntesel, ya bal, sup bal, ch'a, sik_____
(¿Qué calidad tiene esta planta? (por ejemplo: xuch', sup, ch'a)]

7) Bin ut'il ay stulanil te yipe (calidad del #6)_____
(¿Por qué tiene poder curar esta calidad?)
_____

8) Ay bal bi ya skapin ta tuntesel_____
(Otras ingredientes que son mezclados con esta planta)

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9) Binti ya xtuun yisim bal, yabenal bal, snich_____
(¿Qué parte de estos ingredientes se usa?)

10) Jich smiil ta skape_____
(¿Cuánto de estos se usa?)

11) Bin ya'el ta tuntesel.ta skape (ya bal, sup bal)_____
(¿Qué calidades tienen estos ingredientes?)

12) Bin ya'el yip te k'alal ya skap sbayike_____
(¿Como es la fuerza cuando se mezcla?)
(¿Cómo se afecta la medicina cuando se mezcla estos otros ingredientes?)

13) Bin ut'il ta pasel_____
(¿Cómo es preparado?)

14) Bin ut'il ta tuntesel_____
(¿Cómo es tomado (usado)?)

15) Jich smiil ta tuntesel_____
(Cantidad que se toma o se usa)

16) Jay likel ta tuntesel, Jayeb k'aal_____
(Cuantas veces al día y cuantos días.)

17) Bin ut'il ay stulanil te poxe_____
(¿Cómo tiene poder curar esta planta?)
_____

18) Bin ya'el te bakelatik te k'alal ya kuch'tik poxe_____
(¿Cómo siente el cuerpo cuando se tome esta medicina?)
_____

19) Binti ut'il ya smiil be yip te chamele_____
(¿Cómo se afecta la enfermadad esta medicina?)
_____

20) Ay bal yan wamal pajalik ta tuntesel_____
(¿Hay otras plantas que tienen el mismo efecto?)

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21) Binti ay lek yip ta tuntesel sok yantik wamaletik. (Bin oro ay lek yan te poxe)
(¿Cuándo es esta planta mejor de otras plantas?)
_____

_____

22) Bin ut'il ta na'el sba te me pox ini wamal ini_____
(¿Cómo es posible decir que esta planta es medicina?)
_____

23) We'ilil bal_____
(¿Es comida?)

3) Informant Data form

INFORMACION DE INFORMANTES

Nombre del informante_____Sexo_____
Edad_____ Lugar de nacimiento_____

Paraje donde vive_____

Nombre de la esposa (o el esposo)_____

Nombre del papa_____

Nombre de la mama_____

¿Sí Ud. es un curendero, de que tipo? (partera, pulsedor, etc.
_____

Ocupación_____

¿Donde ha trabajado antes (finca, milpa, pueblo, etc.)?_____

¿Quién tiene conocimiento sobre las plantas medicinales?_____

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¿Cómo aprendió Ud. las plantas medicinales?_____
_____

¿Qúe son las enfermedades graves de Cancuc?

1) _____ 6) _____

2) _____ 7) _____

3) _____ 8) _____

4) _____ 9) _____

5) _____ 10) _____

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Appendix B--Illness terms and descriptions.

Illness terms and descriptions recorded in the process of plant collections and garden interviews. Numbers 1-58 are the illness terms used as the basis of many of the structured tasks, and represent, to the best of my knowledge, illnesses for which there was an identifiable biological component. The majority of them were originally taken from the plant collection files of PROCOMITH, for which use I am very grateful. The descriptions are based on discussions with four informants with additional notes as they emerged during plant collections, garden interviews, etc. The descriptions are in many cases translations of those given me by informants. In those cases where we had the opportunity to view the illness they are marked with an *.

(1) jul bak' sik*: 'Arthritis' or 'rheumatism' There are various classes, some of which are probably not arthritis per se, but other kinds of body pain. Some may be like the *abil chamel* described under *ajk'* in that they can only be diagnosed by the *jpoxtawanej*; *ch'ajan jul bak sik* (*ch'ajan* 'cord'), runs throughout the whole body; *ton jul bak sik* is pain of the "heart", very similar to *k'ux o'tanil*; *pachaton jul bak sik* is pain of the torso which does not move, "does not travel through any vein"; *tz'uy jul bak sik*, (*tz'uy* 'rope') runs through the veins, especially in the arms. It is pain in the body that passes. If it is sent by other persons, it is more severe; *chawaj jul bak sik* is also like *k'ux o'tanil*, but there is pain in the whole chest and very severe headache and severe cramps; *ojtzel jul bak sik*, severe cramps that double all parts of the body, legs, arms, the head goes limp, one dies in minutes. Some of these sound as though they might be cardiac conditions or stroke. In most cases *jul bak sik* is not modified in the plant collections. The various "types" of *jul bak sik* appear not to be very common.

(2) tza'nel*: Common diarrhea.

(3) cha'lam tzotz*: Chronic gastro-intestinal illness, marked by diarrhea, high spiking fever(s) and mild to severe malnutrition. This is almost always said to occur with (or to cause) diarrhea (esp. *bos bos tza'nel*) and *nukul ch'ujt*, swollen/distended belly in which the veins are sharply visible (the veins are visible because the belly is swollen). If is very severe they will have *sijt'ubel* (generalized edema). The process is described as first the long hair falls, then in the second phase emerge very short, fine, soft, hairs, in the third phase, short, fine, but stiff hairs, like spines, emerge. It begins on the sides and later in front of the head. It makes the head hot and it itches. At times there is a strong (high) fever; when the medicine is put on the head, vapor (steam) arises. When the hair is combed the short hairs come out, indicating that the child is going to be healed (some people have more luck curing than others). The long hairs that fall out are black but become yellowish when they emerge again, the white, spiny hairs are the most serious. There are three types, white, black, and red, with the red being the most severe. Sometimes people use other names, for example *sbolil sojl*, so that the illness doesn't hear (understand) and hide (see Chapter Three).

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Similarly, the medicine is put on before dawn, usually between 4 and 5 a.m.

It is probably the high (spiking) fevers that cause the hair to fall out in the first place. An initial high fever may occur several weeks before the hair falls, and several weeks more before the appearance of new, short, spiky new growth.

(4) batzil obal*: Simple cough.

(5) belbel on*(≈ k'ael): Pus and blood filled wound(s) on the shoulder, neck or chest. "Rots" on the surface, lots of blood, tissue very red, smells very bad (indicating the possibility of a fungal infection). In cases like this and other illnesses sent by other persons, it is better (indeed necessary) to change houses for 15 days. In the borrowed house the curer comes to cure and another person stays to care for the ill person. It is also necessary to hide the medicine because another (bad) person may weaken it. It may be something on the order of "tropical ulcer", an ulcer which may result from an unhealed wound, involving the bacteria Bacillus fusiformis, Borrelia vincenti. *Belbel on* was stated by some informants to be less severe, less deep than k'ael (this is generally supported by the triads) *Belbel on* smells bad and generates pus whereas *k'ael* does not smell bad and doesn't produce much in the way of pus or blood. Scrofula also fits within this description.

(6) bik tal tza'nel: Small amount of feces, often in small pieces or bits. Some believe this is similar to *sin ak'al tza'nel* and one has to go to the bathroom every little while but can't/don't produce much, can't eliminate the feces, but pass a little blood with the stool. Others note that food passes through largely undigested. If this were the case, and as some have indicated this is the diarrhea that one gets with *cha'lam tzotz*, it would fit with the idea that when one has long term intestinal illness, the microvilae simply get "worn out" and can no longer adequately process the food, so it passes through largely undigested, further contributing to the malnutrition these kids face. Others note that this is related to *sin ak'al tza'nel, obal tza'nel* and *ch'ich' tza'nel*, the stomach and intestines hurt, one needs to go to the bathroom every little while, but don't produce much, small bits, even though one feels the need and desire. There is some disagreement about the relationship between this illness and *cha'lam tzotz*. While some suggest that *bik tal tza'nel* occurs with *cha'lam tzotz*, other assert that it does not, that rather it is *bos bos tza'nel* in which the food passes through largely undigested.

(7) bujk': Small swellings that itch a lot and hurt. They begin when someone speaks bad about one.

(8) cha' nukul: White, gelatinous mucous comes from reddened eyes, hurts with bright light, begins with eye pain (*k'ux sitil*) or with dust, or other particulate matter in the eyes, but there are no tears.

(9) ch'ich' tza'nel: Dysentery; when it is not very serious, some refer to it as *tzajal tza'nel* ('red shit'). One informant noted that the

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stomach and intestines hurt a lot, but one doesn't pass much, mostly gas.

(10) mak sitil: An illness of the eyes, which can become *ma' sitil*, blindness.

(11) chakal: A growth in whatever place but normally in the tender parts, groin, arm pits, below ribs--lymphatic swelling?

(12) xoch: Cracks in the bottoms of the feet (fungal infection?), making it difficult to walk, sometimes the cracks bleed, thought to be caused by a (invisible) worm. It is painful, more common before shoes were regularly worn (thus we could expect it to be more common in women now); more common during the cold season, December to February.

(13) ch'ixal yak' wakax: 'Tongue like a cow', see *ch'ixal yak' mis*.

(14) chay k'ajk'*: Like a burn, but without having been burned. Sometimes referred to as a suffering of the body (padasimiento del cuerpo). It is like a wound or injury around a wound, begins to swell and fill with pus all around, it can become worse, the wound can appear to grow. Sometimes it begins like *sep chin* (scabies), but become worse, the pustules fill with pus, may break open, itches a lot. It hurts like a wound because it causes the skin to peel, like a bad burn.

(15) sik k'ajk' (pronounced *sik'ajk'* in Cancuc): Fever and chills. If one bathes in standing water or in the first water from the wet season, one will contact this illness. Public health message here: If one bathes in water full of feces, one get sick with fever and chills. This makes reasonably good sense in that there is relatively little rain during the dry season and the feces collects everywhere. When the rains begin they are usually forceful and heavy which will wash much of the accumulated feces into the waterways. After a few days of the heavy rains it should be a bit cleaner. Some informants glossed this as malaria (paludismo), which it could fit. As it was explained it seems plausible: First comes the chills, then after a while begins the fever, every 3-4 days, the cycle begins again. Lasts for years, not very common now. The repeating nature of the symptoms would indicate malaria, but they could also cover influenza.

(16) ch'ixal yak' mis*: 'Tongue like a cat'. It has become apparant that this, *ch'ixal yak' wakax*, and *tzon kok* are various signs of dehydration and fever. They are virtually always associated with high fever, often with severe diarrhea and occasionally with respiratory conditions. Because of these associations they are viewed as potentially serious health conditions. One can die from or after these conditions, thus marking them as serious conditions which warrant considerable attention. *Ch'ixal yak' mis* follows *tzon kok*; the tongue feels spiny and the "spines" can be seen, it always occurs with fever and diarrhea. *Ch'ixal yak' wakax* is described as being like grano, large, raised bumps on the tongue. The progression is something like *k'in ch'ajaw* or *tzon kok* (which are not viewed as

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particularly severe) evolves to *ch'ixal yak' mis* which in turn evolves to *ch'ixal yak' wakax*, each turn indicating a worsening of the condition. In response to a question about the relationship between t*zon kok* and *ch'ixal yak' mis/wakax* and *k'in ch'ajaw* one informant said that *tzon kok* and *k'in ch'ajaw* can appear in healthy persons (or in persons who are already ill) and are relatively easily cured, whereas *ch'ixal yak' mis/wakax* appear after one is ill. Another informant volunteered that one gets *ch'ixal yak' mis* as a result of pain and fever. If one has these conditions for an extended period then *ch'ixal yak' mis* can result--which is in agreement with the suggestion that these are manifestations of dehydration and high fever. A description of a child diagnosed as having this, who died several days later, sounded like rheumatic fever

(17) tokal ta sitik: Illness of the eyes, like clouds in the eyes. My physician wife saw a woman diagnosed as having *tokal* and her opinion was that it was a pterygium, a patch of thickened conjunctiva extending over a part of the cornea, normally resulting from chronic irritation. The growth can indeed cover the iris/pupil and result in blindness. Not a great deal of pain involved. Closer questioning of collaborators indicates that *tokal* results in the pupil becoming gray/white, the color of clouds. When we described *bak'et ta sitik* we got the response that would indicate that it is pterygium.

(18) chin*: Scabies and other rashes. This is the generic term for rash and can mean anything from minor bug bites and rashes through to infected, oozing, though small wounds.

(19) k'ajk'eteal: (=*k'in ch'ajaw*) Like a burn on the inside of the lips.

(20) k'ux bak'etaltik: Body pain.

(21) sak obal: "tuberculosis" is the usual gloss, but Susan Niermeyer's research on Acute Respiratory Infection has indicated that it is just as often bronchitis, which also produces abundant phlegm. She is also of the opinion, based on interviews that the reason people in the community so easily gloss.*sak obal* as tuberculosis is because at some point that is what the vaccination program adopted as their gloss for tuberculosis. While TB is certainly within the range of *sak obal*, it has unfortunately narrowed the range of illness probably originally included within the concept, some of them sufficiently dangerous to warrant attention in their own right. Discussion with collaborators indicates that it begins with cough, but if not calmed (treated/cured), it becomes *sak obal*. There are several classes: *tzajal sak obal*, A person can't tolerate this illness for more than a year (before dying), "vomits" blood, hence the name. *Sak sak obal* lasts 6-7 years, white production (mucus?), it is difficult to breath, it is very common, many people have died from it over the years. Affects anyone, but usually adults.

(22) chul chan: Something in the eyes, the color of the sky, the pupil is the color of the sky, it hurts. Eventually it makes one blind, but then doesn't hurt much; the iris appears crystalline.

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(23) echen*: Wounds, cuts, abrasions, etc., minor to severe.

(24) ejsel: Red cracks in the skin; may be found on any part of the body, cracks develop/open and blood comes out.

(25) ixim chakal: Small growth in whatever part (often the neck) with pus and which hurts. It is not necessary to cure it, self resolves, not very common. Perhaps infected hair follicles, or something of that nature.

(26) ja' ch'ujt*: diarrea. This seems to be the general cover term for diarrhea, in that sometimes it is severe, other times not, sometimes it occurs with vomiting, etc.

(27) jik'jik'obal: 'Whooping cough'. (tosferina) is the usual gloss for this, though I believe it covers a range of choking or gasping coughs. The cough begins 2-3 days after the *jik'jik'* (gasping) begins and lasts for months if it is not cured. There is often about three days of fever, then 3 days of normal or regular cough (*batz'il obal*), after which begins *jik'jik' obal.* This type of cough develops because the cough becomes cold. The cough gets cold because one doesn't take care of the food; one cannot eat (be given) food that is 'cold'. When one gets 'cold', one develops a fever. Given the appropriate medicine, the affected person coughs easier (because the cough is warmed) and have the characteristic inhaling wheeze. This indicates that the medicine is working and the cough has been warmed. Children with this illness are not allowed in school until cured. Before vaccinations, lots of children died from this illness. One informant told of his parents who had 13 children, only 4 of whom survived to adulthood; all the others died from *jik'jik' obal.* If the cough gets cold, one can die.

(28) k'ajk'al obal: At times it is a cough, then a high fever that kills many people; fever for 3-4 days, then the cough begins, often with sore throat after 4-5 days, but it is difficult to cough, even though one wants to (feels the need).

(29) k'ael*: Wounds without obvious cause. Probably something on the order of "tropical ulcer", an ulcer which may result from an unhealed wound, involving the bacteria Bacillus fusiformis, Borrelia vincenti. There is undoubtedly some overlap between *belbel on* and *k'ael.* Some see this as a rotting of tissue that results from not bathing or from bathing in dirty water. They suggest that it begins with fungal infection, that itches a lot; the description is something like tinea blanco; first the fungus appears (fruiting bodies?) and then it gets worse. This latter description seems more like that of *belbel on. Belbel on* is said to be pure skin, the pus smells bad, stinky fungal fruiting bodies indicating the possibility of one of several fungal lesions, whereas *k'ael* is deeper, involving subcutaneous tissue and doesn't smell, and doesn't produce the kind of pus and drainage that *belbel on* does, indicating that it is something like tropical ulcer.

(30) k'ajk'*: fever.

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(31) k'in ch'ajaw: 'red tongue'. These seem to be herpes, "fever blisters", one feels badly for having shame, for someone having spoken bad of one. *K'in ch'ajaw, tzon kok, ch'ixal yak' mis and ch'ixal yak' wakax* are all grouped together and appear to all be associated with fever and diarrhea, or sometimes respiratory conditions. One informant noted that after two or three days with *k'in ch'ajaw*, which always occurs with fever, the mouth/breath smells real bad. This is after the person has not been able to eat because of the fever and the blisters--ketosis? Also it can feel as though the tongue has been peeled. If one eats something salty it hurts a lot. See additional notes under *ch'ixal yak' mis.*

(32) k'ajk'et k'in ch'ajaw: Blisters that burn, appears like a 2nd degree burn. It seems to be something like oral herpes, or apthas ulcers; sometimes herpes, sometimes due to fusiform bacillus bacteria. Described as very painful.

(33) k'ux ch'ujt*: Stomach ache. May be a condition by itself or in association with other illnesses, e.g. diarrhea..

(34) k'ux jolobel*: (≈ balil k'ux jolobel): Headache.

(35) k'ux o'tanil: Pain of the 'heart', probably upper gastric pain in most cases. Curable with plants; begins with a pain, at times tremendous. After taking plants 1-3 times the pain is calmed. It almost always comes from evil persons (witchcraft). One informant gave a long story about when he was struck by very severe *k'ux o'tanil*, when he was Nich Te'el and having had a fight with his wife, and leaving the house to sleep elsewhere (he'd been drinking) and came upon *pukujes* after which he was struck down with *k'ux o'tanil* and then had to go through a full round of curing including plant medicine suspended in a bowl full of *pox* (sugar cane liquor. After taking this he (needless to say) passed out (having been up all night before). After a couple of hours he woke up and felt better and was able to return home. This appears to be a very broad category including everything from heartburn to emotional troubles to, possibly, heart problems (e.g. angina).

(36) k'ux sitil: Illness of the eyes, 'eye pain'. This appears to be a general, cover term to describe most any illness or problem of the eyes. In many cases the entrance of "trash" or a blow or something of that nature will cause it. It can change to other illnesses, becoming worse (e.g. *chul chan, sak nok*).

(37) lukum*: 'Worms' or parasites, it is very serious; it is inflicted by other persons (so say some informants). One informant recognizes bad water as a source of worms, whether because he had seen them in the ponds and puddles where he occasionally gets water or if it is some left over bit of biology from his days as a teacher is hard to say. Worms of this type are primarily a condition of children, though occasionally in adults as well. When medicinal plants are taken the worms are killed and pass out in the feces. There is a distinction drawn between *lukum* (worm) and *chan* (snake). Many illnesses that are degenerative (*chan eal*), that seem to move and/or increase in

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size (esp. skin), or that don't have an otherwise obvious etiology are said to be caused by *chan*. These are usually invisible creatures that are inevitably killed by the medicine if the cure is successful. There is another class of *chan:pakum* and *nap'ak* which appear in the stomach region and are only diagnosed and treated by a jpik k'abal. One informant noted at one point that animales/gusanos (worms) are a form of infection from one person to another, especially in the case of skin illnesses--one can get it from the person you sleep with. It is hard to say how much of this is his belief based on his 6 years in Tuxtla and how much of it is Mayan.

(38) muk'ul chin: Large, infected sores/pustules filled with pus which can burst, may cause fever, usually just one or at times more. Probably boils, fever could arise should the infection become systemic.

(39) muk'ul chuel: Smallpox. "No one alive today has seen this illness".

(40) nukul ch'ujt*: The stomach swells some and the blue veins may be seen; abdominal distention arising from parasites, edema of malnutrition, or ? (The veins can be seen for the simple reason that the abdomen is swollen.) Again, this usually is said to occur with *cha'lam tzotz* and *bosbos tza'nel*. "If one has *cha' lam tzotz*, it can be said, that they will have *nukul ch'ujt*". The belly is described as tight, so that when scratched it sounds like scratching a corn husk, or if tapped it sounds hollow like a plastic yogurt container. It often occurs within a couple of weeks after the beginning of *bosbos tza'nel* or other chronic diarrhea. One informant added a social note as well, saying that all of the children of one of his neighbors, who drinks a lot, had *cha'lam tzotz* beginning when they were between 8 months and one year. This could indicate the general level of nutrition, the general lack of well-being in the household, or...? All informants noted that it is related to *cha'lam tzotz*, always occurs with *cha'lam tzotz*. The stomach swells, one can see the blue veins with *bosbos tza'nel*.

(41) obal tza'nel: Translated as dysentary with mucus, but more precisely it is diarrhea with mucus mixed with the feces, no indication of blood. The stomach and the anus hurt because of frequent bowel movements. Upon going to the bathroom one produces half feces, half mucus, with much pain in the lower gastric region, above the pubic bone. One always needs to go to the bathroom because of the pain, but little is produced, pure pain.

(42) paslam*: Redness of the skin in all parts of the body. If it is serious, it bursts/oozes and produces pus; burns like chili or like a burn. It is caused by evil persons (witchcraft).

(43) pumel (*kawayu*): Related to intestinal blockage (*mak tza'il*); when one eats too much (for example), the stomach swells with gas, hurts, air in the stomach. If one is very cold or if one eats too much one gets *pumel*, can be cured with plants.

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(44) sak nok' (≈ *bak'et ta sitik*, maybe): something in the eyes, white, every little while the eyes produce tears; there are one or more small lumps near the iris (≈1mm in diameter), hurts more than *cha' nukul.*

(45) sal: Lots of flaky skin on the whole body. Sometimes the skin is like that of a fish, dry, scaly. One can die of this illness. It is not a normal illness, it is given by other people (witchcraft). Reportedly much more common previously than it is now--better hygiene?

(46) sep chin*: Very small sores; often beginning in children during the corn harvest when they are taken to the fields. The tiny dry hairs of the corn plants cause small localized infections which itch a great deal, bother one a lot and need to be scratched periodically. No doubt there are other causes of this kind of infection but this seems to explain *sep chin* best. Like many other illnesses this one is said to progress to other, more serious conditions. The fact that this itches a lot, and children will scratch, it is likely that, given the poor level of hygeine, that these could become seriously infected.

(47) sijt'el: Inflammation/swelling. There are times when these are associated with sprains, inflamed skin conditions, etc., but there are other times when, so they say, they simply occur. The only thought that occurs at the moment is that perhaps this is associated with stress related trauma. Given the loads these people carry (50kg+), it seems entirely possible that there could be swelling after carrying large loads for several days (e.g., during the corn harvest). Especially since it usually seems to be in the lower thighs, knees and calves. Generally ascribed to witchcraft. Conversations with collaborators indicated that for them it may be a natural occurrence which can be cured with cold plants. This is somewhat at odds with what I was told during many of the garden interviews when it was often ascribed to witchcraft.

(48) sijt'ubel*: Swelling of the entire body--edema. "Chilling" of the body, normally begins in the face and moves downward. There are two types; if it begins below and rises, the person will die; it is very difficult to cure. If it begins above and moves down, one will live a while yet.

(49) simal obal*: Cold with cough.

(50) sin ak'al tza'nel: diarrhea with a little blood. Some believe this is similar to *bik tal tza'nel* and one has to go to the bathroom every little while but don't produce much, can't eliminate the feces, also has stomach pain. Related to *obal tza'nel*, every little while need to go to the bathroom, but not much is produced, but that which does emerge has a little blood; has the same pain as *obal tza'nel.*

(51) sit chay (≈ sit mut): Eyes like a fish. This condition and *sit mut* ('chicken eye') are very similar and according to one collaborator, relatively few people can distinguish one from the other, I would guess they are synonomous along with *sit chan* ('snake eye'). The signs and symptoms are very few, making me think that they are relatively uncommon. Similarly when one collaborator and I were

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doing the health term interviews, many people clearly had no concept, or even knowledge, of these terms. It seems reasonable to posit that these are in the realm of *pukuj* health conditions, sent by another person--to be cured primarily by prayer.

(52) sit mut (≈ sit chay): Eyes like chickens.

(53) tukul ch'ujt: Probably chicken pox (viruela loca). Begins with a high fever, after which emerges the rash which begin small, then gets larger, appear with pus, but red, usually in children, but at times in adults. Some report this as not very common, which wouldn't make much sense if it is chicken pox.

(54) tumin k'in ch'ajaw: The surface of the tongue is like cotton (oral thrush/*Candida*). Can be removed with sour or astringent plants like lemon or lime juice, banana leaf sap, oaks or *paj te'* (*Arthrostema ciliatum*).

(55) tzajal chuel: Measles, generally in children who, having had it once, won't have it again, even though it may pass through the community again.

(56) tzajal paslam: red *paslam* .

(57) tzon kok*: Tongue red, but inside. Some insight on what this and related tongue conditions might be (*tumin k'in ch'ajaw, ch'ixal yak' mis, ch'ixal yak' wakax*): It is beginning to appear as though these are in some way related to fever and/or dehydration and the changes that occur with sudden, severe or chronic diarrhea. The tongue changes color and texture during episodes of diarrhea and subsequent dehydration, with the papillae and taste buds becoming more pronounced as dehydration progresses. What we first saw diagnosed as *tzon kok* was on my wife's tongue after she had had a couple of days of high fever and diarrhea, where her tongue was coated white with bright red bumps (tastebuds, etc.). One informant said that it is possible to have *tzon kok* without other illness, but usually it occurs with small fevers. If the fever gets worse or persists then *tzon kok* continues or converts to *ch'ixal yak' mis* or *ch'ixal yak' wakax*. When one has this it is possible that one can't talk, or eat. Much like *cha' lam tzotz* where the treatment is directed toward the head (the "proximate sign") , the treatment of this is directed to tongue rather than the underlying illness, probably (severe) diarrhea with (high) fever. The treatment involves taking the medicine and rubbing it around on the tongue to remove the coating/discoloration. The important point about these is that they are considered dangerous because they give diarrhea and fever, thus one can die from them. My collaborators note that these conditions always occur with fever; one is always thirsty, and often can't eat. There are two classes: *sakil tzon kok* and *k'anal tzon kok* (white and yellow, respectively). See additional notes under *ch'ixal yak' mis*. One informant noted that this illness appears every little while during the day and that one needs to squeeze a bit of the medicine (*paj te'*) on the tongue/mouth every little while. Adults are much the same but they can consume as much as they please at a time, but

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likewise should do it every once in a while. This would fit with our hypothesis that this results from dehydration from diarrhea/fever. Given that fever and diarrhea usually resolve in a day or two, it is logical that *tzon kok*, which I expect will appear a day or two after the others have begun, will also resolve in a day or two after the other conditions have resolved. If the fever/diarrhea doesn't resolve then probably the *tzon kok* will become something else, like *ch'ixal yak' mis*.

(58) xenel*: Vomit.

Additional conditions

abil chamel: (Shortened from the verb *ak'bil*--sent or placed.) An illness of whatever type which is given or sent by another (bad/evil) person and also the person who has one of these illnesses. The person that can give/send this type of illness is known as *labil winik* or *ak'chamel* ('brujo/witch'). It is said that the *pukuj* reside within the heart, which is to say walk together with those men who have power (to send illness). See *ajk'* for a general description of specific types of illnesses that are unambiguously *abil chamel*.

ajaw chan: 'Rattlesnake', see *ajk'* for a discussion of this type of illness.

ajk': Tortoise (tortuga). Like a tortoise in the stomach, this is a type of *abil chamel*. It is necessary to have a *jpoxtewanej* to make a diagnosis and cure one. There are special plants for each type of "animal" that one can have. In this case the *jpoxtawnej* needs to give power to the plant in order that it may cure. It seems like a tortoise (or whatever animal), but it isn't, it is pure blood. It hurts and (the animal) drinks all of the blood and forms a lump the size and shape of the animal that one has, complete with eyes, mouth, etc. This is known because people have seen this type of animal in cows and horses that died suddenly. The pain is very intense, one can't tolerate it; they begin and grow very rapidly, if the person is not cured they die. The most important thing is that these illnesses are diagnosed by the *jpoxtawanej* by the pulse, that which one has (type of animal) is decided by the *jpoxtawanej* upon taking the pulse. More people die of these illnesses than others. They are described as animals which hurt and that move around the stomach. If the illness doesn't move from one place to another, if it stays in one place, it can't be cured, one will die. An example was one informant's daughter, who was diagnosed as having *nap'ajk*. The healer (the informant) was called in the middle of the night to come treat her; he went looking for the necessary plants, prepared and gave them with the appropriate prayers. She passed out as though dead, blood came from her nose, indicating that the animal had died. Shortly she was relaxed and feeling better.

Other examples include *pokok* (toad), *nap'ajk* (large black worm), *uch* (oppossum) *pakum* ('type of snake'), *ajab chan* ('snake'). These are separate from other illnesses sent by other persons in that these can only be diagnosed by the *jpoxtawanej*, according to the pulse and what kind of pain the person has. Some of the other

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illnesses which are also *abil chamel* but which seem more clearly to have a biological component include *jul bak' sik, k'ux o'tanil, chawaj,* etc.

ajk' k'inal: (natural illness). The body feels bad, can't do ones chores, very weak, always sleepy, it's a debility, one doesn't have the strength to walk. It is cured only with prayer, there are no plants. One has the energy of a tortoise (*ajk'*). It is similar to *mayuk yip k'inal.* Heart arrhythmias, mild anemia, infectious mononucleosis, mild depression are possible correlates.

alaljel: (≈*animal chamel*) Childbirth.

alal ch'ich' or al ch'ich': A lump of blood in the womb that bursts after 2 or 3 months. The woman begins to bleed and passes this lump of blood, sometimes in the form of a pineapple. If the bleeding does not stop, the woman will die; it is cured with plants and prayer. Seems like a spontaneous abortion. Others have described similar occurrences, but the fetus was "in the shape of a doll, hard and stiff". This is inevitably ascribed to witchcraft.

al ch'ich': At time the menstruation stops for 2-3 months, but the woman is not pregnant, described as a "rest"; when the menstruation begins again, it is excessive.

animal chamel: (≈ alal jel) childbirth.

apon chamel: It is like a lump under the ribs, on one side or the other, never in both, hurts a lot. If it gets worse, pus and blood come out. According to the doctors, it is a tumor, but according to the *jpoxtawanej* it is not. It is a lump more or less 15 x 10 cm which one can't touch because it feels very cold for the person who has it. It can burst, one can die, it hurts a lot. It can be cured with various plants mixed together.

bak'et ta sitik: Eyes have a large number of dark colored veins. Possibly pterygium.

bak bak yaubel (*sikil chamel,* 'cold illness'): One is very pale, loses weight, doesn't eat (doesn't want to eat), feels very cold, very weak, sleeps all the time, doesn't have the energy to walk. Even though favorite foods, are well prepared, they don't have any flavor, one is sad, can hear noises like animals which others can't hear.

bejtz'em: Sprain, twisted joint, usually of leg or arm.

balil: Headache with nausea. It is similar to headache, but hurts much more with pain of the ears, eyes and all parts.

bos bos tza'nel: It is said to be like *pumel* ('intestinal gas'), when one eats too much or when one eats something bad, it is necessary to go to the bathroom every little while. Further elaboration and comment indicates that the food passes through unchanged, and at times it is possible to see worms, small and white, moving in a large pile of

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feces. It is stated as resulting from *nukul ch'ujt*, which is closely affiliated with *cha'lam tzotz*.

ch'uch'ul chin: Small skin infections that are very irritating, sting a lot. They can be cured with bitter plants. Normally there are many in one part or another, at time over the whole body, but not on the palms of the hands or soles of the feet.

ch'ujt ta antze ta macha ayale: Pregnancy, and/or the pain associated with it.

ch'ujch' or *uch* (*abil chamel*): See *ajk'*.

chan (*abil chamel*): Animals in the stomach, see *ajk'*.

chawaj: Dizziness with nausea. Described by one informant as similar to when one stands too fast and gets dizzy and can't see and the world goes dark, or you see stars, or when one climbs high in a tree and then looks down or the wind blows, or when one is doing a task and become extremely sleepy; that period in which if one were to put one's head down, sleep would be instantaneous, the type of sleepiness that no matter what one does it.does not go away. M. also said that at times when one is walking on a hot day, either on the road or especially with a heavy load or up a steep hill, one gets dizzy, has a headache, sometimes bloody nose or disorientation, don't feel well, and can fall/pass out (sounds like heat stroke). Others have indicated that with *chawaj* one has a tremendous headache. This headache is what distinguishes this from *k'ux o'tanil* by some.

chawaj o'tanil: Pain of the heart/chest with diarrhea. Heart attack?

chajan jul bak' sik: Cramps and "arthritis" with the pain running through the whole body.

chawaj jul bak' sik: Very strong pain in the whole chest and head, at times with cramps.

ch'e': Children who cry a lot every night, don't sleep, always crying, makes their forehead colored (red). Perhaps colic.

choj: ('cat') Something in the body according to the *jpoxtawanej*; only they can diagnose it, can't be seen, can't be distinguished (felt). Arises because someone speaks ill of one (witchcraft). It is only sent by other persons who wants to cause harm to another. If not cured, one can begin to vomit and may die.

chojk': A permanent bump (bola) on the body, hard, usually on the arms and legs.

chul chan, tokal: Eyes like clouds, very clouded

echej chan: (*abil chamel*, see *ajk'*) There are animals in the stomach in the form of a small lizard and it is made of blood. The *jpoxtawanej* can diagnose it according to the pain.

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ijk'al chamel: ('black death') Tremendous fever that kills many people. It is told only in stories, it doesn't happen now. Men in their 50s say that it happened in the time of their grandfathers, which makes it seem like it might have been the influenza pandemic of 1918. Many people died, often entire households. When I described the influenza pandemic, they agreed that this is probably what it was.

ilim baj: Anger, nothing more.

joviel: (see *sojkol jolobel*)

juk'ubajel: Hiccup
juk'ubajel chawa: Hiccup with *k'ux o'tanil* (upper-gastric pain).

k'ajk'et chin: Small, numerous rash bumps that grow and itch and hurt a lot. They may be found in any part of the body. Result in fever if not cured, contain a small amount of pus and can burst, can peel the whole body if severe. It is difficult to cure, need to continue applying medicine. Affects relatively few people, more often children.

k'ajk'al jul bak' sik: Very painful form, it is said to walk with fever throughout the whole body, hurts more in the back.

k'ajk'al nuk'ubel: Heat in the throat. The descriptions we have received indicates that this is probably reflux, both from simply eating too much (of squash with sugar or corn on the cob) or having a mildly upset stomach, to more serious conditions having to do with intestinal blockage and gastro-intestinal upset, including *me' winik*.

k'ajk'al tiawal jul bak'sik: Very strong pain in the teeth/jaw, head and eyes. There is color in the part that hurts. Results from harm inflicted by other persons (witchcraft).

k'ajk'al obal (k'aal obal in Cancuc): Fever and cough ('cold/flu').

k'ajk'el: Burns

k'axem alal: "Spontaneous abortion", also reported as transverse presentation. One informant said it is fairly common and is caused by another person inflicting harm (witchcraft). Another informant told us about a spontaneous abortion that his wife had where the fetus was born, supposedly at term, but was stiff and hard like a doll. Either his dates were wrong or the child died long before.

k'exlal: "Shame", when someone speaks bad about one, it doesn't sit well, one feels badly. One can have fever, diarrhea and vomiting. Everyone can cure it.

k'ixnajib ch'ujtik: Described as what the stomach feels like when one eats chilis, warms the stomach; it is how the stomach feels when *ch'ich' tza'nel* begins or when one takes *chabul ich'* (water, cloves,

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ground chilis and sugar), a medicine designed to warm a person with a cold illness.

k'un k'ajk': Small fever, not serious nothing to worry about. One informant described it as being like a comal (griddle), well warmed, but not too hot.

k'ux chuxubel: Painful urination. Noted by one informant to involve a great deal of pain and "pure pus" upon urination. "When one urinates it hurts, sometimes a lot. Other times it is described as a type of incontinence where one is forever dripping, soaking one's pants. The pain of urination continues for a while at which point erupts *k'ael* on the glans penis (which could be penile cancer or syphilis/gonorrhea). Also described as having to go to the bathroom every little while and not producing much (prostate problems?). Most common in men but very occasionally in women, more common in other places than in Cancuc. At times there is pain upon urination, caused by *sik* 'coldness', if one is warmed in the *pus* (steam bath) or with medicine, then the pain will quit.

k'ux o'tanil chawa: 'Heart' pain plus severe headache, similar in feeling to a hangover, dizzyness.and ache in all parts.

kexton, ja'al: A hardness on one side or the other, underneath the ribs which moves, hurts a lot and produces more diarrhea, hence the name *ja'al* (?, lit 'rain'). When it is mature, it kills people from the pain, the affected person becomes thin and weak because they can't eat; if they eat a little, it hurts even more. The lump is not hard and is between the size of a baseball and softball.

kexton, tzajal: A lump but with red skin and it remains on one side. The difference between this variety and *ja'al kexton* is determined by the type of pain and the location/stability of the lump.

lek' situbel: Sounds like trachoma, the eye lashes turn in, causing irritation and the eyes are always tearing, can become other illnesses, makes one blind.

lok ch'ich'ail: Nosebleed, at times because of the heat. Also bleeding which doesn't stop, for example when they prick the forehead in a curing, at times it doesn't stop. Bleeding in the medieval sense.

ma' chu'ul: When women don't have enough milk. One informant made the distinction between woman who don't have breasts large enough to support milk production, "no tienen nada" ('they don't have anything'), one could cut their hair and dress them in men's clothes and not tell the difference, and those who for whatever reason simply don't produce enough milk. The latter is the more common and is treated with medicinal plants.

mak tza'il: Blockage; when the feces can't/doesn't pass. The affected person dies very quickly. One falls ill with this in the morning and is dead in the afternoon. The stomach swells rapidly, one dies of the pain. Any kind of intestinal blockage could cause this kind of illness,

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including appendicitis, colon cancer (not highly likely in this group), intestinal torsion, intussusception (where one part of the bowel, including polyps intrudes into another part, compromising the blood supply, resulting in swelling which then causes *mak tza'il*). A related condition is *yalel jowinte'* where the torso is full of liquid the color of pepsi, part water, part blood, pus, etc. and as is usually the case in these situations comes from other people (witchcraft).

mayuk yip' k'inal: A feeling of being very weak. Weakness of the body, can't walk, or work, one feels very tired. It is not very common, don't eat, thus get thin and weak, can last years. This can be extreme to the point that one simply can't get out of bed or motivate oneself to do anything. At times it is associated with, or results from other illnesses, but can also occur on its own. It is similar to *ajk' k'inal*--energy of a tortuga.

me'ch'utik (*me'winik* in Tenejapa and Oxchuc): Appears in the stomach like a pregnancy, the person can't eat or anything. It is a lump which moves or jumps. If nothing is done one can die. Sergio Castro (a development worker with many years experience in the highlands) suggested, based on the description of *me'winik*, that it might be a bolus of parasites which might block the distal end of the esophagus and which could migrate and be felt externally. (Berlin, et al. 1993) demonstrate that biliary disease also covers part of it.

milel: Assasination/murder

nap'ak chan: Black worm with sharply pointed end, like a parasite in the stomach, see *ajk'*.

obal: Cough, see *batz'il obal.*

ojtzel: Like *jul bak' sik*, very strong cramps, causes one to double up completely, arms, legs, head, one dies in minutes.

ok'el alal: When children cry all of the time. Very similar to, or the same as, *ch'e'*.

pach'aton jul bak' sik: Pain in the whole body.

pakum: Type of "snake", see *ajk'*.

pokok: Like a toad in the stomach, see *ajk'*.

p'ulum chamel: Depigmentation of skin, but transient. According to one informant it is something one encounters by bathing in dirty water. It is better to bathe in running water.

sakil paslam: White *paslam*.

sik ta ch'utik: 'Cold of the stomach'. More precisely it refers to woman who do not become pregnant. Thus one uses a *k'ixin pox* to warm the woman so that she can conceive.

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sik ik': Air/wind Reportedly not known in Cancuc.

sik ta ch'utik: Noise in the stomach (lit. 'cold of the stomach').

sikil chamel: Without warmth, emaciated, skin cold, feel cold, pale.

sme' ch'utik: See *me'winik*.

ste'el spat antzantik: Menstruation.

sojch: Skin of feet cracked.

sojkol jolobel (joviel): Tremendous headache, one becomes crazy, might leave running through the mountains, bothering or harrassing people with a machete as though crazy drunk. Often glossed as rabies.

sujtel: Male impotence or something related.

tiel chan: Snakebite.

tob jol balil: Headache and pain in the whole face, the ears and jaw. It is like *tiawan jul bak sik.*

tokel: It is the effect of ice on the skin, frostbite?

t'ul t'ul tza': Type of diarrhea, but there isn't much, just drops, one must go to the bathroom frequntly, but with little output.

tzuj chakal: Large growth.

tzisim ik': Like *sijt'el*, but larger, with small bumps that burst on various parts of the legs, hurts a lot. Could be the early stages of tropical ulcer.

wayet k'inal: Similar to *mayuk yip k'inal* and *ajk' k'inal* in that one has no energy to take care of ones responsibilities, except in this case one simply wants to sleep all of the time, hence the name.

xiwel: Fright.

xixiton jul bak' sik: A lump in whatever part of the body.

ya xmak te antze: To give a rest to the woman--contraception?

ya slokesbil baketal sitik: Bad eye--eyes like dead cows.

ya xtiawan spat antzetike: Pain of menstruation

yak'ubel: Drunkeness, one can die.

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Appendix C. Rated severity of selected illnesses, percentages from pile sort data.

	From God	Witch-craft	True illness	Common	Not common	Serious	Not serious
jul bak sik		54		85		85	
tza'nel			54	77		62	
cha'lam tzotz	46		38		69	92	
batz'il obal	54		46	100			69
belbel on	38	46			100	77	
bik tal tza'nel	54		46	69		54	46
bujk'		31	46		54		54
cha' nukul		54			62		69
ch'ich' tza'nel	69				77	92	
mak sitil		62			85	62	
chakal	46		46		54		77
xoch	46		46		77		69
ch'ixal yak' wakax	46		46		54	62	
chay k'ajk'		69			77	69	
sik k'ajk'	54				54	69	
ch'ixal yak' mis	46	23	31		62	69	
tokal ta sitik	38	31	31		85	54	
chin			54		54		92
k'ajk'et chin			62		69		62
k'ux baketaltik	38		46	85			77
sak obal		62			92	100	
chul chan	31	38	31		92	62	
echen	54				54		69
ejsel		46	46		85	62	
ixim chakal	54		46	54			77
ja' ch'ujt	54		46	92		62	
jik'jik'obal	85			85		92	
k'ajk'al obal	62			100		69	
k'ael		69			100	92	
k'ajk'	62			92		69	
k'in ch'ajaw			69	62			69
k'ajk'et k'in ch'ajaw			54	54			77
k'ux ch'ujtubel		54		69		54	
k'ux jolobel	23	46	31	85		54	

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k'ux o'tanil		54			54	92	
k'ux sitil	69				62		77
lukum			62	69			77
muk'ul chin	46		38		62		62
muk'ul chuel	77			69		77	
nujkul ch'ujt			62		69	77	
obal tza'nel	46		46		77	62	
paslam		92			92	77	
pumel			54	69			69
sak nok'	54				69		62
sal	31		46		92		69
sep chin	38	23	38	69			85
sijt'el		46	38		85	54	
sijt'ubel	38	31	31		77	62	
simal obal	54		46	100			62
sin ak'al tza'nel	54		46	62		54	
sit chay	38	31	31		85		77
sit mut	31	46	23		85	54	
tukul ch'ujt	69			77			54
tumin k'in ch'ajaw			62	54			69
tzajal chuel	85			92		100	
tzajal paslam		85			69	77	
tzon kok			69	54			62
xenel	46		38	62		62	

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Appendix D

Definitions of chemosensory quality terms as applied to medicinal plants collected during the course of this research.

1) Ya--Picante like chile; anything that is pungent/piquant: *yaal wamal* (*Fleischmanniopsis* spp., *Chromolaena odorata*), *k'anal nich wamal* (*Achmella oppositifolia*), and *ich'il ak'* (*Clematis grossa*) are examples. The taste/odor experiment data indicate that Chinese mustard, fresh and dried ginger, garlic, and odors like menthol or camphor ("Tiger balm") are also *ya*.. In short anything that is picante and/or is highly aromatic in the mouth). Other representative plants: *Piper jacquemontianum, Polygonum punctatum, Sisyrinchium convolutum.*

2) Bilil--Gelatin-like, like mucus, slippery/slimy, *tza'mut* (chicken shit), sap from *Opuntia* cactus or the mashed (or chewed) leaves of *Anoda cristata* (*malwax*) (these plants tend to have a very slippery, sometimes slimy, gelatinous sap, which often dries as a layer on the skin. Additionally, it often has a very cooling feeling when first put on the skin, though I don't know what the reaction would be when taken internally).

3) Ch'a-- Bitter; *ch'akil* (*Tithonia diversifolia*), *ton ch'a te'* (*Calea ternifolia*), *ch'aba ch'a ak'* (*Salmea scandens*). This is a complex concept, with the bitterness ranging from the very mild, barely detectable, to the overwhelming. Some of the plants were bitter in the truest sense of the word, making one spit without thinking, others were not bitter in the same sense, but produced an overwhelming sense of nausea and desire to vomit. Still others were noticably bitter, but not necessarily unpleasant, i.e., one could keep them in the mouth without severe discomfort. There also was variation in the rate at which the bitter sensation would manifest itself. In some plants it was immediately obvious and undeniable, while in others it would require chewing the leaves a bit before receiving the sensation. This didn't seem to be correlated to the strength of the sensation, though those which were most powerful generally expressed themselves soonest. Other representative plants: *Cissampelos pareira* (*patax chinin ak'*), *Solanum torvum* (*ijk'al tujkulum ch'ix*).

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4) Chi'--Sweet, *nantz chi'* (*Byrsonima crassifolia* fruit), *pax chak*, guava (*Psidium guajava*), *durazno* (*Prunus persica*, Peach), *chichoj te'* (*Prunus serotina* 'wild' cherry). This is one which seems to have two definitions. On the one hand, it refers to fruits and the like that are simply sweet, though these parts are seldom used for medicine. Often fruit trees are used for medicine, but it is the leaf or some other part that is used, though the plant will be defined according to its fruit. Thus the bark may be astringent (*sup*), but the plant will be labeled *chi'*. The other main definition seems to stand opposite *xin*. Any plant that is not clearly anything else and doesn't have a disagreable flavor will be labeled *chi'*, which I would characterize as something on the order of "neutral" or innocuous. This is also the term used to describe the taste of salt. In the taste/odor experiment, sugar and salt were universally labeled as *chi'*, with salt occassionally being labeled *lom chi'* indicating that it was very 'sweet'.

5) Jababet--A flavor that is like water, agreeable, the sensation one gets when drinking water. I get the sense that it is the feeling one gets when one drinks cool, clean water, you can feel it go down, it often does not have a particular flavor, and if you are thirsty, it feels good, seldom applied to plants.

6) Jik'jik' yik'--Odor which causes one surprise, strong and biting, like chili in the fire, *k'anal wamal* (*Nama dichotomum*), *otox wamal* (*Satureja brownii*) Any odor which is sharp, aromatic or intense likely will be labeled as *jik'*, though it may be "unpleasant" like the smoke from burning chilies, or "pleasant" like "Mentholatum" or "Vick's Vaporub". Representative plants: *Litsea neesiana*. (*sakil tziltzil uch'*).

7) Jik'jik' xial--Similar to *jik'jik' yik'*, but only medium picante: *otox wamal* (*Satureja brownii*), *tzajal xnen* (*Peperomia liebmanii*).

8) Jik'jik' xojet--Strong odor, but agreeable, like cilantro (*Coriandrum sativum*), mint (yerba buena, *Mentha sp.*), *sanswire wamal*, (*Tagetes lucida*).

9) K'ojoj yik' = K'ojoj--The odor of something being toasted or perhaps over toasted/burned. The usual example is the toasting of a tortilla to make a tostada. Representative plants: *pay te'* (*Petevaria alliacea*), *k'an chij te'* (*Nectandra coriacea*).

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10) Xyuket yik'--When one touches a plant that smells strong, agreeable or not. There are some plants that have a very strong odor which is released when the plant is moved or brushed. Sometimes you can smell it if you are near the plant, other times you need to actually touch the plant. Not a very common phenomena. Tomato plants (*Lycopersicon esculentum*) would probably be defined as *xyuk et yik'*, were they not food producing plants which calls into place a different set of qualitative statements. Representative plants: *tzajal ch'iliwet*, (*Lantana camara.*).

11) K'ixin--Something which warms one, like black pepper, cloves, or allspice. "It is warm (*k'ixin*) because it stops the cold that afflicts us. One can feel the change against the cold." This is part of the hot/cold dichotomy and stands opposite *sik* (cold) and so is used to treat cold illnesses, but is different from *k'ajk'*. Something which is hot (the sun, fire, fever) is *k'ajk'* while something which produces warmth (eating chilies, cinnamon with honey) is *k'ixin*. Representative plants: *pimento ak* (*Scleria hirtella*).

12) Sik--Cold, one feels a change, coolness. *Sik*, like *k'ixin* refers both to a state of being (cold) and the status of a medicine used to treat the opposite health condition. The plants, according to some informants. result in a change of state: hot-->cool, cold-->warm. One can feel the difference. This is not usually related to the physical temperature of the medicine, but to the perceived change in state of the body. Representative plants: *pimil ti' wamal* (*Byrophyllum pinnatum*), *sak pejtz wamal* (*Stellaria* spp.).

13) Siket--It is like water, it is not cold, it is not hot, described as the the feeling one has after a fever goes down--cool, comfortable.

14) tuj--Bad odor, like feces, seldom, if ever applied to plants.

15) Yabet--A flavor which is neither bitter, nor picante, rather it is smooth. I get the sense that this is a pleasant sensation, more or less neutral in taste/sensation. One collection: *sakil nich wamal* (*Buddleia crotonoides*).

16) Xuch'--Sticky, gummy, *mut tut* (*Ficus aurea*), *ch'uy nuk' te'* (*Ficus pertusa*) *limete wamal* (usually orchids). Most of these plants have a white milky sap that is usually quite tacky as it dries, and dries as a layer, sometimes sticky on the skin. They are always used for

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wound treatment. Other representative plants: *k'an chu' wamal* (*Euphorbia graminia.*).

17) Tzij yik'--Bad odor of whatever type, see discussion in Chapter Four. Lavendar oil from taste odor experiment nearly universally labeled as *tzij yik'*. Representative plants: *kulentu mis* (*Apium leptophyllum*), *ch'ix ch'a ak'* (*Thalictrum guatemalense*).

18) Tzitzitik--Odor like urine, not agreeable.

19) Xojet (Sowjet)--Very pleasant odor = jik'jik' xojet, as in *xojet sbutz'*--good flavor/odor. Representative plants: *Mentha sp., chicle wamal* (*Tagetes filifolia*), *ch'iliwet* (*Lipppia alba.*), *k'ak'an* (epazote, *Chenopodium ambroisioides*).

20) Paj--Sour, like lemon/lime (*Citrus sp.*) or *paj te'* (*Arthrostema ciliatam*). These are not very common, but those that are encountered are generally unambiguously sour.

21) Sak'--Something which causes one to itch and/or sting. *pej tak'* (*Opuntia*) glochids, (*Salvia urica.*), *tzajal tatam* (*Desmodium aparines*), *jos wamal,* (*Sansevaria thrysifolia*) *naj choj*--Urticacious plants.

22) Sup--Astringent. This was a difficult one for informants to define, they knew what it was, but could not put words to it, only give examples. Representative plants: leaves and bark of *nantz chi'* (*Byrsonima crassifolia,*) bark or immature fruits of *pax chak* (*Psidium guajava.*).

23) Siset yaal--Described as being like chewing chiclets: the air in the mouth and nose is warmed or burns. It is the sensation one gets when one has something highly aromatic in ones mouth. Another example given was the sensation one gets when one puts something like Vick's Vapor Rub under the nose--that feeling that one can feel this in all parts of the mouth, nasal passages and even into the lungs.

24) Xin--An odor/taste which is generally disagreeable, though not necessarily foul, like the smell of raw eggs, or raw meat, distinctive. Representative plants: *tut chiob* (*Castelleja arvensis*), *bojt'il chenek'* leaf (*Phaseolus coccinea*), *ch'abin* (*Crotolaria* spp.).

25) Yayatik = Ya, modified to indicate that it is medium pungent.

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