

## Chapter 29

# Traditional Knowledge of Plant Resources

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### *INTRODUCTION*

Thanks to the work of a great number of scholars, Maya knowledge of the environment has been thoroughly recorded. The “traditional ecological knowledge” (or TEK) of the Mexican Maya groups is probably better documented than that of any other indigenous groups in the world. (Knowledge of Highland Guatemalan Maya TEK lags far behind, but this situation, fortunately, is changing for the better.)

The reasons are not hard to find. First, the Maya remain numerous, diverse, and politically important; they are still prevalent throughout much of south Mexico and Guatemala. Second, they are a vocal and sophisticated set of communities. They share their knowledge relatively readily and easily. Their names for local fauna and flora have been widely assimilated into Spanish and even into English (e.g., “cacao” from the widespread root *kakaw*, “shark” from Yucatec *xok*, etc.)<sup>1</sup> Third, the glories of Maya civilization—ancient and modern—has led to important scholarly attention.

### *HISTORY OF RESEARCH*

The Maya written record of plant and animal names can now be traced to Classic Maya times (ca. 400–800 A.D.). The word *kakaw* shows up on

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Research was supported by, or conducted with help from, the University of California, Riverside, through a series of intramural grants; by the University of California Pacific Rim Project; and by the Sostenibilidad Maya project funded by the MacArthur Foundation. I am extremely grateful to the people of Chunhuhub, especially Felix Medina Tzuc and Pastor Valdez, for their help; and to Betty Faust, Scott Fedick, Arturo Gomez-Pompa, Eugene Hunn, and other scholars too numerous to mention, for help in the field and at home.

countless vessels, some of which actually contain chocolate residue. Kings' names such as "First Crocodile" and "Yellow Peccary" (Harrison 1999; Martin and Grube 2000) provide evidence of which animals were regarded as powerful and spiritually charged. Martin and Grube (2000:15) list jaguar, quetzal, macaw, snake, crocodile, turtle, and peccary as common name-animals; less common are shark, gopher, and other fauna. Many animals served as waay—transformation-animals of shamans, or spirit-animal companions of people in general. It is not known whether plant names were used much, but Central Mexican native peoples have always used flower names for girls. Xochitl, which is Nahuatl for "flower," is common even in Los Angeles, California. The Maya probably used flower names as well.

The Lowland Maya archaeoethnobotanical record is notoriously poor, but fortunately not so poor as it once was. In fact, in a recent review, David Lentz reports 118 plant genera or species identified from Classic Maya sites (Lentz 1999:6–9). Most of these are plants now used for food, fiber, or medicine, although some were probably mere wild plants of the area, and others may be contaminants (genera such as *Echinochloa* and *Paspalum*, recorded in Lentz's table, are common introduced weeds).

When the Spanish convinced themselves that they had conquered the Maya (a delusion they were frequently to regret), they quickly began compiling dictionaries. Excellent early-Colonial dictionaries (from the late sixteenth, seventeenth, and the eighteenth centuries) of most major Maya languages are available. Study of plant and animal names in these dictionaries has been spotty, but, at least for Yucatec Maya plant names, solid identifications are now possible.

With the coming of modern anthropological research, the study of Maya ecological knowledge entered a new era. This was due above all to three huge projects: (1) The Carnegie Institute of Washington's research on Maya archaeology and ethnography in the 1920s and subsequently; (2) the Harvard (later Harvard-Chicago-Stanford) Chiapas Project in the 1950s through 1970s; and (3) the research of Arturo Gómez-Pompa and his associates, beginning in the 1980s (e.g., Gómez-Pompa, Flores, and Sosa 1987) and continuing today (e.g., Herrera 1994; Ross-Ibarra and Molina 2000).

The Carnegie Institute research led to the classic ethnographic work of Robert Redfield and his associates (Redfield and Villa Rojas 1934). This eventually led to the collection of a great amount of data on food (Benedict and Steggerda 1936), milpa agriculture, and other relevant matters.

Meanwhile, interest in ethnohistory led to support for the epochal work of Ralph Roys. Roys brought ethnobotany (a new field) to Latin America and almost singlehandedly created the field of ethnohistory. Among other things, he studied Colonial medical texts. To understand the plant names, Roys

worked with botanist Paul Standley and others. He appended a prototype ethnobotanical dictionary of Yucatec to his study of Maya medical texts (Roys 1931). This book, an incredible achievement, has unfortunately come to have a rather stultifying effect on the field. The tendency has been to assume “Roys did it all,” and to ignore later work (notably Barrera, Barrera, and López 1976) or the possibility for further research. Also, Roys’ inadequacies, such as identifying huhub as *Pinus caribaea* (Roys 1931, 246) without noting its use for wild *Spondias purpurea*, have been perpetuated without checking. Roys went on to produce an edition of the ethnobiologically rich Colonial Maya text, *Ritual of the Bacabs* (Roys 1965), recently reedited in Spanish by Arzápalo (1987).

The Harvard Chiapas Project, organized by Evon Vogt, led directly or indirectly to a great deal of research on all matters ecological. In particular, it stimulated the work of Brent Berlin, who has become a leading authority on Maya ethnobotany (Berlin 1992 reviews most of the relevant literature). The Chiapas Project is largely outside the scope of this chapter, but Berlin’s long shadow is still felt. Not only did he set the pattern for a great deal of ethnobiological research in Mayaland, but I am a Berlin student. (I also took courses with Vogt.) Berlin’s botanist collaborator, Dennis Breedlove, went on to work with Robert Laughlin on the greatest Maya ethnobotany to date, a study of the Tzotzil of Zinacantan (Breedlove and Laughlin 1993).

Finally, a third great project was organized by Arturo Gómez-Pompa (see e.g., Gómez-Pompa, Flores, and Sosa 1987). This project stemmed originally from work by Mexican botanists and anthropologists, notably E. Hernandez Xolocotzi (1985), Alfredo Barrera Vásquez, Alfredo Barrera Marín, and Rosa Maria López Franco (Barrera, Barrera, and López 1976; see also texts usefully collected by Vázquez 1981). Their work was crystallized in the research done at INIREB-Mérida in the 1980s, and later in collaborative work by the University of California at Riverside (UCR) and the Universidad Autónoma de Yucatán. This led to my own Maya work. Much of this research was published by INIREB (notably Mendieta and del Amo 1981), and by INIREB and later UADY in the series “Etnoflora Yucatanense”; particularly long and detailed works in this series include Sosa et al. (1985), Sanabria (1986), and Herrera (1994). Other UADY publications include Sosa and Salvador (1993).

Recently, a large number of Mexican governmental and nongovernmental agencies have organized and published research on Yucatec ethnobotany. Among a number of organizations and publications, notable is work of ECOSUR (e.g., Pulido and Serralta 1993) and of Silvia Terán and Christian Rasmussen (1994; Terán, Rasmussen, and Cauich 1998). Many other works on Maya culture or agriculture touch on ethnobiological knowledge to varying degrees. A recent valuable contribution is Anne Bradburn’s list (1998), which is appended to Victoria Bricker’s dictionary of

Yucatec. Medical botany has been examined (Ankli, Sticher, and Heinrich 1999).

Moreover, the neighboring Itzaj Maya, speaking a dialect of Yucatec, have been studied extensively by Scott Atran (1993, 1999a, 1999b) and a dictionary compiled by Charles Andrew Hofling and F. Tesucún (1997). This material deserves extensive discussion; see Atran's paper in this book. "Anthropogenic Vegetation: A Garden Experiment in the Maya Lowlands."

Finally, relevant to all these concerns are the recent editions of colonial dictionaries (Acuña 1993; Andrews Heath 1980; Arzápalo 1996) and synthetic works drawing on them (Álvarez 1997; *Diccionario Maya Cordemex* 1980).

### CHUNHUHUB: USES FOR PLANTS

As the material found in the publications referenced above is far too extensive to be examined here, the analysis will be confined to the research conducted in and around Chunchuhub, Quintana Roo, Mexico.

As with many Maya towns, Chunchuhub has an ethnobiological name: which means: "Trunk of the wild plum tree." Wild plums (*Spondias purpurea*), still abound in the community. Thus, the name remains as appropriate as ever, although it goes back to pre-Hispanic times. It may even be the Classic Maya name of the site, which has been almost continuously inhabited since at least early Classic times—although there was a long break between the War of the Castes and resettlement by ex-"rebel Maya" in the 1940s.

In spite of encroachment by pan Bimbo, white sugar, and refrescos, Chunchuhub still depends on its own home-grown maize. Among the more traditional cultivators, maize still makes up about 75 percent of the diet, as it has among the Maya for countless centuries (White 1999). Until the very recent rise to eminence of white flour and white sugar, there was no "second most important" plant. Beans (mainly *Phaseolus vulgaris*, of the general type informally called "black turtle") and chiles (*Capsicum annuum* and *C. frutescens*, as well as the habanero, which is probably *C. chinense*) are daily fare. Sweet potatoes are the major famine food. Oranges, mangoes, papayas, squash (several species), and tomatoes grace the table very frequently. Less common, but important, are white potatoes, mameys (*Pouteria mammosa*), chicosapotes (*Achras sapota*), cabbage, cilantro, and various other plants. Achioté (*Bixa orellana*), a pre-Columbian plant of ritual significance, remains the commonest condiment after chile. Important is the abal (*Spondias* spp.), whose fruit, when dried, has a special name, k'ul (*Diccionario Maya Cordemex* 1980, 421). This name is sometimes generalized to other dried (and

often powdered) fruit, including mamey and chicosapote as well as abal, which was stored in the old days in case of shortages.

In all, in this study 122 locally grown plants used for food were recorded. Some of these are grown only for fun; for instance, people grow sugar and sometimes white potatoes, but most such foods are imported. (Another 17 species are brought in from outside; of these, only wheat is important. The rest are minor condiments.) The Maya love to try anything and everything, and individuals have experimented with such unlikely plants as grapes and apples. One man proudly showed me his grapevine; it bore no fruit in the tropical climate, but it was a lovely plant to look at and enabled everyone in the neighborhood to know what a real grapevine looked like.

By far the most diverse set of plants are the medicinals. In this study, 330 plants used medicinally were recorded (many have not been identified to date), and this number may be only a small fraction of the whole. Traditional curers (*jmeen*) seem able to find uses for every plant and often have discovered new ways of utilizing bark, leaves, and roots. As in most studied cases, a high percentage of these plants are dooryard herbs and weeds. Some are grown deliberately; every extensive garden includes rue (*Ruta chalepensis*), mint (*Mentha* spp.), aloe vera (*Aloe* sp.), and epazote (*Chenopodium ambrosioides*). Others are used simply because they are easily available.

On the other hand, the most highly regarded medicinals are largely deep-forest plants: elemuy (*Malmea depressa*, a diuretic and thus believed to be a kidney medicine), wako ak' (*Aristolochia maxima*, a stomach medicine and general tonic), tankas che' (*Esenbeckia pentaphylla*, used for paralysis and the like), among others. Of these high-powered anodynes, only kambajau (*Dorstenia contrayerva*, an antidote) is a milpa weed.

Another 168 plants are used as ornamentals. Most are introduced, but many are native. Presumably the ancient Maya had their flower gardens, as flowers are prominent in their art. Some spectacular flowering trees, such as hok'ab (*Tabebuia rosea*), have spread from Mesoamerica to gardens around the world.

Logging is important, and 41 species are cut for sale. Sixty-two species are harvested for local timber use.

Minor uses may also be significant. Fourteen species are used for fiber and bast. All woody plants can be used for firewood; some thirteen species are sought out in particular, having superior burning qualities. Plants provide animal forage, wildlife food, basketry materials, nectar and pollen, tannin for hides, soil quality indicators, dyes, drugs, toys, soap, disinfectant, and ritual and symbolic values. Wild grapevines (*Vitis bourgaeana*) provide lifesaving water in the dry forest. There is even a plant whose sticky leaves are used to trap fleas.

So far, I have recorded 826 plant names, of which 460 have scientific identifications. Further research is continuing.

The Maya also recognize different sorts of vegetation, soil, and landscape. They are aware, for instance, of succession stages. In Chunchuhub, a regrowing milpa is first sak'al (weedy), then hubche' (young brush and trees), and finally kaanal k'aax (high forest)—at which time it is ready to cut again. Vegetation-landscape types include ak'alche' (low-lying damp areas) and other specialized formations. Soil terminology is complex and largely based on soil color (see Terán and Rasmussen 1994).

The Maya also find useful the Spanish custom of coining a plant community term by adding the suffix *-al* to the name of the commonest tree. Thus, tinal is used for forests of tinto (*Haematoxylon campechianum*, eek' in Maya), zacatal for tall grasslands, and so on. Modern Maya plant terminology has been enriched in many ways by Spanish influences, just as Yucatán Spanish has been enriched by countless borrowings from the Maya.

### PLANT CLASSIFICATION

Yucatec Maya plant classification well exemplifies Berlin's general comments on ethnobiological nomenclature (Berlin 1992); this is not surprising because Berlin has worked largely with Mayan languages.

The concept of "plant" is expressed by the classifier *kul* (derived from *kul* "tree-trunk," but used to count any type of plant). Relevant also is the term *k'aax* "forest, wild vegetation." Within the plant category are life-form classes: *che'* "tree," *ak'* "vine, liana"; *xiiw* "herb"<sup>2</sup>; *su'uk* "grass"; and *k'uxun* "fungi," which are dubiously plants. Recently, this set has been enriched by borrowings from Spanish, now thoroughly Mayanized: *arbusto* "shrub" and *zacate* "large grass." (At least in Chunchuhub, large introduced grasses are truly seen as a separate life-form, not *su'uk*. *Zacate* is a Nahuatl word, assimilated into Maya via Spanish.) A large number of plants, including bromeliads (*ch'am*), reeds and reedlike plants (*halal*), cacti (each species or genus with its own name), sedges, and several other groups, fall very uncomfortably into these life-form classes, and are considered separate little worlds unto themselves. (This is a phenomenon widely reported for Mexican indigenous languages, as well as for other languages, including English, in which "reeds" and "cacti" are outside the normal life-form classes.)

Cross-cutting the life-form category, and conceptually separate from it, is the basic taxonomy. This, like other Native American taxonomies, is notably rich in generics and poor in higher-order and lower-order terms. Almost every

plant, or class of plants, has its own name—either monolexemic (elemuy, kambajau) or combined with a life-form term (*wako ak'*, *kaanser xiiw*).

Higher-order categories that would seem “obvious” to an Indo-European speaker, such as “squash” and “beans,” are not at all obvious concepts to the Maya. They see each squash species as a very separate and distinctive thing, and lumping beans under one term seems inconceivable to them because each species is so different! In some cases, Spanish has provided useful higher-order categories where none exists in Maya; all squashes, for example, are now lumped as calabazas in ordinary conversation. In fact, Yucatán Spanish has assimilated some Maya names. This is not due to a failure to see general similarities, but rather to a profound knowledge of the unique qualities of each species. In Spain, I learned that the Spanish language (as in Yucatán) separates each leguminous species.

Lower-order breakdowns do exist. Some folk generics are broken down into rather vague folk specifics. Thus, generally darker-looking acacias are box katsin “black acacia,” while generally paler-looking ones are sak katsin “white acacias.” Elemuy comes in three colors, black (box—the common form), white (sak) and red (chak); as far as I can tell, they are all just slightly different-looking individuals of *Malmea depressa*, but more research is needed here. Most other folk specifics are color terms too. Oranges, however, are either suuts' pak'al (“sour orange,” *Citrus aurantium*) or ch'ujuk pak'al (“sweet orange,” *C. sinensis*).

Major domestic plants have varieties, such as the common maize variety known as nalt'eel, “rooster maize.” (This term has been widely assimilated into English, interestingly, as “Nal-Tel.”) Lima beans (iib) have some delightfully named varieties: “tinamou egg” for one that is shiny and brown like a tinamou's egg, and “peccary's eyelashes” for one whose vivid stripes remind people of the long, thick vibrissae above the eyes of the peccary.

Life-form categories cross-cut, rather than include, these generics and specifics. Plants that can take either herb or tree form, such as cotton and pigeon peas, are well known. Still other cross-cutting distinctions exist, such as the distinctions between wild and tame plants, between domestic and weedy varieties of the same plant, and between tuberous plants (wiij “swollen root,” makal “tuber/corm”) and nontuberous relatives. (Makal is, however, also a specific term for *Xanthosoma yucatanense*, and ak'ij makal “vining makal” is a Colonial coinage for *Dioscorea* spp.) Hofling and Tesucún (1997) combine all these categories into one system, as if they were divisions within one taxonomy.

For the Yucatec, it is also clear that some plants are closely related to each other although they may be called by very different names. This can be deduced from the use of assimilated Spanish terms as folk familiars, as in the case of squash, or palms (Sp. *palmas* has no Maya equivalent). It can also be

deduced from routine generalization of native Maya names to cover entire categories. Bignoniaceous vines are routinely lumped (usually as sak ak' "pale vines" or the like), for instance, although several species actually have their own names.

One should be extremely conservative about inferring any perceived relationships beyond what is clear from the above usages. In fact, even a generalization of name is no proof of any relationship. Names such as k'an lool "yellow flower" or chak lool "red flower" are used too widely and vaguely to imply anything beyond the obvious. (K'an lool specifically means *Senna* spp., or similar plants, but is just as often used to mean literally any flower that is yellow. There is not even the juncture difference used in English to separate "black bird" from "blackbird.") Superficially similar plants can easily be confused by a careless speaker. Perceived relationships, beyond such unmistakable cases as squash and Bignoniaceous vines, are a very idiosyncratic thing—psychologically interesting, but not part of encoded Maya traditional knowledge.

### MANAGING PLANTS

The Quintana Roo Maya are superb plant managers. They have an enormous and highly self-conscious knowledge of how to use plants, as well as how to use the environment to maximize the production of plants they use. When traveling in fields or forests, they are constantly performing small tasks, from clearing trails to repairing damaged wildlife habitats. The whole forest is constantly being influenced by thousands upon thousands of these tiny, almost subconscious acts. Even a brief catalogue of common management techniques would be far too long for this chapter. Though a few highlights will be mentioned.

In field agriculture, the Maya are expert at combination planting. The combination of maize (corn), beans, and squash has many advantages: maize serves as support for the beans and as shade and protection, beans fix nitrogen, and squash suppresses weeds and insects. The Maya know which species and varieties to combine to maximize these benefits, and which combinations do better on specific soil types.

When they cut forest for fields, they eliminate useless plants; they coppice trees that grow back fast and provide values such as holding the soil; and they carefully protect the most highly useful trees, such as thatch palms, wild fruit trees, and bee trees.

When Maya find a sapling of a useful tree species in the forest, they often cut a little firebreak around it. They are careful not to damage useful wild plants. When harvesting medicinal plants, they never take a whole stand; they leave some to reproduce and restore the stand. In fact, the whole Quintana Roo forest is managed like a farm. In a sense, it *is* a farm, because

every part of it has been repeatedly cut, burned, and shaped by selective management. It is no accident, for example, that 15 percent of the tree cover in mature forests around Chunchuhub is provided by chicozapote (*Achras sapota*=*Manilkara sapota*; this figure was kindly provided to me by the Plan Forestal office in Chetumal, and confirms my own observations). This tree provides fruit that is not only valuable for humans, but is also a staple food of game animals; a superior timber; and chicle, which is a commercial product. For thousands of years, Maya have been protecting these trees, which have come to dominate many forest areas.

Recently, reforestation with cedro (*Cedrela odorata*) and mahogany (*Swietenia macrophylla*) has become common. Also, the Plan Forestal, a government forestry plan, has worked successfully with several communities in Quintana Roo (Flachsenberg and Galletti 1998; Galletti 1998; Primack et al. 1998). The Plan Forestal uses traditional Maya management skills as well as modern forestry science. The results are much more successful than most tropical forest management schemes, and indeed the Plan Forestal has become something of a model. Traditional Maya plant management is thus, potentially, of world importance.

Maya forest management is maintained partly because of supernatural sanctions. The Lords of the Forest (yuumijk'aax or yuntsijloob) punish people who use the forest in a wasteful, inconsiderate manner. A man hit by a falling branch or tree, for instance, is often assumed to have done something that angered the yuumijk'aax, and stories of his thoughtless behavior are recollected to support this belief. The elves (alux, pl. aluxoob) are often put in charge of guarding a section of forest; both supernatural beings and humans can get them to do the work. The aluxoob scare away intruders by making a dreadful racket. These are part of a wider pattern of direct supernatural sanctioning of moral principles.

### CONCLUSION

Recently, anthropologists have taken a thoughtful second look at traditional ecological knowledge. Particularly interesting has been a long dialogue between the Athapaskan peoples of Canada and a number of anthropologists (Cruikshank 2000; Goulet 1998; Ridington 1988; Sharp 1987; Smith 1998; see also Turner, Boelscher, and Ignace 2000 for a brief but model account of a neighboring group). The Athapaskans are among the few peoples who actually lived—and often still survive—largely by hunting large animals. Their knowledge system is very different from bioscience, but is consistent, well described for us, and above all brilliantly successful at keeping them alive in an incredibly harsh environment.

Scholars of Athapaskan knowledge are thus confronted with a system maximally different from their own, but clearly and formidably successful.

They naturally have become interested in contrasting the two, and understanding the Athapaskan “ways of knowing” (Goulet 1998).

Athapaskan knowledge is highly local, and is typically communicated either nonverbally (Goulet 1998) or through specific personal stories that have wide implications (Cruikshank 2000). Declarative, analytic, verbal explanation is seen as foreign and unsettling. They also attend to dreams, visions, subconscious perceptions, and indeed to the whole range of mental acts and processes. This is clearly related to their hunting activities (see Smith 1998). A hunter must attend to all possible cues, and integrate them at an intuitive or preconscious level; it is just not possible for the conscious mind to attend to all the cues that the “bush” presents. A hunter may dream that a moose is in a particular place, then actually go there and find it (Ridington 1988; Smith 1998). The dream serves to integrate the cues that the hunter has perceived while awake in the bush.

The Athapaskans prefer to teach by example. The young and naïve are expected to accompany their elders and to learn by watching and imitating. Later, tales and personal stories are used to convey more abstract messages.

Not surprisingly, the Maya also attend constantly to consciously and subconsciously perceived cues, and often understand nature through dreams and visions—although they do not (usually) dream the locations of game animals. The Maya, however, are more self-consciously pragmatic, systematic, and verification-oriented than the Athapaskans. They provide a useful intermediate case between Athapaskan and modern scientific “ways of knowing.”

It seems quite natural to me that people learn by observation, experience, story, and subconscious monitoring of the environment. How else, really, does one find animals in the field? Any veteran hunter or field naturalist experiences the field as a rich, complex, textured environment—far too complex to be monitored on the conscious level alone. Every field naturalist has his or her stories and personal experiences, and tends to remember knowledge in such concrete terms. Knowledge has its places, situations, and persons. Only in the classroom is it generalized and decontextualized.

Thus, there is a contrast between detached urban-academic ways and rural, contexted, experiential ways.

The Yucatec Maya are much more verbal than the Athapaskans and, indeed, love to explain things such as plant uses at enormous length. However, they also partake of the same rich ways of knowing as the Athapaskans. They, too, make their points by telling stories about specific events and places. They, too, prefer to teach and learn by example and observation than by verbal report. They, too, expect the aspiring student to come along in the field. Working with them has involved thousands of hours in the field, as well as much food preparation, medicinal plant selection and

use, and the like. I have spent hundreds of hours on remote forest trails and in isolated milpas. Without constant observation of how the Maya actually interact with plants in the field, the student cannot learn the details of Maya plant knowledge.

Some of the writers, notably Goulet (1998), have been led to see all knowledge as arbitrary. For them, knowledge is culturally defined and systematized. Each culture is a closed world, with its own ways of knowing. Thus, knowledge itself is not knowledge of some objective or external reality, but merely cultural lore. Goulet frequently reiterates that his friend's

accounts are immune to the arguments that might be made against them by an outsider to the interpretive community in which they are held to be true. In other words, in any interpretive community, reality is self-validating in that all aspects of it are mutually constitutive and, further, in that it reflexively preserves itself by stipulating in advance what is allowable as evidence" (Goulet 1998, 257–258).

Goulet makes it clear (here and in many other passages) that he does not believe in an objective reality or science; each culture has its system, self-validating and apparently self-created. Feedback from the outside world is irrelevant. Goulet believes this in part because the Dene Tha (the Athapaskan group with whom he lived) understand their world through dreams, visions, and prophecies as well as through direct interactive experience.

Smith has been led to exactly the opposite conclusion (Smith 1998). Experience with the Maya (and with many other traditional and nontraditional groups) shows that they have a superb grasp of objective reality, based on countless years of interacting with it. They use dreams and visions, as well as interaction and systematic learning, because dreams and visions work. They do not always provide accurate information, but neither does ordinary observation and interaction. Dreams and visions are often accurate when they integrate subconscious cues and long-buried, half-forgotten knowledge. Inaccuracies from visionary experiences are a small price to pay for the values of an intuitive system in a forest environment.

Goulet confuses factual knowledge with inferred explanations, meanings, and significances. Factual knowledge is verifiable and experiential—at least potentially—for the Athapaskans, the Maya, or anyone else. Thus, mint either helps stomach ache, or it does not. Inferred explanations are different in that they are typically hypothetical, in both Athapaskan and bioscientific circles. They are more or less indeterminate until overwhelming proofs are adduced. Meaning and significance, as well as religious belief, are in still a different cell; they are, typically, outside the realm of evidential proof altogether. If a moose is regarded as a sign from God, or seen as a visionary reminder of a

dead relative, no one can really prove or disprove that vision. The significance is an existential internal fact for the perceiver. (This is not to say that one cannot study visions scientifically—but that is a quite different question.)

Goulet usefully critiques interpretive anthropology for its indifference to direct experience. I agree, but I would add that Goulet's own theory is, basically, an interpretive theory, and thus subject to the same criticism. Goulet's own experiences, as recounted in his book, clearly play against his theory.

Goulet, like many anthropologists, sees knowledge as socially constructed, *and therefore arbitrary*. This is both a factual and a logical error. Of course, knowledge is socially constructed because it arises through human interaction. But humans interact with each other and with their environment, and thus are forced to learn—to make their knowledge ever more extensive and accurate. People cannot persist in the belief that strychnine is good food, nor socially construct such a belief as “knowledge.” Usually, the more socially constructed knowledge is, the more accurate it is. The obvious exceptions—racism, for instance—are clearly driven by perverse psychological mechanisms (Beck 1999). Anthropologists frequently assume that “socially constructed” means “irrational,” or even “wrong,” because they are used to dealing with religious, symbolic, and other nonscientific systems. Goulet looks at theories, and also at methods of teaching (stories vs. analytic lectures), and says knowledge systems (including “science”) are constructed out of whole cloth. I look at the actual data, and say that these systems are constructed, but on a basis of empirical truths—however many mistakes traditional people (and scientists) may make, due to limitations in the observations they can perform with the equipment at hand.

This matter is considered at some length because many anthropologists make similar mistakes, to the considerable cost not only of anthropology but also of the indigenous people in question—whose knowledge is, once again, peripheralized and trivialized. Traditional knowledge is *not* a mass of confused magical beliefs. It is a body of hard-headed empirical wisdom, integrated and held together by higher-order representations. These latter are often wrong and more often unprovable, and they may also lead to logical extensions that are incorrect. However, they are better seen as organizing heuristics than as defining theories. They play the same useful but often misleading role that paradigms play in western science (Anderson 1996).

The Maya are superb natural historians and folk scientists, and they are the better for their use of *all* methods of perceiving and integrating data. It is the academic biologist that is deprived—perhaps necessarily so, given the biologist's mission to verify every datum experimentally, but deprived nonetheless. Conversely, the Maya are deprived of the vast scholarly literature

available to the academic. Of course, most of the plant knowledge of both Maya and academic botanists comes from direct work with plants.

This is not to say the Maya are always right. I believe their knowledge of food, forage, timber, and craft plants is entirely accurate (except for a few details of medical belief about foods). Their plant cover management skills are consummate. Their medical knowledge is more controversial. Most of the medicinal herbs that I have tried actually work—some much better than drug-store remedies. However, many Maya herbal remedies seem to have few or no detectable pharmacological effects. Maya belief in their efficaciousness may be due to confusion, mistaken logic, wishful thinking, or simply to someone's use of an herb just before recovering naturally from a disease.

Finally, Maya knowledge of spirit beings in the forest seems to be based wholly on tradition and imagination rather than on believable evidence. But does this distinguish the Maya from the academic biologist? Academic biologists also believe in higher-order beings that do not verifiably exist: harmonious ecosystems, climax plant communities, group selection, etc. Academic economists also believe in the "invisible hand of the free market." The tendency of humans to see higher-order entities out there, controlling life, is irresistible.

Note that—contrary to Goulet's claim—both the Maya and outside visitors *can* evaluate the truth-value of many of these claims. For example, medicines can be tested in double-blind experiments. Other claims, however, are untestable. The Lords of the Forest, if they exist, are subtle beings, like other gods. They must remain matters of belief. The same is true of the virtues of the Free Market because a perfectly free market is inconceivable in the real world; thus, we will never observe how one would function.

In other words, beliefs may be true, false, or indeterminate. They may also be still under judgment, which means they are at present indeterminate but will not be so if they are examined; thus, many of the medicinal plants the Maya use are still not adequately tested by either Maya or biomedical curers, and are thus "hypothetical" as far as medical value is concerned (see Ankli, Sticher, and Heinrich 1999). In all these ways, Maya folk science is indeed a science, equivalent to academic biology in basic structure although not in sheer ability to generate factual knowledge quickly.

The Maya are constantly testing their views against experience. Mistaken beliefs do not usually last—if they are testable. New ideas are tested, and adopted if they are useful. Inherently untestable beliefs, such as religious beliefs, may persist indefinitely. In short, Maya traditional knowledge is scientific, in that it is based on systematic interaction with the world, and systematic testing of claims. It is not fully scientific, because it incorporates many beliefs that are called supernatural and that are not fully testable<sup>3</sup>. But neither is contemporary bioscience, for it too—in spite of its vast mass of

accurate knowledge and predictively-validated theory—depends to some extent on assumptions.

The idea that traditional cultural views are closed, self-maintaining systems is not confined to Goulet; it is common to many (perhaps most) anthropologists. Yet it is clearly wrong. Maya have incorporated not only Spanish plants, but also Spanish concepts, insofar as they find these useful. Of course, through the Spanish, they assimilated plants from all over the world. They are now assimilating words more widely too, as globalization brings English and other languages to their doors. Concepts also spread. In pre-Columbian times, the Maya incorporated concepts from central and east Mexican indigenous peoples. Today, they incorporate ideas about integrated pest management and sustainable development into Maya garden plots, thanks to such influences as the local agricultural college.

Similarly, the world is better for borrowing cacao (*Theobroma cacao*) and other plants from the Maya. The world would be still better off for borrowing plants such as chaya (*Cnidocolus chayamansa*; see Ross-Ibarra and Molina 2000) and mamey sapote (*Calocarpum mammosum*)—and also for assimilating concepts such as the Maya's active management of milpa regrowth. Views similar to those of Goulet ghettoize traditional knowledge, turning it into a mere curiosity.

There are also those who ghettoize traditional knowledge in the opposite way, by restricting the term “science” to modern western academic inquiry. Wolpert (1992), for instance, denies the name “science” not only to indigenous traditions but even to traditional Chinese inquiries into nature, although the latter were consciously experimental and theory-based. Inconsistently, Wolpert also calls the ancient Greek natural philosophers “scientists,” although their views resemble Chinese cosmologies more than modern scientists' views.

One could argue that the Maya do not have laboratories, or refereed journals, or case/control experiments, and thus cannot be said to possess truly systematic, accurate knowledge. This is clearly wrong; the Maya know the forest very well indeed—far better than any academic biologist. One could argue that the Maya live in a world of religion, magic, and dream, and thus cannot have accurate knowledge. This too is false; believing in the Lords of the Forest does not preclude knowing exactly when the sapotes will fruit, or what part of the elemuy tree is diuretic, or how to intercrop milpa. In fact, belief provides the moral and social grounding within which factual knowledge can be systematized and taught<sup>4</sup>.

The stakes in this seemingly arid debate are high. Insofar as all knowledge is merely an arbitrary social game, or insofar as all worthwhile knowledge is derived from laboratory science, Maya knowledge of the environment can be and should be ignored and rejected. Insofar as science is a

human endeavor in which indigenous forest-dwellers can generate useful knowledge and interesting theory, we cannot ignore Maya knowledge. For thousands of years, the Maya have been the only successful managers of the Yucatán Peninsula's fragile environment. Their knowledge has grown and evolved in the face of millennia of experience. We need to learn from them, and they have much to teach. To do this, we have to be properly respectful of the Maya and their wisdom.

In fact, more should be done. We have to be properly respectful of humanity. Our species has been wasteful and destructive, but has somehow kept the search for truth alive, and has used hard-won truths in successful management of harsh environments. We also have to be properly respectful of the other lives on this planet. That is perhaps the most important thing we can learn from the Maya.

## NOTES

1. The name “Yucatec” is one of those words that delight a philologist. The people in question call themselves *maayaj*, source of the word “Maya” that now is generalized to all linguistic relatives. “Yucatán” was the name the Spanish applied to the peninsula when they first saw it. Stopping a canoe, they asked the startled paddlers about the name of the land now visible on the horizon. Evidently there was stunned silence, broken by some helpful soul who volunteered “He didn't understand what you said” (*ma' u yu'u'b' ka t'aan i*—or, as one Colonial Maya writer glossed it, *matan cub a than*, which would be *ma' t'aan ku yu'u'b' a t'aan i* in modern writing; Restall 1998, 122). The Spanish duly noted the accented syllables. Later, to compound confusion, they invented the word “Yucatec” by inflecting the name as if it were Nahuatl (-*tan* “place” being replaced by -*tek*- “person [of]”).

*Note:* This paper uses the new standardized transcription system for Maya; however, the sources quoted normally use the old Spanish Colonial system. For example, Roys' *huhub* is *jujub* in the new system.

2. *Xiiw* is a Nahuatl borrowing (from *xiuitl*—probably via Spanish), but *Itzaj* has a native Maya word, *teek*, covering the same semantic space; *Itzaj* uses *xiiw* for certain medicinal herbs only (see Hofling and Tesucún 1997). I assume Yucatec once used *teek*, which is a term amusingly close to *TEK*.

3. On the other hand, individuals do report actually encountering the *yuumijk'aax* and other such entities. The outsider may cynically note that these encounters typically follow on the consumption of large amounts of *chakpool* (raw rum), but the Maya are not easily persuaded of the relevance of this fact. Witchcraft, too, can be validated by experience, as when my field assistant watched a curer taking a live scorpion out of the body of a girl. Having had the opportunity to observe the sleight-of-hand skills of the healer in question, I suspect there is no real proof of witchcraft in the observation. The point here, however, is that observation *does* give some support to traditional beliefs—*within the limits set by the testing situation*. The Maya do not have the luxury of million-dollar labs and case-control studies of thousands of volunteers. To this extent, Goulet is correct.

4. This is probably true everywhere, but especially in the western world. Would biology have developed without pre-Darwinian theories of change and organization? Would ecology have developed as it did without the Clementsian belief system?

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