Migration and Immigration.
Safety Issues When Gathering Wild Plants.

Once there was a time in the evolutionary history of humans, prior to the domestication of plants and animals, when all humans were hunter-gatherers. Members of each hunting band – usually not more than 30-35 persons per band – learned to recognize what was safe to eat in their respective band territories, otherwise they would not have survived. In the 1970s several colleagues argued that since the vast majority of all plants in all ecological niches are toxic in one or more ways to humans, then it had to be that before the discovery of how to make and maintain fire, the dietary patterns of these earliest ancient human populations focused upon meat. It was the invention of fire, specifically the ability to make and to maintain fire, so argued Leopold and Ardrey,that ultimately led to cooking practices that allowed toxic, secondary compounds in wild plants to be reduced or neutralized. The earliest confirmed human use of fire – in association with a hearth – stems from approximately 500,000 BP. Leopold and Ardrey argued that the invention of how to make and maintain fire was the most important link in a long evolutionary process that ultimately led to 21st century humans.

Toxic factors contained in plants that could be reduced or eliminated through cooking include: enzyme inhibitors (for example favism substances in legumes; cyanogens; alkaloids); physiological irritants (more than 80 plant families possess the property of forming foam in the human gut, a process that retards nutrient absorption and bioavailability); hemoglutins in legumes (factors that disrupt red blood cell function); lathyrogens in legumes (factors that disrupt collagen structure and produce lower-limb paralysis in humans); oxalate crystals (present in beet and rhubarb families); allergens (thousands of plants produce allergic reactions that range from inconsequential to lethal); still other plants alter human hormonal functions (for example estrogen in yams; goiter-producing substances in beets, cabbage, and legumes); and numerous wild plants also contain various vitamin antagonists.

Cooking does three things: denatures proteins that cause allergies; accelerates oxidation reactions; and dilutes toxins if the foods are cooked in fluids. Leopold and Ardry proposed that the invention of how to make and maintain fire opened an enormous quantity of safe foods for humans to utilize, whereupon human food supply stabilized and population increased.

Although attractive, their thesis can be opposed on two lines of evidence: First, dentition associated with the genus *Homo* is not that of a meat-eating carnivore, but reflects the evolutionary dentition pattern of an omnivore. Second, their thesis does not resolve the basic problem of how humans came to identify and understand which wild plants offered potential safety with consumption, and which were toxic and sometimes lethal. How is it that humans learn what is safe and not safe to eat? Who become the first tasters, the so-called filters, through which foods were evaluated by societies as safe or unfit to eat? How was it that before fire, the earliest humanoids first learned what was safe to eat in their environmental niches?

Once safe species were identified in any given ecological niche, one may speculate that poisonings from incautious consumption of wild plants would decline significantly with the

exception of poisonings seen in incautious infants and children who foraged outside the management of their respective care-givers. Still, even when this knowledge was developed and integrated into band and tribal lore, such knowledge would apply only to specific niches, not adjacent territories, where hunter-gatherers were unfamiliar with available species. What, then, about potential risks to immigrant or migrant populations?

Since earliest times human populations have not remained static in spatial distribution. Consider the peopling of the Americas when bands of hunters entered North, Central, and South America from Asia and elsewhere, and where human populations ultimately reached the southern portions of what is now Argentina – a distance of more than 10,000 miles. Geographers and ethnobotanists recognize that the great soil/vegetation zones on earth primarily extend east-west. As members of these invading hunting bands moved southward across and through the different vegetation zones and ecological niches – how did they solve the "toxic plant problem" during their migrations? How did they learn what was safe to gather, and what was toxic?

Social groups who migrated from one ecological niche to another in antiquity – and those who have immigrated to other lands today in the 20th and 21st centuries – commonly place themselves at risk when they collect plants for culinary purposes. We may speculate and theorize that four primary mechanisms have been used since remote antiquity to reduce human risk from incautious gathering of toxic plants: 1) observing what animals eat; 2) use of animal or human tasters; 3) abstention, or reaching the decision not to gather plants in new ecological niches, and 4) cultural traditions such as bride-service/training.

Humans watching and observing what animals ate appears logical at first glance, but would be effective only if the animals observed were similar in human physiology and digestive processes. Watching what herbivores ate, for example antelope or mastodons, would not readily help early humans solve the toxic plant problem. Watching what non-human primates ate could provide clues – but non-human primates are not distributed universally within all latitudes and continents. Mimicking what non-mammals ate also carries risk: many species of birds consume berries, nuts, and seeds high in cyanide and other compounds potentially lethal to humans – at little to risk themselves and others of their species.

Use of animal or human "tasters" would be a logical approach to solving the potential toxic plant problem. Regarding animal tasters, this approach would be linked to the concept just identified, and is not without risk. Still, certain animals could be "filters" through which different categories of plants might be identified as relatively safe for humans. And for this conjecture, there are supporting data.

Domesticated dogs were some of the earliest companion animals associated with humans, an association that perhaps dates to 50,000 years BCE. Domesticated dogs could have been fed unfamiliar, unusual fruits, nuts, roots, seeds by their human masters, who then – in turn – could have paused and observed the food's effect on canine physiology (i.e. smiles and tail-wags vs. vomiting and/or death).

The Gwembe Thonga of Zimbabwi, a south-central African society, have used this technique in modern times. Young Thonga boys train together and doing so learn local edible wild plants in the bushlands that surround their settlements. Before embarking upon these training exercises, elders provide the boys with a dog, whereupon the boys and the dog embark upon a bush-food training exercise. When the boys want to try a new, potentially edible berry or fruit, bulb or tuber – an item that represents a degree of safety uncertainty – the boys collect specimens, feed the dog, then wait and observe the results. If the dog-feeding "experiment" produces no ill-effects after a prescribed length of waiting, the boys then taste the food themselves. In this way the boys learn together about the safety of various veldt plants, information that then can be passed on to other children.

The use of human tasters as a buffer against accidental or criminal poisoning from food has been documented throughout history. Use of tasters usually has been described relative to protecting royals, nobles, or ancient "godfathers" who were insecure, worried about assassination, and concerned with their own safety. Commonly, captives from neighboring bands or "social enemies" tasted food in advance of serving, and those fearful of their food supply watched the result – a basic zero sum game. But not all such human tasters were captives or "social enemies." There is a rather interesting account from the Mediterranean island of Kea, where in antiquity, elderly women were used as tasters because they were beyond child-bearing years and their deaths were perceived as of little consequence to younger adults in this society.

Abstention and the decision not to consume wild plants in new, unfamiliar ecological niches, would not have been a viable mechanism in remote antiquity, given the hunting-gathering economies of early humans. No society, to my knowledge, has been exclusively meat-eating, and all have used plants to one degree or another. Abstention, however, could be a decision in recent centuries where immigrants who chose to abandon use of "edible wild plants" would be protected.

Their remains a fourth mechanism, a cultural practice commonly called bride-price service. The potential problem of human poisoning by miss-identification of wild plants has been observed when hunting-gathering bands have been studied. Hunting-gathering bands, without exception, are exogamous and exhibit patrilocal residence when it comes to marriage. Exogamous, of course, means that marriages must take place between individuals of two different, distinct bands, whereas patrilocal means that brides leave their families band territory to reside with their husband's band. It is this exogamous/patrilocal pattern of hunter-gatherers that has attracted those of us interested in the evolution and development of human intake patterns.

The problem is obvious: two hunting-gathering bands – A and B – are contiguous, but their respective territories extend across different ecological niches. Through long and involved personal experimentation, observation, and trial-and-error, adult members of each band previously have learned to identify what is safe to eat within their specific ecological-cultural niches. Males within the hunting-gathering band primarily serve as hunters, while females primarily serve as gatherers of plant-based food resources. Marriage, however, requires taking females – who are primarily responsible for plant food gathering – from OUTSIDE the band. So when males from band A marry females from band B, C, or D and bring them back to band territory A, the problem and potential danger immediately becomes apparent.

How is this problem solved? There are several solutions that would reduce the risk of potential accidental poisoning from wild plants given the band exogamy/patrilocal pattern of hunter-gatherers.

One solution would be for married males to leave their own band and take up residence with their wife's group. This solution would be superior for the wife's band, since a young, able hunter would be added to the population. This same solution, however, would be deleterious for the husband's own patrilineal band – since they would lose able hunters, the band would become gentrified and experience gradual loss of able-bodied hunters, with the ultimate result being the demise of the band. This potential solution, therefore, may be rejected.

A second solution could focus upon new brides, who leave their band to live with their husbands and extended families. Such brides could be forbidden to gather or collect plant food since they posed an unacceptable dietary/health risks. Such a solution would solve the risk for accidental poisoning through incautious plant collecting. In the long term, however, it would be deleterious to the husband's band, since the logical extension of this approach would result in a band where none of the adult women gathered. This solution, too, also may be rejected.

A third solution, however, is realistic and practical. New brides would be required to undergo what commonly is called "bride-service." They enter this category of status for specific periods of time, and are forbidden/enjoined from gathering until trained to identify which local wild plants are safe to gather and eat. It works basically this way: new brides are seconded to elderly women/female in-laws, whereupon these women teach them how to identify and recognize subtle differences in morphology between safe and unsafe specimens so risk from poisoning is reduced.

Such theoretical issues related to solving potential poisoning from wild plants have direct application to immigrant populations today in the 20th and 21st centuries. Migration and safety when identifying, collecting, and eating wild plants are not just theoretical issues. Further, today, the problem is not restricted to traditional hunter-gatherer and agrarian societies, but is encountered in rural and urban settings diverse as rural Africa and urban North America. In the time that remains I will present three cases to illustrate this point.

The first case stems from a remarkable set of human poisonings that occurred in Zambia, after the construction of the Kariba Dam in 1959. Those who suffered were the Gwembe Thonga, a baNtu-speaking culture, agrarian in economic pattern, and conveniently divided by ethnographers into two primary sub-sets: Valley Thonga occupied and farmed the Zambezi River Valley between modern Zambia and Zimbabwe, whereas the Plateau Thonga occupied and farmed the lands in Zambia to the north of the Zambezi River Valley.

Construction of the Kariba Dam necessitated that the Valley Thonga be relocated in advance of the inundation. The government of Zambia instituted a relocation project and settled the Valley Thonga on lands within Plateau Thonga territory. Initially, the relocation went relatively smoothly, and few problems were evident between members of the two Thonga groups. But there came a time when this situation changed.

Between In the 1960s 157 deaths were reported within the geographical area of the resettled Valley Thonga. The deaths exhibited curious demographic characteristics: all those poisoned were young adult Valley Thonga women, and the children of these mothers, both girls and boys. No teen-age males, or middle age or elderly Valley Thonga men or women were poisoned. The unusual number of deaths – and the concentration of cases reported for young women and their children – raised concerns with local police and governmental officials, and one suggestion even circulated that suggested the dead women and children had been murdered.

An investigation ensued but the police and government officials remained baffled: were killers loose roaming the territory? Was ritual murder for whatever reason a root cause? perhaps revenge? Still, the investigations came to naught.

Thayer Scudder, a respected anthropologist, was called to investigate. Scudder had received his Ph.D. from the University of California, Berkeley, and had studied with the eminent African anthropologist, Elizabeth Coleson. He re-examined the interesting age/gender relationship associated with the poisonings, and offered an intriguing thesis.

Scudder argued that the deaths had been caused by incautious collection and consumption of wild plants presumed to be edible by young Valley Thonga women, women inexperienced in plant collecting. He observed that Thonga women worked in family agricultural fields with their infants and small children securely fastened on their backs, held by blankets wrapped around and under the children, and tied in front. Scudder argued that the young women while out weeding family agricultural fields, spotted what they presumed to be edible types of wild plants, collected them, took a bite, then turned and shared the presumed safe plant food with their babies. The mother, after having given the plants to their babies to eat, resumed munching the plants and consumed the remainder. Infants and small children died earlier than their mothers – because of their body size and because they ate less quantities of the toxic plant(s). But why would the mothers have selected toxic plants to eat in the first place, to share with their babies?

Scudder presented a logical argument that went something like this: Within the homeland of the Valley Thonga, prior to construction of the Kariba Dam, young women through the years would have trained with their mothers, aunts, and grandmothers and would have learned how to identify edible wild species and would have known which species were safe and not safe to eat. Such decisions would have been based upon a range of criteria: previous experience coupled with subtle differences in external morphology issues related to color, shape, and perhaps plant seasonality. But once relocated to the new lands on the high plateau above the Zambezi River Valley, the younger Valley Thonga women were now living in a new ecological niche, and had less familiarity with regional variants in local plant morphology. These migrants assumed that what they collected was safe. Older Valley Thonga women – with more experience in gathering – would have seen these same plants but would have rejected them as food. Why?

Scudder suggested that these more experienced gatherers recognized something present in the external morphology of the plants that raised a caution flag – that such examples were to be avoided. The younger Valley Thonga women, without the breadth of gathering experience, and without the advice from older Valley Thonga women, thought that the plant(s) were safe, and in thinking so, paid a terrible price.

Scudder coined the term toxic analog as the key to understanding this tragedy. He defined the term this way: toxic analogs were plants that in one ecological niche were safe to eat, but in another niche toxic. Toxic analogs might represent hybrids, variants of the same species, and could be differentiated only by experience based upon subtle differences in external morphology.

Scudder's concept of toxic analog also could be linked and associated with the general idea of cultural conservatism. The food psychologist Paul Rozin argued that the world was divided into two types of humans: those who experimented with new foods, persons who find pleasure in trying different items (he called these humans neophiles), and others, who once they determined what they liked to eat, maintained their food-intake patterns through cultural conservatism and basically rejected new, exotic, different foods (he called these humans neophobes). In terms of basic human evolution, it can be argued that the survival potential of neophobes would be superior to that of neophiles.

Returning to the case of the relocated Valley Thonga, the elderly women who rejected the presumed toxic analogs – because of the principle of cultural conservatism – clearly were neophobes and those Valley Thonga young women who died would have been "accidental" neophiles – who thought they were eating a favorite old food resource, but who unwisely and by accident selected toxic analogs.

The second case comes from my own fieldwork in the eastern Kalahari Desert of Botswana. Some decades ago I worked among the baTlokwa ba Moshaweng, a Tswana-speaking agro-pastoral/hunting-gathering society. The baTlokwa had an enormous food base of several hundred wild and domesticated food resources that were regularly available to them even during periods of extreme drought. The baTlokwa had migrated to the eastern Kalahari from what is now the central Orange Free State and the eastern Transvaal region of South Africa and arrived in their present territory only during the late 19th century. They ultimately settled within a zone, sandwiched between three other Tswana societies: the baKagtla to the north, the baMalete to the south, and the baMangwato to the west. These societies had resided for longer periods in this eastern Kalahari arid thirst-land.

During the course of my fieldwork during 1973-1975, I identified more than 150 species of edible wild plants regularly used by the baTlokwa. This pattern of diversified dietary use of wild species typified Tswana societies of the eastern Kalahari. During my stay I became aware that some baTlokwa had been poisoned by incautious consumption of wild plants thought to be safe to eat. If I recall – and I did not make systematic tallies at the time – I recall that the number was about 25-30/year. Visiting other tribal capitals of the baKagtla, baMalete, and baMangwato, I learned that at these sites, there were relatively few instances of human poisoning after consuming wild plants. What this meant to me was that the incidence of such medical-related cases from eating misidentified toxic wild plants might be used as a proxy to determine the relative length of residence of a society within a given geographical area. I cannot with certainty – from the vantage point of today – state that the number of poisonings from edible wild plants within baTlokwa territory was due to overall lack of adjustment to learning what was safe and not safe to eat. But it is correct to note here that of the four Tswana tribes in the general vicinity, the baTlokwa had arrived most recently.

What I did not investigate at the time – and now regret – was not following up on this information, since I could have interviewed family members of those who had been poisoned after eating wild plants, and could have determined their demographic characteristics and histories. It could have been, for example, that those poisoned had long residential histories in the geographical area and had simply made a mistake – perhaps consuming a toxic analog in the sense used by Scudder. On the other hand, baTlokwa territory also was a haven for new arrivals from elsewhere in Botswana (since the tribal capital was near the national capital with associated economic opportunities). Further, there were refugees from South Africa and Rhodesia who lived in the tribal territory at the time of my fieldwork. I cannot say with certainty today whether or not the poisonings might have been concentrated within such groups of recent migrants to the area.

My third and concluding example comes from my own state of California in the western United States. During the past 25 years numerous Hispanic and Southeast Asian immigrants to California have been poisoned through incautious wild plant collecting. Across the United States, there may be as many as 9,000 cases of mushroom poisoning each year that are reported to Poison Control Centers. So let us examine just cases of mushroom poisoning in California.

Examination of the *San Francisco Chronicle* newspaper reveals a large number of cases. In 1982 there were three deaths and eight additional poisoning cases reported in the San Francisco bay region. In 1983, twenty Laotian refugees were hospitalized in the east bay region after they had collected mushrooms presumed to be similar to those consumed in Laos, but in fact were toxic. In 1985 three Mexican illegal immigrants died foraging for food near San Diego. In 1996 a Hispanic adult male living in the San Francisco Bay Area died, and several other Hispanic children were poisoned after incautious mushroom gathering and their lives were saved only after securing liver transplants. In 1997 there were 10 cases of mushroom poisoning and two were fatal.

Asian immigrants to the San Francisco bay area have been the most common victims through the years since 1975. Mushrooms figure in Southeast Asian cuisine, and several edible species used in the homeland to prepare soups, are misidentified when gathering in the Bay Area. Local physicians consider immigrant families from Asia, Eastern Europe, and Mexico who continue to gather mushrooms and other wild plants while living in California to be at greater risk than native Californians.

In 1997 there were 10 cases of mushroom poisoning, two fatal. Fortunately, no local instances of human poisoning from incautious selection of mushrooms have been reported in the *San Francisco Chronicle* since 2003. The danger, however, continues to exist, given the large number of immigrants to the San Francisco Bay Area each year.

Summarizing, earliest humans had to learn how to differentiate between safe and toxic foods before they learned how to balance food intake for energy and nutrients. Mechanisms used to differentiate safe from toxic wild plants may be inferred through logic and deduction, and by examination of historical and contemporary practices used by hunting-gathering and agrarian societies. Once individuals, families, bands, and social groups have learned what is safe to eat, these practices can be passed to subsequent generations through oral traditions. Individuals who

eat more quantities of fewer – but safe foods – live to eat another day. Such individuals would be called neophobes in the Rozin system – these persons would be selected, genetically, over their contemporaries (Rozin's so-called neophiles). The so-called neophiles who like to sample and try new, unusual, and different foods – risk their lives.

Human migration and immigration to new lands, however, resets the starting point for individual and communal education regarding what is safe and not safe to eat. Scudder's toxic analogue concept remains a conceptual measure when examining human poisoning after ingesting wild plants. In the case of the Gwembe Thonga, forced to relocate in new lands, those who were not poisoned reflected cultural conservatism and Rozin's concept of neophobia. The unfortunate young women and children of both genders who died after eating toxic wild plants – could they have been educated and protected against selecting toxic analogues? I would suspect not; but if so, not easily. But had they undergone training in how to identify local edible wild plants – training by local Plateau Thonga familiar with local species – I suspect that the outcome would have been different.

In the case of human poisonings from wild plants among the baTlokwa of the eastern Kalahari, these cases also were concentrated among recent migrants to the geographical area. The argument can be advanced that since few baKwena were poisoned annually from wild plants – in contrast to a significant number of baTlokwa – this reflected baKwena adjustment to the environmental offering of species and their ability to determine readily which species were safe and which were potentially toxic. As new arrivals to the eastern Kalahari, the baTlokwa had not yet adjusted to the array of potential species in this new ecological niche.

We may conclude, therefore, that recent migrants who decide to augment their food resources through plant gathering place themselves and their families at significant health risk.

THANK YOU