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The Acquisition of Medicinal Plant Knowledge: A Cross-Cultural Survey

Anna Ruth Dixon
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Anna Ruth Dixon entitled "The Acquisition of Medicinal Plant Knowledge: A Cross-Cultural Survey." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Michael H. Logan, Major Professor

We have read this thesis and recommend its acceptance:

Benita Howell, Jefferson Chapman

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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THE ACQUISITION OF MEDICINAL PLANT KNOWLEDGE:
A CROSS-CULTURAL SURVEY

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Anna R. Dixon

May 1990

STATEMENT OF PERMISSION TO USE

THIS THESIS IS DEDICATED TO MY MOTHER,

RUTH SELLERS NUNNERY DIXON

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ABSTRACT

Purpose of Study

A 10% random sample of fertility-related plants was taken from Table III of Farnsworth et al.'s article, "Potential Value of Plants as Sources of New Antifertility Agents I" (Farnsworth et al. 1975: 547-554), one of the most extensive compilations of cross-cultural and chemical information on fertility-related plants available in the literature. A single class of medicinal plants, fertility-related medicinals, was chosen because it is possible that the attributes that lead to the identification of fertilty-related plants are different than for plants used to treat other conditions. Five objective criteria related to plant morphology, chemistry and ecology were proposed as being significant in contributing to the perceptual salience of potential medicinal plants. The chemical, botanical and ethnographic literature was searched for descriptions of each plant contained in the random sample.

Findings

Of the 15 plant species in the random sample, approximately 70% were found to fit one or more of the criteria related to perceptual salience, supporting the hypothesis that acquisition of medicinal plant knowledge is not the result of purely random processes. It is possible that these attributes are in some way clues to the potential bioactivity of the plant's chemical

constituents. Once a link between a certain odor, taste or other characteristic and a specific physiological effect was noted by humans, this may have led to experimentation with other plants with a similar odor, taste,or appearance to produce the same physiological effect.

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INTRODUCTION

In the past few years, the field of ethnobotany has begun to take a new approach to the study of traditional herbal medicine. Previous research on medicinal plants used by traditional societies has either focused on understanding plant classification from an emic (cognitive) perspective (e.g., Berlin et al. 1974; Hunn 1982), or from an etic point of view, i.e., proving the efficacy of traditional herbal medicines (e.g., Farnsworth et al. 1975; Ortiz de Montellano 1975; 1986; Browner and Ortiz de Montellano 1986). Research in both of these areas has been an extremely important and valuable contribution to anthropology and botany. However, the work of recent researchers has also shown the value of combining both etic and emic approaches, resulting in a more holistic, "multicontextual" (Etkin 1986:11) approach to ethnobotany (e.g., Alcorn 1984; Etkin 1986; Etkin and Ross 1982; Johns 1986, 1989; Logan 1989; Moerman 1989). The work of these authors not only takes into account the cultural context and meaning of plants, it also demonstrates the complex interrelationships between the cultural and environmental spheres which result in observed patterns of plant use. As Michael Brown states, such a holistic view "forces the analyst to forego monistic explantations and instead take a broader, systemic view of the relationship" (between humans and plants) (Brown 1987: 8).

The problem which this thesis will address is outlining the processes, both cultural and "natural," which contribute to the acquisition and organization of medicinal plant knowledge. It is argued that the patterns of medicinal plant use observed today are not the result of random processes. Rather, comparison of cross-cultural data concerning one class of medicinal plants will be used to demonstrate that specific attributes served to make these plants the target of human investigation and experimentation (c.f. Logan 1989; Moerman 1989). In the past, researchers explained the observed complexity of indigenous plant-based knowledge as the result of generations of random experimentation. This model, while intuitively plausible, implies a limited involvement with a vast array of plants, where a human subject tests a plant by tasting a bit, then waiting to see what happens. As Logan (1989: 2) points out, "oral dosages in such small quantities would rarely contain sufficient amounts of a plant's biologically active components to induce any perceptible physiological change." This is not to argue that some kind of experimentation does <u>not</u> occur (e.g., shamans in South America testing potential drugs on dogs, Rodriguez 1982), but that the plant species chosen for experimentation in the first place have distinguishing characteristics which have made them the targets of human experimentation.

If a cross-cultural study of medicinal plants demonstrates patterning in these distinguishing characteristics, then anthropologists will be better able to understand the ways in which traditional (non-Western) human groups understand and organize part of their natural world (i.e., the vegetation). Given the extreme diversity of the natural environment, it is no wonder that human groups have been able to consistently utilize such a small proportion of all potentially usable plants (Gottleib 1982: 236; Koopowitz and Kaye 1984: 32). The position taken in this paper is one stated by Logan (1989: 2): " By keying in on certain species, and thereby largely ignoring others, peoples in non-Western cultures transformed the exceedingly diverse and complex world of plants into a meaningful and manageable cultural domain." In addition to isolating plant attributes which tend to make plants perceptually salient (Turner 1988), that is, noticeable, this paper will place the acquisiton and development of medicinal plant knowledge in a coevolutionary perspective. The hypothesis that this thesis will explore is that, with changes in cultural complexity, and as human-plant relationships became more obligate (as with domestication), the process of the acquisition and development of medicinal plant knowledge became more complex as well.

The author's interest in this problem began several years ago after reading an article by Peter Kunstadter entitled "Ecological Modification and Adaptation: An Ethnobotanical View of Lua' Swiddeners in Northwestern Thailand" (Kunstadter 1978). While Kunstadter's article discussed many aspects of Lua' subsistence, it was his discussion of the Lua's use of medicinal plants which raised a number of significant questions. In a discussion of medicines used to treat postpartum women and other fertility-related conditions, a listing of herbs labeled "hot" medicine was given (since the bodies of women who have recently given birth are considered "cold" according to traditional Lua' humoral principles, medicines to "warm" the body are prescribed).

Concerning these herbs, which included cumin (Cuminum cyminum), cloves (Eugenia caryophyllata), kha (Alpinia galanga) and ginger (Zingiber officinale), Kunstadter (1978: 190-193) made several interesting observations:

1. most "hot" medicines are also aromatic spices and herbs;

2. many "hot" medicines are also used for other (non-medicinal) purposes;

3. in addition to being purchased at markets, many hot" medicines are either grown in the village gardens or are collected at the edges of fallow fields or gardens;

4. the empirical efficacy (etic) of many "hot" medicines used by the Lua' has not been established.

Kunstadter's brief discussion prompted one to ask why the "hot" medicines shared such common characteristics. Why were these specific plants, many of them also food plants, spices or "weeds," chosen to treat one class of physical complaints i.e., fertility-related conditions?

A similarly thought-provoking observation was made by Julia Morton in a 1968 article concerning the medicinal plants of Curacao. Morton suspected a link between the high rates of esophageal cancer among the people of Curacao, and the herbal teas they used to treat sore throat, coughs and respiratory problems.

> One of the most striking facts which have appeared in my appraisal of the plant life and usages of the island is that most popular herbs gathered for medication or "tea" are highly aromatic weeds which the 'roaming goats avoid' (Morton 1968: 91, emphasis added).

The significance which Morton attributes to her observations is that since goats will not eat these aromatic weeds, medicinal plants are readily available to people: there is no competition between the goats and the people for the same plants. While this is true, Morton's observations, like Kunstadter's, also hold a number of implications for the acquisition of medicinal plant knowledge.

The original focus of research on this topic was to find chemical bases or "proof" of the empirical efficacy of the plants listed in Kunstadter's article. While many of the herbs listed in his article are indeed known to be effective (such as ginger, fennel and cumin; Farnsworth et al. 1975: 576; 577), research on the less well-known species was hampered by this author's lack of chemical expertise. Once the research began to resemble what Michael Brown has termed "alkaloid mongering," emphasis on "efficacy" was abandoned. "Alkaloid mongering" refers to the unfortunately common practice of:

> searching the literature for information on bioactive chemicals that might be present in the species (or when writers are grasping for straws, in the genus or even the family) under consideration (Brown 1987: 7).

Far from being a fruitless pursuit, chemical research did lead back to the other points raised by Kunstadter concerning the characteristics shared by Lua' "hot" medicines. A review of the literature revealed that the same or similar species of plants were used for fertility-related purposes, not only in Thailand, but in many other cultures as well. For example, Sambucus javanicus, in Asia, Sambucus mexicana in Mesoamerica, and Sambucus canadensis (elderberry) in North America, have all been used by groups indigenous to those areas for fertility-related purposes (c.f. Luis Diaz 1976; Moerman 1979; Perry 1980). Similarly, the many different species of birthwort (Aristolochia spp.) which have been employed worldwide as abortifacients (Farnsworth et al. 1975; Browner and Ortiz de Montellano 1986; Bianchini and Corbetta 1977; Perry 1980; Spoerke 1980).

The list of such cross-cultural uses of the same or similar species is extensive, and while diffusion of medicinal plant knowledge may be cited as one reason for commonalities, it cannot be the sole reason. Further, would generations of "trial and error" testing of the local vegetation in geographically, culturally and botanically disparate areas have resulted in such striking similarities in fertility-related medicinals?

It will be argued here that such cross-cultural similarities among herbal medicines used to treat fertility-related conditions are not the result of purely random processes. A cross-cultural study of medicinal plant use, as illustrated in this thesis, can reveal the ways in which non-Western cultures interpret and manage the diversity within local environments.

CHAPTER 1

LITERATURE REVIEW

In the vast body of ethnobotanical literature produced in the last decade, only a few researchers have addressed, in a systematic manner, the problem of the acquisition of medicinal plant knowledge. In other words, how have "so many peoples with very simple technologies...been able to discover so much from the plant kingdom?" (Logan 1989: 2). As both Logan (1989) and Johns (1986) have pointed out, the lack of attention to this problem may be due to a popularized notion concerning the acquisition of plant-based knowledge which is seldom stated explicitly, but is nevertheless pervasive in the anthropological literature. That is, native peoples worldwide gained knowledge concerning the medicinal values of plants through a trial and error process. For example:

> It is probably in the field of botany that there is the strongest basis for attributing to Indians the use of scientific method in connection with nature. The observation of plants and knowledge of their uses indictates a pragmatic concern with natural phenomena. However, the manner by which the usefulness of plants was established is a matter of conjecture. Societies such as the Midewiwin of the Ojibwa were organized to preserve and to pass on the herbal knowledge of the group, but whether that knowledge was gained by trial and error methods with observation of results and conclusions or a kind of inductive method, or whether the doctrine of signatures might in some cases provided a rational basis for selection, cannot clearly be determined at this time" (Kidwell 1973:46; emphasis added).

A similar quote is also found in Krochmal and Krochmal's A Guide to the Medicinal Plants of North America:

> We suspect that man very early in his agricultural development associated the wild plants he used for curative purposes with the untouched woods and forests. Perhaps he felt or believed that these wild plants, because of their 'purity' from disturbance by man himself, were stronger and better able to fight the diseases man tried to cure himself of. To this day our prime sources of botanical drugs are plants growing in the wild--in the forests of Appalachia mainly, but also in the states along the Great Lakes as well. Long before the settlers arrived on the shores of the New World, the highly developed cultures of the Aztecs,the Maya, the Incas, and the Indians of the United States had learned well, by generations of trial and error, the medicinal uses of the plants growing around them (Krochmal and Krochmal 1973: 5; emphasis added).

What the research that a handful of anthropologists, notably Alcorn (1981a,1981b,1984); Etkin and Ross (1982); Johns (1982, 1986); Logan (1989); Moerman (1989) and Turner (1988), will demonstrate is that these previously implicit assumptions concerning acquisition of plant-based knowledge are inaccurate. The "manner by which the usefulness of plants was established" is not a matter of conjecture. While it may be impossible to delineate all the ways by which such knowledge is acquired, an examination of the ethnographic, botanical and chemical literature does allow ethnobotanists to put forward testable hypotheses. Furthermore, the work of researchers in the past decade, and the work reported in this thesis, refutes the claim that most medicinal plants come from "wild" habitats. Krochmal and Krochmal (1973) are correct in associating the development of agriculture with greater use of medicinal plants; however, cross-cultural research demonstrates that the plants used medicinally following the development of an agrarian lifeway were those plants found in anthropogenically modified habitats (c.f. Alcorn 1981a, 1986; Kunstadter 1978; Logan 1989).

The current interest in the acquisition of medicinal plant knowledge is an outgrowth of related studies of botanical and faunal resource perception in traditional societies (c.f. Alcorn 1981a, 1981b, 1984; Berlin et al. 1979; Hunn 1982; Turner 1988,1989), incipient domestication of plants in contemporary contexts (c.f. Bye 1979; Nabhan 1986; Nabhan and Rea 1988) as well as the empirical bases of traditional medicinal plants (e.g., Ortiz de Montellano 1975). Because research related to the acquisition of medicinal plant use is a relatively recent phenomenon in anthropology, there is only a small body of literature devoted to the subject (e.g., Etkin 1982; Johns 1982, 1986; Logan 1989; Moerman 1989). The novelty of this research topic is reflected in the range of theoretical perspectives and research foci in the work of the latter authors, as a brief review of the literature will demonstrate.

One of the pioneering researchers in the area of botanical resource perception is Janis Alcorn, who spent 13 months doing fieldwork on land management and plant use by contemporary Huastec farmers in northeastern Mexico (Alcorn 1981a, 1981b, 1984). Alcorn's field observations and interviews with informants showed that the Huastec's use and understanding of their natural environment was extremely sophisticated. Depending upon culturally-defined needs for fuel, food, medicine, or construction products, different classes of plants were defined and managed accordingly by the Huastec.

Alcorn defined three "anthropogenic vegetation zones" which surround Huastec farmsteads: dooryards, agricultural zones, and forest areas, all of which were managed to varying degrees (Alcorn 1981a: 404-411). In addition to fields of crop plants such as henequen (Agave spp.), sugarcane (Saccharum officinarum) and maize (Zea mays), there were also areas where stands of grasses used in roofing were maintained, as well as isolated coffee or palm trees which had been spared from swidden activities because of their usefulness.

Particularly interesting was the dooryard zone, that area closest to the dwellings. This zone was composed of two areas: the ele:b, " a virtually plantless, clean-swept area" (Alcorn 1981a: 406), and the wal ele:b, a border which:

> contained a riotous mixture of spontaneous and planted useful plants including ornamentals, edibles, medicinals, utilitarian, and ritual plants, as well as 'useless' neglected plants which are slashed back at regular intervals...wal ele:b is not a carefully tended area, and to the stranger's eye the profusion of plants would seem 'purposeless' and 'wild' (Alcorn 1981a: 406).

Significantly, the few plants remaining in the ele:b zone are medicinal herbs which are left there, Alcorn explains, so that they may be readily found with a minimum of searching.

Alcorn's research demonstrates well the dynamic nature of human-plant relationships. She cautions against generalizations of the "usefullness" of specific plants without a thorough understanding of the cultural, natural and social contexts which affect such an assessment (Alcorn 1981b: 229).

Like Alcorn, the work of Timothy Johns (Johns 1981, 1982, 1986) has focused on defining the dynamics of plant use in essentially one culture area. Unlike Alcorn, who describes a wide range of human-plant relationships, Johns' aim is to "elucidate the ways by which humans select plants for chemical constituents, a process referred to here as chemical selection" (Johns 1986: 266).

Johns' multidisciplinary research on two Andean tuber crops, anu (Tropaeoleum tuberosum), and maca (Lepidium meyenii), revealed a link between sensory perception and medicinal plant selection. Chemical analysis of the two plants, both of which were used by the Peruvian Indians for fertility-related purposes, revealed that the active constituents of the two plants were identical. Johns hypothesized that the Indians, with no access to modern technology, had been able to associate the two unrelated plants on the basis of the taste and odor of these active constituents. Johns identified one, isothiocyanate, which gives both plants a characteristic "mustardy" taste and odor as a significant discriminating factor.

How was the link between the taste and odor of these Andean tubers and a specific medicinal use made? The work of Nina Etkin and Paul Ross

(Etkin and Ross 1982) provides a plausible explanation. In an article entitled "Food as Medicine and Medicine as Food," Etkin and Ross showed that among the Hausa of northern Nigeria, the boundaries between what constitutes a food and what constitutes a medicine are quite fluid. A survey of Hausa medicinals revealed that many medicinal plants used to treat gastrointestinal complaints (a common disease category in that area, as well as Mesoamerica, as demonstrated by Logan 1973), such as cloves (Eugenia caryophyllata), black nightshade (Solanum nodiflorum) and ginger (Zingiber officinale), were also commonly used foods or condiments. In addition, an examination of the chemical constituents of these plants showed that they were empirically effective for gastrointestinal complaints (Etkin and Ross 1982:1561-1567).

The significance of Etkin and Ross' research for the work of Johns on anu and maca is that it provides one probable cultural avenue or mechanism for the acquisition of medicinal plant knowledge.That is, realization of and experimentation with the medicinal possibilities of plants may have occurred subsequent to a plant's introduction to the diet. In this sense, the dinner table may have served as the "laboratory" of traditional peoples. Etkin and Ross also conclude that the biocultural adaptive significance of plants used as seasonally available "snacks," flavorings and condiments as they contribute to the health and nutritional status of peoples in developing nations must be taken into account in formulating food policies for these countries.

Discounting the not insignificant contribution that these items make to the diet may:

> increase the risk of reducing the range of nutrients available to food producing populations. Further, we suggest that other ecological balances may be jeopardized as well, insofar as these perturbations affect the multicontextual use of plants such as those considered here in their roles as gastrointestinal medicines and dietary constituents (Etkin and Ross 1982: 1572).

Only two researchers, Daniel Moerman and Michael Logan, have placed the study of the acquisition or "discovery" ("acquisiton" is preferred over the term "discovery," as it refers more to a process, rather than event) of medicinal plant knowledge in a broader, comparative context. Moerman, in a paper entitled "Poisoned Apples and Honeysuckle: the Medicinal Plants of Native America," (1989) attempted to determine the plant families most often used as medicinals in native North America, and what the patterning observed says about the ways in which traditional peoples choose medicinal plants. Logan, in a paper entitled "Plant Attributes, Selection and the Discovery of Medical Knowledge" (1989), examined some possible reasons why the botanical lexicons of agriculturalists were larger than those of hunter/gatherers.

Both authors used large databases containing lists of medicinal plant species as sources of comparative material against which their hypotheses could be tested. Moerman utilized two databases: 1) Medicinal Plants of

North America (MPNA; Moerman 1986), composed of 2397 taxa with 17,634 recorded uses, and 2) the Flora of North America (FNA; Shetler and Skog 1978), a checklist of all North American flora (Moerman 1989: 2). Logan's source was the database generated by the Instituto Mexicano para el Estudio de las Plantas Medicinales (IMEPLAM; Luis Diaz 1976), composed of over 2,000 taxa with 844 uses.

The central focus of Moerman's research was to determine which plant species were used most and least often by Native Americans for medicinal uses, and "...what can we learn from this about the human process of making choices" (Moerman 1989: 1). Moerman hypothesized that if the process of choosing plants for medicinal purposes was totally random, then all plants in a given area would have an equal opportunity of being chosen for experimentation. By counting the total number of species within a plant family (given in FNA), Moerman was able to use regression analysis to predict the number of species which would have been used medicinally if choice was indeed random. This predicted value could then be compared against the actual number of species used medicinally (given in MPNA). If the actual number listed in MPNA exceeded the predicted number, then this was taken to mean that non-random, purposive processes were involved.

For example, 2231 species were listed in the FNA as members of the Asteraceae (sunflower) family. Using Moerman's regression equation (Moerman 1989: 3), a figure of 250 species was obtained as the predicted number of species used medicinally if choice were random (Moerman 1989:4). The actual number of species used medicinally in North America was 345, or 95 more species than predicted. In this manner, Moerman was able to identify the plant families with the highest, as well as the lowest, incidences of use.

In attempting to explain why such patterning occurred, Moerman searched the chemical literature for information on these families. He found that the Poaceae (grass) family, a large family which comprises nearly 10% of all species on the North American continent (Moerman 1989:6), was one of the families least used for medicinal purposes. The chemical literature revealed that most grasses do not produce the protective secondary plant chemicals most often associated with bioactivity in plants. In part, this is due to the survival strategy evolved by many grasses as a response to browsing by herbivores, obviating the need for chemical protective measures (Janzen and Rosenthal 1985). Significantly, the one species of grass which was frequently represented in Moerman's database was Hierochloe odorata (sweetgrass), a fragrant grass often burned as incense or made into an infusion or decoction used as a wash (Moerman 1989:6).

The high-use category families, in contrast to the Poaceae, included many plants known to produce toxic secondary plant substances in at least some of their plant parts. For example, many species of the Rosaceae (which includes apples, pears, roses and blackberries) produce cyanogenetic glucosides which may be used medicinally, but which can also cause, in sufficient doses, cyanide poisoning. Moerman terms this family's propagative strategy the "poisoned apple syndrome," where dispersal of the plant's seeds (in which the toxic compounds are concentrated) is accomplished by browsers, who are attracted by and consume the edible fruits, excreting the inedible seeds.

Moerman's discussion of the Caprifoliaceae (honeysuckle) family is interesting in the light of this thesis topic. Regression analysis revealed the Caprifoliaceae to be in the high-use category: "all seven genera in this family were used medicinally by Native Americans, as were 35 or its 77 species, in nearly 450 ways" (Moerman 1989:8).These seven genera are: Diervilla, Linnaea, Lonicera, Sambucus, Symphoriocarpos, Triosetum, and Viburnum. Why were all seven genera, which included "less obviously useful taxa" (Moerman 1989:8), used medicinally? Of the genera comprising the Caprifoliaceae, Sambucus was listed most often as a medicinal. The medicinal uses of Sambucus (elderberry) fall into two categories: internal, as an emetic or cathartic (berries); and external, as a discutient for skin disorders (flowers, leaves and stem bark), (Moerman 1989:9; Spoerke 1980). Moerman states that it is easy to imagine how the emetic effect of elderberries was discovered; though edible, the uncooked berries (especially the seeds) have an emetic effect upon most individuals if eaten in quantity. However, Moerman is at a loss to explain how the dicutient properties of Sambucus, as well as the other genera of the Caprifoliaceae, were determined by Native North Americans.

Given the propositions made concerning attributes which lend plants "cultural salience" (Turner 1988), what can we say about the Caprifoliaceae? What factors placed this family's members into situations where human interest was aroused? A survey of entries concerning the Caprifoliaceae in regional floras as well as ethnographic sources was illuminating (Balls 1962; Britton and Brown 1970; Densmore 1928; Halls 1977; Hayes and Garrison 1960; Krochmal and Krochmal 1973; Peterson 1977; Radford et al.: 1968; Saunders 1948; Spoerke 1980; Sweet 1976; Turner 1988).

Habitat information on species of Sambucus, Symphoricarpos, Lonicera, Triosetum, Diervilla, and Viburnum indicate that many of these genera have species commonly found in openings, thickets, or in human-disturbed habitats, such as fencerows, old fields, or along roadsides. For example, Radford et al. (1968) note that Diervilla sessilifolia is common along road banks in the Carolinas and surrounding areas. Of the seven species of Lonicera listed in Radford et al., six are commonly found in waste places or thickets. Hayes and Garrison note that Symphoricarpos rivularis (snowberry) is cultivated in Washington and Oregon (Hayes and Garrison 1960: 95). The three species of Triosetum listed in Radford et al. (1968) are all common not only in deciduous or mixed woods, but also in forest openings. Halls (1977: 95-100) calls the southeastern species of Viburnum "mid to late successional species," and Krochmal and Krochmal (1973: 233-234) state that V. prunifolium is commonly found along fencerows and roadsides. Several North American species of Sambucus are considered to be common to disturbed ground: Sambucus glauca (Hayes and Garrison 1960: 103) and S. canadensis (Radford et al 1968: 996). In addition to being commonly found in disturbed habitats, members of the Caprifoliaceae also produce berries which are edible for humans: Sambucus, Symphoricarpos (Peterson 1977; Hayes and Garrison 1960: 95); Lonicera (Peterson 1977: 78), and Viburnum (Densmore 1928; Halls 1977: 95-100; Krochmal and Krochmal 1973: 233-234; Peterson 1977: 178).

Aside from medicinal and food purposes, the ethnographic literature reports additional uses for members of the Caprifoliaceae. Sweet (1976: 18) reports that Southwestern Indians made flutes from the hollow branches of Sambucus mexicana and S. caerulea, and the long shoots of these two species were also used to make arrow shafts. Balls (1962: 61) states that in California, the berry stems of S. mexicana were processed to make a dye used in the coloring of basketry materials. Densmore (1928: 289) reports that Diervilla lonicera was used for "utility purposes." Saunders (1948: 230-231) notes that Viburnum spp. foliage was dried and used in smoking mixtures.

Thus, the frequent use of the members of the Caprifoliaceae as medicinals, which Moerman found difficult to explain, may be reinterpreted in part by the three interrelated factors that Turner outlines as contributing to the cultural significance of plants (Turner 1988: 276): ecological salience, perceptual salience and potential utility. Members of the Caprifoliaceae were not only ecologically salient ("weeds" or successional species frequently encountered on the landscape), they were perceptually salient (e.g., the characteristic shape and odor of elder flowers, or the hairy leaves of some viburnums), as well as being potentially useful in dyemaking, manufacture of artifacts, and as foods. It is also interesting to note, as Turner observes concerning the Thompson and Lillooet Indians of British Columbia:

> almost all of the highly visible tree and shrub components of the flora are recognized nomenclaturally and cognitively as distinct types by native consultants....The herbaceous, bryophyte, fungal and lichen components are less universally recognized (Turner 1988: 277).

In the Caprifoliaceae only one genus (Triosetum) is herbaceous. The remaining six genera are shrubs (Radford et al. 1968: 988). It may be that the factors which affect the recognizability of trees and shrubs as opposed to herbs, bryophytes, fungi and lichens which Turner observed among the Indians of British Columbia may be applicable to other areas as well.

In summary, a constellation of factors come into play with the Caprifoliaceae, and undoubtedly other families, which served to bring its members into frequent contact with humans. As the ethnographic literature suggests, these genera may have been used for a myriad of uses prior to their incorporation as medicinals. As Hunn (1982) and Turner (1988) have stated, multiple uses of a single species contribute to its "cultural significance," and non-medicinal uses of the Caprifoliaceae may have resulted in the accumulation of knowledge concerning their possible medicinal value.

Moerman's analysis of the most- and least- used North American medicinal plants is an excellent preliminary study of the subject. However, given the great floristic diversity of the North American continent, how applicable is a statistical analysis which treats North America as a single floristic unit? For example, many xerophytic species found commonly in the Southwest are not commonly found (except as ornamentals today) in the Southeast. Therefore, these plants would not have had an equal chance of being chosen for medicinal use by native inhabitants of the Southeast. What this means is that Moerman's data, though probably generally valid, are somewhat skewed; the Agavaceae (maguey) family (more correctly, the Amaryllidaceae) almost certainly would be rated a higher-use family if a regional perspective, where the Agavaceae's use within the indigenous flora of the Southwest, was taken.

As an aid to focusing scientific inquiry on selected families which are probably most culturally significant, Moerman's study of "poisoned apples and honeysuckle" is an important first step. Future research might best be directed towards analyzing patterns of medicinal plant use and the cultural importance of plants on a regional basis, such as Turner's work with the Thompson and Lillooet of British Columbia (Turner 1988, 1989). In fact, Moerman did take a regional approach in an earlier paper (Moerman 1979) on the empirical bases of North American Indian medicinal plants, an approach that would have been helpful in this current paper (Moerman 1989).

Michael Logan's recent paper, "Plant Attributes, Selection, and the Discovery of Medical Knowledge" (Logan 1989), comes closest to this thesis in its theoretical orientation. Logan examined the attributes of one class of medicinal plants (emmenagogues) listed in the database IMEPLAM (Luis Diaz 1976) to argue that:

> the discovery of plant-based knowledge in traditional societies was, and in most cases has always been, a non-random process, one resting on a simple yet universal feature of human-plant interaction: only certain species were, or are, targeted for human inquiry and eventual use, for they, unlike countless others, were somehow distinct or unusual (Logan 1989: 2).

Logan also used his analysis of the IMEPLAM data to test an assertion by Cecil Brown (Brown 1985). Brown, who argued that agriculturalists have larger botanical lexicons than hunter/gatherers because these larger botanical lexicons constitute a body of retained knowledge concerning wild resources which serves as a "fail-safe" mechanism in case of crop failure. The IMEPLAM data listed 84 plants used as emmenagogues, of which approximately 40 are native to the New World (Logan 1989: 9). Logan found that over 60% of these plants were "controlled" plants, i.e., weeds, food plants, spices, medicines or ornamentals. This is significant, given the floral diversity of Mexico, where wild plant species greatly outnumber "controlled" species.

The results of Logan's survey of the IMEPLAM data have a number of implications: first, that acquisiton of plant knowledge is not random and second, that the larger botanical lexicons of agricultural groups are not fail-safes, but are a result of other selective factors. Logan's data on the species used as emmenagogues shows a definite patterning; "controlled" plants greatly outnumber the wild plant species, and all the plants possessed one or more distinguishing features (e.g., aromatic, characteristic taste etc.). Logan's results accord well with those of Etkin and Ross (1982) and Kunstadter (1978): many of the IMEPLAM medicinals were also foods or spices, and their medicinal properties may have been discovered subsequent to many years of use as foods or spices. As for the fail-safe argument, it appears that the greatest amount of lexical attention is devoted not to naming wild plants which may serve as foods during times of scarcity, but to "controlled" species. This same patterning applies not only to medicinal plants,but to other classes of plants as well (c.f. Chang 1989, concerning rice varieties). On the other hand, knowledge concerning potential plant food species which are common in secondary, disturbed, habitats may have helped in times of scarcity for both agriculturalists and hunter/gatherers.

Logan's study also led him to make a significant observation concerning the biocultural significance of medicinal plant use. As the ethnographic and archeological literature have shown, the change from a hunting and gathering to and agrarian lifestyle did not always result in an improvement in the health of human groups (Goodman and Armelagos 1985; 1978; Richardson 1989; Rubel 1984; Wirsing 1985). In fact, maternal health in particular was jeopardized by the preference for larger families in agricultural groups. As Frisch and McArthur (1974) note, not only was there shorter birth-spacing among agricultural groups, age at menarche was lower. Thus, not only did women begin childbearing at a younger age, births were more frequent. As Logan observes, this situation:

> intensified maternal health problems, which in turn led to a greater need for plants that could affect human reproduction; plants used as parturients, galactagogues, emmenagogues, and abortifacients (Logan 1989: 6).

In contrast, hunting and gathering societies controlled population size through mechanisms such as fission, infanticide, or prolonged breastfeeding; consequently, there was little need to employ plants for fertility regulation. The latter mechansims are not approved of in agricultural societies, and other, more covert, methods are utilized (c.f. Browner 1985; 1989). Logan concludes:

> If I am right, we can now place medicinal plant use into a broad historical perspective. With the transition from hunting and gathering to agriculture, human groups entered into a novel form of botanical resource management, one where the process of medicinal plant selection gained an additional dimension or focus. For the first time there was a new pool of plants -the controlled species- from which health related discoveries would and, in fact did, arise (Logan 1989: 11).

Despite the variety of research interests and methodologies employed by the handful of anthropologists working on the acquisiton of plant knowledge, it is clear that this new field of inquiry will be a significant contribution to the field of anthropology. Not only will this research orientation allow us to look at the mass of data in "useful plant lists" collected in the past century (e.g., Altschul 1973) it may also demonstrate the complex and dynamic coevolutionary relationships between humans and their environments (Alcorn 1981a; McKenna 1989).

CHAPTER 2

METHODS

Sample

A random sampling strategy was selected as the best way in which to generate a body of data against which hypotheses concerning the acquisition of medicinal plant knowledge could be tested. The use of a random sample taken from a larger set of data concerning fertility-related plants serves a threefold purpose:

1. to eliminate bias towards those plants for which the most information is available;

2. to reduce the number of plants in the data set to a manageable size;

3. to eliminate the possibility of bias towards those plants whose characteristics fit the author's hypothesis.

A sample of 15 species of plants was selected at random from Table III in Farnsworth et al.'s article " Potential Value of Plants as Sources of New Antifertility Agents I" (1975: 547-554). Farnsworth et al's compilation of pharmacological information on hundreds of fertility-affecting plants reported worldwide in the ethnographic literature is one of the most complete references available to researchers today.

Despite the size of Farnsworth et al.'s list, the quality and amount of information varies widely for individual plant species. Therefore, a random sample approach was chosen to eliminate bias towards those plants for which more information was available, or selection of plants whose characteristics did indeed fit the model set forth in this study. In addition, a subsample derived from the hundreds of plants covered in Farnsworth et al.'s paper reduced the number of plants under study to a more manageable size. This is a serious consideration when one takes into account that finding sufficient descriptive material (much less a drawing) on even one of the more exotic plant species may take several weeks of research.

The 157 entries in Table III were assigned individual numbers and the numbers were placed on slips of paper. The strips of paper were placed in a basket, mixed, and drawn out one at a time until a total of 15 had been selected. An approximately 10% random sample of Table III's total sample was thus obtained.

A number of attributes were isolated as being potentially significant in contributing to the "perceptual salience" (c.f. Turner 1988) of plants. If one or more of these attributes was listed in a species description such as a plant key or regional flora, then this attribute was recorded as significant in the overall characteristics of that plant. The plant attributes or qualities chosen as contributing ot perceptual salience for the purposes of this study are:

1. wild vs "controlled" plant;

2. insecticidal, piscicidal, vermifuge or other poisonous properties;

3. irritant properties;

4. aromatic smell/characteristic taste properties;

5. unusual or significant physical characteristics.

Definitions

"Wild" plants may be defined as those "which grow outside the man-disturbed habitat, and which cannot successfully invade permanently man-disturbed habitats" (DeWet and Harlan 1975: 99). The category of "controlled" plants is broader in definition; this category not only includes cultivated and domesticated plants, but the "weedy" plants which flourish in disturbed habitats such as old fields, along paths and roadsides, or along the edges of cultivated fields.

Toxic properties, whether poisonous to humans or animals, are distinguishing characteristics often noted in plant descriptions in regional floras or ethnographic reports. The literature describing plants included in the random sample was searched to find mention of insecticidal (poisonous to insects), piscicidal (poisonous to fish; often this category includes plants used to "stun" fish as a fishing technique), vermifuge (medicine used to expel parasitic worms in humans or animals), or other toxic properties.

Many plants possess irritant properties which serve to make them eminently noticeable to humans (e.g., poison ivy, Rhus toxicodendron). The ingestion of, or skin contact with, certain plants can produce adverse reactions ranging from mild irritation to a life-threatening allergic reaction.

The types of skin irritation produced by plants may be grouped into four general classes: mechanical or chemical irritant injury; contact urticaria; phytophotodermatitis; and allergic contact dermatitis. Mechanical or irritant chemical reactions are commonly produced by thorns, spines, raphides (oxalic acid crystals) and the like, for example, the spines of cactus (Opuntia spp.), or the mouth-tingling effect produced by raphides in the aptly-named dumbcane (Dieffenbachia spp.). Contact urticaria is produced by chemicals which:

> either cause the release of histamine and other vasoactive substances after cutaneous penetration or that they contain these substances themselves and introduce them into the skin by means of specialized hairs (Lampe and McCann 1985: 187).

Stinging nettles (e.g., Urtica spp.) commonly produce contact urticaria. Other plant compounds, such as psoralens, sensitize the skin to ultraviolet light. Even weeks after initial contact, the area of the skin exposed to such compounds will burn or blister following exposure to the sun (Lampe and McCann 1985: 198-199). The effects of allergic contact dermatitis, best represented by the reaction of some individuals to poison ivy, occur after initial sensitization to a plant allergen. The initial exposure prompts production of an antigen, which causes an allergic response upon subsequent exposure to the allergen.

Characteristic tastes and odors of plants also play an important role in their identification. Although the intricate relationship between the smells and tastes perceived by humans and animals is still imperfectly understood (Gibson 1966; Rhoades 1985), research has shown the importance of such subjective qualities in plant selection and experimentation by humans (c.f. Johns 1981, 1986; 1989; Bye 1979).

Chemists have defined six general odor qualities: flowery, putrid,fruity, spicy, burning, and resinous (Gibson 1966: 149). Characteristic odors or tastes attributed in the literature to species in the random sample were noted when present.

Descriptions or drawings of plants contained in the random sample were examined for the presence of unusual or significant attributes. If a plant had unusual, large, or "showy" flowers, leaves, or fruit, these characteristics may have made the plant the target of human experimentation. The flowers of birthwort (Aristolochia spp.), for example, are not only large, but are unusually shaped and colored in addition to (in many cases) having a peculiar odor usually described as similar to decaying meat. Not surprisingly, many species of Aristolochia are prominently represented in folk medicine, and somewhat surprisingly considering their odor, are often grown as ornamentals.

Belief in the "Doctrine of Signatures" in some cultures is one example of how certain plants were selected on the basis of distinct physical charateristics. The Doctrine of Signatures guides the selection of medicinal plants based on their similarity to the condition they are to treat i.e., plants with liver-shaped leaves (e.g., Hepatica spp.) are good for liver ailments; plants with reddish sap (e.g. Sanguinaria spp.) are good for the blood, and so forth. However, plants selected as medicinals by peoples who adhere (or adhered in the past, as in England) to the Doctrine of Signatures may not fit the other criteria such as distinct smell or taste; plant selection is targeted to a set of very specific morphological characteristics.

Sources

The chemical, botanical and ethnographic literature was searched for information concerning the plants chosen for this study. Botanical and chemical sources consulted included Britton and Brown (1970); Chemical Abstracts; Merck's Manual (Windholz 1976), Pammel (1911), Radford et al. (1968), Watt and Breyer-Brandwijk (1962), and many ethnographic sources. Although information concerning the chemical composition of these plants was collected, proving "efficacy" of any of these plants is not a major focus of this paper.

A literature search methodology was chosen to demonstrate that the pattern of medicinal plant use observed today is not the result of random processes (c.f. Johns 1982, 1986; Logan 1989; Moerman 1989). Rather, specific plant attributes served to make certain plant species the target of human investigation and experimentation, both leading to initial discoveries, which then became part of cultural tradition.

Statistical Methods

Because of the small sample size, only summary statistics will be used in this paper. Percentages, means and averages will be employed to illustrate how well the plants selected for the random sample fit the various criteria proposed to contribute to the perceptual salience of plants.

CHAPTER 3

DATA

Attributes Selected for Analysis

The random sample consisted of 15 plants representing 10 families: Adhatoda vasica, Artemisia maritima, Astragalus glycyphyllos, Berberis vulgaris, Carum carvi, Citrus aurantium, Clerodendrum uncinatum, Cnicus benedictus, Marrubium officinalis, Ocimum sanctum, Orthosiphon stamineus, Pisum sativum, Plumbago zeylanica, Solidago odora, and Withania somnifera. The chemical, botanical and ethnographic literature concerning these taxa was searched to find references to the five objective criteria which were proposed in the Chapter I as contributing to perceptual salience. The criteria are reiterated below:

Wild vs. Controlled

A plant species was regarded as "wild" if references to its habitat did not include secondary (disturbed) habitats such as open areas, thickets, roadsides, old fields, along the edges of fields, etc. "Controlled" plant species included not only plants regarded as disturbance indicators ("weeds"), but also cultivated and domesticated plants. As DeWet and Harlan (1975) point out, the "weediness" of any given plant is relative; the same species may be regarded as a weed in one area, but wild in another, depending on factors such as temperature, moisture, soil type, and degree of competition with other plants.

European barberry (Berberis vulgaris) is a good illustration of this: in its natural range (Europe), it grows either wild or is cultivated as an ornamental. In parts of North America, however, it is a "serious pest" because it serves as an alternating host for Black Stem-Rust of wheat and other cereals (Wilkinson and Jaques 1972: 67). Perception of "weediness" (a relative, culture-bound term that generally means "uselessness") is also influenced by cultural factors, as discussed by Janis Alcorn regarding the Huastec's definition of "weeds" (Alcorn 1984). An example of this perception of "weediness" is kudzu (Pueraria lobata), which is not regarded as a weed in its native Japan where a number of factors act to to control its spread, but which is thought of as a noxious weed in the United States (Radford et al. 1968: 741).

With these considerations in mind, the relevant literature was evaluated accordingly. If a plant species from the random sample was regarded as a "weed" in one part of its range, but wild in another, then a species was recorded as having both attributes.

Toxic Properties of Plants

Many floras and ethnographic sources contain references to the toxicity of individual plant species. If a plant was reported to have toxic effects upon animals (insecticide/piscicide/vermifuge/poison) or humans (vermifuge/poison), this was recorded. Several sources which dealt specifically with poisonous plants were also consulted (Lampe and McCann 1985; Pammel 1911; Watt and Breyer-Brandwijk 1962).

Irritant Properties

Sources showed that many plant species possess chemicals or structures which can cause skin irritation in humans. The various types of irritation, which are outlined in greater detail in the Chapter I, are:

1. mechanical or chemical irritant injury: e.g., spines, thorns or oxalic acid crystals which cause discomfort upon contact with the skin;

2. contact urticaria: produced by stinging hairs; these are found in four families: the Urticaceae,Euphorbiaceae, Loasaceae, and Hydrophyllaceae. None of these families were represented in the random sample.

3. phytophotodermatitis i.e., causes sun sensitivity;

4. allergic contact dermatitis which may be caused by irritant sap or latex.

A major source for information concerning the irritant properties of plants was Lampe and McCann's AMA Handbook of Poisonous and Injurious Plants (1985).

Unusual Physical Characteristics

Plants have evolved a wide variety of unusual physical characteristics, such as large or "showy" flowers. While the primary function of these structures is to serve as attractants to pollinators such as hummingbirds or bees, unusual physical characteristics are also noticed by humans, as the popularity of ornamental horticulture today indicates. Evidence for the antiquity of human interest in flowering plants comes from the Neanderthal burial at Shanidar, where evidence for several species of flowers was found (Solecki 1975). These flowers were apparently interred with the Shanidar individual; whether they possessed ritual significance is unclear, although many are used as medicinals today e.g., tansy, Tanacetum vulgare (Moerman 1989).

The Doctrine of Signatures may also serve as a guide for the selection of medicinals, e.g., the use of Hepatica's liver-shaped leaves to treat liver disorders. Color of particular plant parts may also be selected for culture-specific ritual purposes, as Ford (1980) has demonstrated for the different colors of maize varieties in the Southwest.

Characteristic Odors and Tastes

Analysis of the data shows that this category, along with the "controlled" category, is extremely significant (Table 1): all but one plant can be demonstrated to have a distinctive odor or taste. The ability to perceive tastes and odors is critical for the survival of all animals:

> It is apparent that there is an important, and in some cases vital, need for animals to be able to perceive and recognize secondary plant substances, and selection will have favored the development of this capacity to various degrees (Chapman and Blaney 1979: 162).

In an article entitled "How Animals Perceive Secondary Compounds," Chapman and Blaney (1979) state that in contrast to herbivorous insects, where adaptation to toxic compounds in plants takes the form of some kind of physiological/anatomical responses only, e.g., the evolution of specialized chemoreceptors on mouthparts, learning ability may play a dominant role in the avoidance behavior of mollusks and vertebrates:

> This change of emphasis provides for greater versatility within the individual...the ability to perceive and recognize secondary plant chemicals has influenced the evolution of both the herbivores and the plants. Without this ability, adaptation to a a chemically new host would not be possible, and the chemical diversity of plants would be pointless if herbivores could not distinguish between them (Chapman and Blaney 1979: 192-193).

Secondary plant chemicals, or secondary metabolites, refer to a wide range of compounds (such as alkaloids, pyrethrins, cyanogenic glycosides, gossypol, tannins etc.) which are produced by plants for which "explicit physiological ("primary") functions are rarely known" (Chew and Rodman 1979: 271). The general explanation for the production of potentially autotoxic compounds in plants is that they serve a defensive purpose against herbivores (c.f. Rosenthal and Janzen 1979). The perception of secondary compounds by animals occurs through the interaction of both the senses of taste and smell. Chapman and Blaney state that experimentation demonstrated that olfaction and gustation are so closely related that for the purposes of their discussion the two are considered together, not as separate senses (1979: 173).

The importance of odor and taste perception to humans cannot be underestimated. Although there is a great deal of variation in degree of ability to perceive odors (Berglund et al. 1971; Cain and Gent 1986; Genders 1977), most people do respond to a wide range of odors. Scent of flowers, leaves and other plant parts is an important distinguishing characteristic; not all plants possess distinctive odors. Out of approximately 250,000 different plant species existant today, it is estimated that:

> there are 4,000 to 5,000 species of plants utilized for various purposes and of these, no more than one-tenth have a pleasing smell, the rest being either scentless or having an unpleasant smell (Genders 1977: 73; emphasis added).

The families of plants which most often have flowers, leaves, or other plant parts bearing unpleasant scents include the Araceae (which includes not only the foul-smelling skunk cabbage, Symplocarpus foetidus, but also the pleasantly-scented sweetflag, Acorus calamus), the Aristolochiaceae, the Rosaceae and flowers of the stapeliad group (Genders 1979: 59-60). Some plant families contain taxa which are almost all scentless, e.g., the Scrophulariaceae (which includes foxglove, Digitalis, which is nevertheless an important medicinal) (Genders 1977: 73).

Among those plant families which contain many members which are scented, the "scents of the various genera which comprise a plant family are usually similar throughout the family" (Genders 1977: 73). For example, members of the Leguminosae, which include Pisum sativum and Astragalus glycyphyllos (plants in the random sample for this study) all have flowers bearing a "vanilla-lemon" odor, and the Caprifoliaceae have honeysuckle-scented flowers for the most part (the exception being the distinctly unpleasant blooms of elder,[Sambucus]) , The Rutaceae, which include Citrus aurantium (also in the random sample), have flowers and other plant parts with an orange/ lemon scent (Genders 1977: 73).

Scent in plants, as Chapman and Blaney (1979) stated earlier, plays an important role in adaptation and evolution of plants as well as animals. For example, the essential oils which give some plants' leaves characteristic "pungent" odors serve a protective function:

> Plants with scented leaves are amongst the most primitive and are usually free of thorns; they grow in warm climatic regions, especially near the shores of the Mediterranean, and the oxidized oil provides an invisible cloud which protects the plants from scorching and undue loss of moisture (Genders 1977: 49).

Aside from moisture retention, secondary plant substances also act as deterrents to browsing animals. The most primitive tree species (conifers, balsam poplars, walnuts and birches) contain aromatic resins which, when exuded from an injury to their bark, act as a protectant with antiseptic properties (Genders 1977: 49). Humans have also discovered the antiseptic properties of the resin from these trees e.g., the use of incense as a "purifier" for sickrooms, in traditonal healing ceremonies, and in ritual contexts (such as the use of censers at Masses in the Catholic Church).

Flowering plants, which coevolved with insects, have developed an even more complex set of scent-related characteristics. Flower form, coloring and scent are related to their interaction with agents of pollination such as hummingbirds, butterflies, dungflies, or bees. For example, most bee-pollinated plants do not rely on scent primarily to attract bees-- they rely instead on color. Bees (Hymenoptera) use the colors and markings of flowers as cues to the location of nectar in plants. In most cases, bee-pollinated plants usually bear blue flowers (bees are able to see the color blue best; they are red/green color blind). These blue flowers are also usually scentless. As Genders observes:

> Of just over 4,000 plants examined by a French authority on scented flowers in the 19th century, white and yellow flowers (and especially those which are pale yellow in color) accounted for more than 60% of all fragrant flowers; the rest with but one or two exceptions bearing pale pink or purple coloring (Genders 1977: 73).

Plants bearing flowers with unpleasant odors usually rely on dung flies, bluebottle flies and the like for pollination, as their odor mimics that of decaying flesh, which attracts such insects. Likewise the brownish-purple mottled color as well as the fur-like texture of the petals of these plants mimic carrion. Many members of the genus Aristolochia (which includes many well-known medicinals) possess these fantastically-shaped, malodorous, purple and brown mottled flowers.

The relationship between the scent of an individual plant species' flowers and foliage varies. Members of the Labiatae, which often bear scentless blue flowers and are pollinated by bees, have highly aromatic leaves. Likewise, the flowers of autumn-blooming plants such as members of the Asteraceae (sunflower) family, although often yellow in color, are usually scentless because they rely on short-tongued insects, such as most beetles, for pollination (Genders 1977: 73). The foliage of these plants,in contrast, is usually strongly scented (e.g., Solidago odora, fragrant goldenrod; in the random sample). Other plant families such as the Rutaceae, contain genera e.g., Citrus (in the random sample), where many of the plant parts, including the flowers, fruit, and leaves, are scented. Further, there is also great intra-plant variation in the distribution of secondary compounds; for example, the leaves of many plants contain entirely different compounds than are found in their flowers (Genders 1977; McKey 1979).

Flower and Leaf Scents. Although there is still no consensus in the chemical literature concerning classification of scent types (c.f. Berglund et al. 1971), Genders (1977; in part, after Hampton 1925) has defined 10 flower scent groups which are associated with specific chemical compounds. These compounds may also be found in the leaves and other parts of plants. They are:

1. Indoloid: these plants contain indole, which imparts a "carrion" odor. Examples: flowers-- usually blotchy, brown-purple; birthwort or Dutchman's pipe, (Aristolochia spp); cuckoo-pint, (Arum maculatum). Leaves-- stinkwood, (Celtis reticulata).

2. Aminoid: contain trimethylamine which "occurs in the early stages of putrefaction and is also present in herring brine" (Genders 1977: 62), which produces a fishy and/or ammonia-like odor. Examples: Flowers-- dingy white to cream colored, small and borne in inflorescences or clusters (Genders 1977: 62); chokecherry (Sorbus), serviceberry (Amelanchier) and many of the Umbelliferae. Leaves-- dog's mercury (Mercurialis perennis) and stinking goosefoot (Chenopodium vulvaria).

3. Heavy: contains a higher concentration of indole as well as benzylacetate (produces a jasmine or pear-like fragrance; Berglund et al. 1971: 382) and methylanthranilate. Examples: Flowers-- usually white to pale cream, usually from subtropical areas; tuberose (Polianthes tuberosa), lily of the valley (Convallaria). Leaves-- scented-leaf geranium (Pelargonium 'Pretty Polly').

4. Aromatic: contains essential oils such as eugenol (produces a clove or cinnamon scent), vanilla scent etc.; Examples: Flowers-- white, pale yellow, pale pink and rarely blue; magnolias (Magnolia), barberry (Berberis vulgaris-- in the random sample), sweet pea (Pisum sativum-- also in the random sample). Leaves-- Carolina allspice (Calycanthus).

5. Violet-scented: produced by a ketone ironone (flowers) or irone (roots). Examples: Flowers-- violets (Viola), mimosa (Albizia). Roots-- orris root (Iris), Indian violet grass (Andropogon muricata).

6. Rose Group: rose scent is due to an alcohol, geraniol. Examples: Flowers-- geranium (Pelargonium), rose (Rosa). Leaves-- geranium (Pelargonium).

7. Lemon Group: scent is due to citral, the first product of geraniol by oxidation (Genders 1977: 65). Examples: Flowers-- evening primrose (Oenothera), water-lily (Nymphaea odorata); Leaves-- southernwood (Artemisia abrotanum; A. maritima is the species in the random sample), lemon thyme (Thymus).

8. Fruit Group: fruity scent is produced by esters and fatty acids. Examples: Flowers-- iris (Iris graminea), mock-orange (Philadelphus). Leaves-- rue (Ruta graveolens) and many of the Rutaceae (includes Citrus aurantium, in the random sample).

9. Animal Group: scent is also produced by other fatty acids and esters . Examples: Flowers- St. John's wort (Hypericum), which smells of goats. Leaves- burning bush (Dictamnus alba) and hyssop (Hyssopus officinalis), both of which are resinous plants which emit a fur-like smell.

10. Honey Group: scent is produced by chemicals similar to those of the animal group, but sweeter-smelling. Examples: Flowers-- honeysuckle (Lonicera). Leaves-- few leaves emit a honey-like scent, except for the olearias (Asteraceae).

In addition to the 10 "flower" scents, the leaves of some plant species also contain secondary substances in their leaves which are not found in their flowers. Genders (1977) has defined four main groupings of leaf scents, most of which have a pungent or "refreshing" odor:

1. Turpentine: due to the presence of the essential oil borneol acetate, which has a "pine" scent; e.g., rosemary (Rosmarinus officinalis).

2. Camphor and Eucalyptus: scent due to the presence of menthol and eucalyptol (cineol), both of which are alcohols; e.g., sage (Salvia), wormwood (Artemisia absinthum), camomile (Matricaria) and catmint (Calamintha).

3. Mint Group: scent is due to menthol; e.g., the mints (Mentha spp.), and geraniums (Pelargonium).

4. Sulfur Group: due to the presence of sulfur compounds; eg onions (Allium spp.), mustards (Brassica spp.), and watercress (Nasturtium officinale).

Wood, Bark, and Root Scents. Plant species whose wood, bark, or roots contain secondary substances are found primarily in subtropical areas and may be divided into two main groups (Genders 1977: 68-70):

> 1. Aromatic: includes plants whose bark and wood "exude a gum-like substance of resinous quality, often with the odor of aniseed, balsam or poplar" (Genders 1977: 68). Examples: sweet birch (*Betula lenta*), which has a wintergreen scent and taste; and sassafras (*Sassafras albidum*), which has a spicy taste and odor.
>
> 2. Turpentine: this group includes many conifers. Examples: *Pistacia lentiscus* and *P. terebinthus*, the trees from which turpentine is obtained; elderberry (*Sambucus*), whose bark smells of "stale perspiration" (Genders 1977: 434), due to the presence of valeric acid.

Random Sample Data

The random sample is composed of 15 genera/species representing 10 plant families. All 15 plants in the sample fit at least two of the objective criteria for perceptual salience, as discussed above. Because the sample was randomly chosen, the amount of information available on individual species' geographic distribution, habitats, and characteristics varies. Below are descriptions of the distinguishing characteristics, growth habits, common habitats, genera and world distribution of the families and the genera/species which make up the random sample, and their related species.

I. BERBERIDACEAE

BARBERRY FAMILY

The Berberidaceae are perennial shrubs or herbs whose natural distribution is in the temperate areas of the Northern Hemisphere but which can also be found in the Southern Hemisphere "to a limited degree" (Benson 1979: 146). According to Britton and Brown, there are approximately 80 species within this genus, found in North America, Europe, northern Asia and South America (Britton and Brown 1970: 127). Heywood's estimate is much larger; he says that there are 13-16 genera comprised of 550-600 species in the Berberidaceae (Heywood 1978: 45). In North America, both native and introduced species of barberry are found; the European barberry (Berberis vulgaris is regarded as a pest, as it serves as an alternating host for a parasite dangerous to cereal crops (Wilkinson and Jaques 1972).

In Western North America the family is represented by the genus Mahonia (Oregon-grape), a shrub with spiny, dark green leaves, which is often cultivated as an ornamental. The shrub bears bright yellow flowers and later, bluish, grapelike fruits (Benson 1979: 146).

Herbaceous genera of Berberidaceae which are found in the eastern portion of North America include the mayapple (Podophyllum peltatum), umbrella-leaf (Diphyllea), twinleaf (Jeffersonia) and blue cohosh (Caulophyllum).

Asian genera of the Berberidaceae include Berberis, Epimedium, Mahonia, and Nandina; many species belonging to these genera are used medicinally as well in Asia. However, Perry (1980: 54-56) does not list any fertility-related uses for members of the Berberidaceae.

Pammel (1911: 810) reports that a number of genera as being toxic, from areas such as North America, Asia, India and Europe. Of the five genera listed (eight species) in Pammel, none were reported to be abortifacients. Two species of Berberis were reported to have piscicidal properties and two species of Podophyllum were listed as having cathartic or purgative properties. Perry (1980: 55) notes that Nandina domestica Thunb. (nandina) is used as an insecticide.

Genus Berberis

The genus Berberis contains approximately 450 species, native to a wide area: North and South America, Europe and Asia. Barberries are usually woody shrubs, evergreen or deciduous, often with spiny stems and/or leaves (Genders 1977: 123-124). Most species of Berberis flower in the spring, then produce large red or purplish berries in the fall. Barberries are eaten by many species of wildlife, and are frequently used as ornamentals or hedge plants.

In eastern North America, this genus is represented by two species: B. candensis and B. thunbergii (Radford et al. 1968: 469). Both species bear scarlet berries. B. candensis is typically, though infrequently, found along rocky bluffs, creek banks and roadsides, while B. thunbergii is a rare escape from cultivation and is found on wooded slopes (Radford et al. 1968: 469).

In the western part of North America, B. vulgaris is adventive, and many species attributed in the ethnographic literature to Berberis are more properly assigned to another genus, Mahonia. This is due to the fact that there is some confusion as to the assignment of plants to these two genera, as their characteristics are so similar. For example, both are usually evergreen shrubs bearing edible purple or red (and sometimes white) berries and both have yellow wood and flowers. However, at least one species of Mahonia, M. beali (also assigned to Berberis by some sources), is said to have fragrant flowers, rather than the usually unpleasantly scented flowers of most species of Berberis (Radford et al. 1968: 469). According to Heywood (1978: 46), Mahonia and Berberis are so similar, they could be subsumed under a single genus.

The inner bark and wood of Berberis is yellow, leading to such common names as jaundice tree or jaundice berry. Moore (1979) has described the color of the root wood as "bright, almost fluorescent yellow," and also asserts that the brighter the color of the wood, the more potent the medicine made from it is (Moore 1979: 33). Since this yellow color is due to the yellow alkaloid berberine, one of the active principles of Berberis, this is probably true.

Medicinal Uses of Berberis

Most of the medicinal uses for Asian species of Berberis listed by Perry (1980) fall into four categories: as a stomachic (related to the bitter taste of Berberis spp.); as an antipyretic or fever reducer, as an antibacterial medicine, and as an antimalarial medicine. Several of these uses can be confirmed empirically; Windholz (1976: 152-153) states in Merck's Index that this genus contains not only bitter-tasting tannins, but berberine (which is antibacterial), as well as other alkaloids. Perry (1980: 54) states that the bark of B. thunbergii is also used in China and Japan as an anthelmintic.

The reported medicinal uses for Berberis in North America are similar to those in Asia: stomachic, antimalarial and antibacterial (c.f. Spoerke 1980: 28; Moore 1979: 32-33; 117). In addition, the powdered bark is used to treat diarrhea, a use supported by the presence of astringent tannins (Spoerke 1980: 28). Paradoxically, Balls (1962: 42) says that the bark of B. repens (more properly Mahonia repens) and B. pinnata were used by native peoples of California as a laxative; these same plants were also used to make a lotion for skin disorders, the roots were made into a tonic ("blood purifier"), and the leaves of B. repens were boiled to make a rheumatism tonic.

Fertility-Affecting Uses

Farnsworth et al. list several species of Berberis which have been used for fertility-related purposes (1975: 542). In India, the exudate of B. aristata is decocted in water and drunk as an infertility agent (1975 542). Other species which were evaluated for emmenagogic, abortifacient, or uterine stimulant activity (in vitro or in vivo) included: B. amurensis; B. aristata (India); B. lycium (Pakistan); and B. thunbergii (Japan). The roots, wood, and possibly other plant parts (some plant parts were not specified) contained berberine and other alkaloidal substances which exhibited abortifacient activity (B. aristata); uterine stimulant activity (B. amurensis; B. thunbergii; B. vulgaris); emmenagogic effects (B. aristata); or contained substances which were isolated and exhibited uterine stimulant activity in vitro or in vivo (all species listed); (Farnsworth et al. 1975: 557). Perry (1980: 54) states that in China and Japan, B. thunbergii is used to treat menorrhagia.

Non-Medicinal Uses

Aside from B. vulgaris, which will be discussed below, several other species of Berberis were used for non-medicinal purposes. For example, Saunders, writing in 1920, noted that barberry bark and roots (especially that of B. Fremontii) "yield a yellow dye, of which the Navajo used to be fond of as a color for their buckskins" (1934: 223). Balls, writing on early uses of California plants, says that the Karok Indians used the berries of Oregon-grape, Berberis aquifolium (a synonym for Mahonia repens), to make a blue paint for bows and arrows. The fresh fruits, regarded as poisonous by the Karok, were pounded with the flowers of Delphinium decorum (larkspur) and mixed with salmon glue to make this decorative paint. Balls adds that the fruits of this species are not poisonous, and were made into jelly by Whites living in Oregon.

Many species belonging to this genus are used as ornamental shrubs. Species of Berberis which are grown as ornamentals include: B. buxifolia, B. calliantha, B. darwinii, B. x stenophylla (a hybrid), and B. thunbergii (Heywood 1978: 46).

Berberis vulgaris

Scientific name: Berberis vulgaris L.
Synonym(s): none
Common names: American barberry; European barberry; common barberry; barberry; wood-sour; jaundice tree; jaundice barberry; jaundice berry; pepperidge bush; sowberry; sour-spine; dragon grape; guild tree; yellow root
Related species: B. amurensis; B. aquifolia (B. aquifolium Pursh.; B. repens Lindl.); B. aristata; B. barandana Vidal.; B. Bealii [Mahonia beali (Fortune) Carr.] ; B. canadensis Mill.; B. dulcis; B. Fremontii Torr.; B. griffithiana Schneid.; B. vulgaris var. japonica Regel.;B. julianae Schneid.; B. lycium; B. sargentiana Schneid.; B. thunbergii; B. wallichiana DC; B. wilsonae Hemsl. & Wils.; B. verruclosa.
References: Benson (1979); Britton and Brown (1970); Bunney (1984); Genders (1977); Hampton (1925); Krochmal and Krochmal (1977); Millspaugh (1974); Moore (1979); Perry (1980); Radford et al. (1968); Saunders (1934); Wilkinson and Jaques (1972); Windholz (1976).

Berberis vulgaris is a spiny, perennial shrub which grows to a height of approximately 2.5 meters. Originally native to Europe and Asia, it is naturalized in parts of North America, where it is commonly found in thickets and along fencerows (Radford et al. 1968: 469). In Europe, this shrub is found throughout in "hedges and bushy places" and is also grown as an ornamental (Bunney 1984: 85). Typical morphological characteristics of this species include:

> Leaves: small, green above and gray below. Leaves on young sprouts very spiny; stems also spiny;
>
> Flowers: yellow, 7-9 cm. broad; flowering May-June;
>
> Fruit: oblong to ellipsoid; scarlet when ripe, with acid flavor (high in vitamin C).

The flowers of B. vulgaris have been variously described as having a "slightly unpleasant," "disagreeable," and "rather animal" scent (Britton and Brown 1970: 127; Hampton 1925: 48).

Medicinal Uses

The medicinal uses of this species are similar to those of the genus, i.e., stomachic and antipyretic. Although Farnsworth et al. (1975: 548; 557) report the results of evaluation of this species for fertility-affecting activity, there is little reference to the folkloric use of this species as an emmenagogue, abortifacient, etc.

Perry lists the following uses for B. vulgaris: in Mongolia, this species "aids in driving out dampness, stanches blood, and helps in treating mucoidal diseases," and the stem and root of B. vulgaris var. japonica is prescribed as a stomachic in Japan (1980: 55).

In North America and Europe, this species was used for similar purposes. For example, Krochmal and Krochmal (1973: 53) note that "the fruit, which is rich in vitamin C, has been made into a confection and eaten to reduce fever and stomach distress" by descendants of European settlers in eastern North America.

Fertility-Affecting Uses

Farnsworth et al. report that B. vulgaris was evaluated for fertility-affecting activity with positive results. Experimentation with this species in India (Farnsworth et al. 1975: 548) demonstrated an anovulatory effect, but the plant part which was tested was not specified. Upon evaluation, the stem bark of B. vulgaris exhibited uterine stimulant activity, which was attributed to the total alkaloids present in the plant (Farnsworth et al. 1975: 557). Folkloric references to the use of this species as an emmenagogue or abortifacient were not found in the sources consulted for this thesis.

Non-Medicinal Uses

Charles Millspaugh, writing in the 1890's on American medicinal plants, listed the following non-medicinal uses for B. vulgaris (Millspaugh 1974: 53-76):

1. the bruised leaves were used like sorrel for flavoring a sauce for meats (perhaps cooking reduced the toxic qualities reported by Bunney [1984: 85] for all parts of the plant except the berries);

2. the roots were steeped with water and ash-lye to make a yellow hair dye; the wood was steeped with alum to make a dye for wool and linen;

3. the berries were used to make a jelly or confection.

Summary

B. vulgaris, then, posesses several of the criteria outlined as contributing to the perceptual salience of a plant: in its native habitat, it is commonly found in disturbed areas, or is cultivated as an ornamental; although this species is a relatively recent introduction to the the United States, it is also considered "weedy." The stems and leaves of this shrub are armed with spines, and the bright red berries and yellow inner bark and wood render the shrub eminently noticeable. Further, the berries of this species as well as other members of the Berberidaceae are edible for both humans and wildlife. The flowers of B. vulgaris are scented, albeit unpleasantly; this characteristic was sufficiently significant to have been mentioned in a major plant key (Britton and Brown 1970).

II. LEGUMINOSAE (FABACEAE)

PEA FAMILY

The Leguminosae, or Pea Family, is a large family encompassing approximately 700 genera and over 13,000 species distributed worldwide (Benson 1979: 294-300; Heywood 1978: 149). It is the second largest of the 300 families of flowering plants, "exceeded in numbers of species by only the sunflower (Asteraceae) family" (Benson 1979: 295). Members of the Leguminosae are most often herbs, but sometimes shrubs, and less frequently, trees. Typical morphological characteristics of the Leguminosae include:

> <u>leaves:</u> pinnate to tripinnate, sometimes palmate to simple;
>
> <u>flowers:</u> bilaterally symmetrical; sometimes butterfly-shaped; scented; usually colored white, pink and sometimes yellow;
>
> <u>fruit:</u> typically a legume.

Benson says of the Leguminosae:

> In the Southwest, (especially in Arizona and Texas), and in the South, members of the other subfamilies are fairly abundant either as native plants or in cultivation. These trees and shrubs together with various herbaceous legumes are the most outstanding element in the flora of the Southwestern Deserts. Although they are not bizarre in appearance as are the cacti, yuccas and century plants, they form the real backbone of the desert vegetation (Benson 1979: 295).

The Leguminosae is made up of three subfamilies: the Mimosoideae (e.g., <u>Acacia</u> spp.-- the acacias), numbering approximately 56 genera and 2500-3000 species, located mainly in the tropics and subtropics; the Caesalpinioideae (e.g., <u>Caesalpinia</u> spp.-- bird of paradise flowers), with 180 genera and 2500-3000 species, also a mainly subtropical and tropical subfamily; and the Papilionoideae (e.g., Pisum -- peas, and Phaseolus vulgaris-- common beans), with 400-500 genera and 10,000 species located in subtropical, tropical and temperate areas. In most of the U.S., only the last subfamily, the Papilionoideae, is commonly found. This subfamily derives its name from the butterfly-like appearance of its flowers, the Papilionidae being a typical family of butterflies (Benson 1979: 300).

Some representative members of the Papilionoideae include (Benson 1979: 294-300): the garden or field pea (Pisum sativum, included in this study), common beans (Phaseolus vulgaris), vetches (Vicia spp.), clovers (e.g., Trifolium repens), lupines (Lupinus spp.), brooms (e.g., Cytisus scoparius), locoweeds (Astragalus spp.--including A. glycyphyllos in the random sample), licorice (Glycyrrhiza spp.), tick-trefoils (Desmodium spp.) and rattleboxes (Crotolaria spp.). Many of these plants are also regarded as "weedy."

The Leguminosae include many economically important plants; many members of this family provide food for both humans and livestock, such as peas and beans for humans, alfalfa (Medicago sativa) for livestock. Because many leguminous plants are nitrogen-fixing (alfalfa, soybeans, clover etc.), these plants are grown as soil-building crops as well.

The Leguminosae also includes species regarded as ornamentals, such as wisteria (Wisteria), lotus (Lotus), lupine (Lupinus), and even kudzu (Pueraria lobata). Kudzu, now regarded as a noxious weed in parts of the U.S., was originally brought here from Japan as an ornamental.

In sum, "From an economic point of view the pea family is second in importance only to the grass family" (Benson 1979: 296). Paradoxically, for both the pea and grass (Poaceae) families, this economic importance as food, fodder, fertilizer or ornamentals, is not matched by medicinal importance. As Moerman (1979; 1989) has determined through statistical analysis of North American medicinal plants, both the Poaceae and Leguminosae are low-use families in this regard. A brief survey of Perry's Medicinal Plants of East and Southeast Asia shows that out of several thousand plant species in this source, approximately 10% belong to the Leguminosae. A survey of Altschul's Drugs and Foods from Little-Known Plants (1973) had similar results. Out of 5178 individual entries, only 353 (less than 10%) are from the Leguminosae.

This is not to say that members of this family are not important contributors to pharmacology; however, of the species which do contain bioactive principles, many are quite toxic. Major chemcial constituents of the Leguminosae include "alkaloids, heterosides or various little-known substances which render them toxic" (Paris and Dilleman 1960: 71). As Benson observed earlier concerning the distribution of leguminous plants in the United States, many of these species are found in arid regions of the world. Consequently, the secondary metabolites which constitute their bioactive substances tend to accumulate under such dry conditions, rendering the plants even more toxic than species found in temperate areas. Paris and Dilleman observe:

> So far as we are aware no alkaloidal species of the arid zones has so far been used therapeutically on any important scale, although research has already been done on some of them (1960: 71-72).

Some of the leguminous species which Paris and Dilleman discuss in Medicinal Plants of the Arid Zones (1960: 72-77) include:

> Retama spp. (subfamily Papilionoideae): a Mediterranean species which contains the hydroxysparteine alkaloid, retamine, a strong oxytocic, i.e., capable of inducing spontaneous abortion. This genus contained a great many alkaloids.
>
> Crotolaria spp.(subfamily Papilionoideae): a tropical and subtropical genus. Although some species are grown for use as fodder, many contain powerfully toxic alkaloids. Farnsworth et al. (1975: 566) list three species of Crotolaria (C. incana, C. juncea, and C. spectabilis) which contained at least four different alkaloids with abortifacient or emmenagogic properties. One of these alkaloids, monocrotaline, is known to cause poisoining in livestock (Lewis and Lewis 1977: 42).
>
> Piptadenia spp. (subfamily Mimosoideae): native to South America and Florida, some species are smoked as hallucinogens in South America. The hallucinogenic principle was identified as bufotenin.
>
> Cassia spp. (subfamily Caesalpinioideae): the cathartic medicine, senna, is made from these species. The active principles are anthranols and anthrones. Several toxic principles are found in Cassia, according to Lewis and Lewis (1977: 42): anthraquinones and hydrocyanic acid. "Cassia spp. are toxic though not fatal to sheep and other animals in the United States; elsewhere, fatalities to hogs, sheep and cattle have been reported, as well as human deaths from herbal remedies containing Cassia" (Lewis and Lewis 1977: 42).
>
> Acacia spp. (subfamily Mimosoideae): the acacias, native to tropical and subtropical areas, yield gum arabic, an important emulsifier used in making candy, glues, etc. Many species contain potentially toxic cyanogenic glycosides (Lewis and Lewis 1977: 42).

> Astragalus spp. (subfamily Papilionoideae): a few species of Astragalus, one of the genera represented in the random sample for this thesis, produce gum tragacanth. (Gum tragacanth is used mainly as an emulsifier in the pharmaceutical industry). These species are "distributed over the sub-desert regions of Asia Minor, Kurdistan, and Iran. All are thorny often bushy suffrutices with deciduous leaves and yellow flowers" (Paris and Dilleman 1960: 76).

Other members of the Leguminosae which are used as flavorings, foods, or medicines include licorice, carob-bean (Ceratonia silique L.) and fenugreek (Trigonella foenum-graecum).

Fertility-Affecting Species

Farnsworth et al. (1975: 565-567) reported the results of chemical evaluation of members of the Leguminosae for abortifacient, emmenagogic and uterine stimulant activity. Some of the genera represented included Acacia, Albizzia, Astragalus (A. hamosus), Bauhinia, Caesalpinia, Cassia, Crotolaria, Glycyrrhiza, Lupinus, Sesbania, Tephrosia, and Trigonella (T. foenum-graecum). Of this partial listing, all but three genera contained species with potentially toxic compounds. The active constituents of these plants included alkaloids such as nicotine, tyramine, sparteine and monocrotaline, whose potentially toxic properties contribute to their ability to produce an abortifacient or emmenagogic effect. For example, Lewis and Lewis included the following in a listing of internal poisons:

> Caesalpinia pulcherrima: "the leaves of this species are used as a fish poison in Guatemala and Panama, and the seeds have been used to poison criminals" (Lewis and Lewis 1977:42). Perry (1980: 207) says that

the leaves, wood, and bark of this species are reported to be an emmenagogue in Indo-China.

Sesbania spp.: the seeds of members of this genus contain saponins which are dangerous to animals. The flowers of this genus are also reported to be poisonous (Lewis and Lewis 1977: 45). The seeds of this genus (various species) are used as an emmenagogue in Egypt and Asia (Farnsworth et al. 1975: 544; Perry 1980).

Lily Perry's collection of East and Southeast Asian medicinal plants (Perry 1980) included many of the leguminous species cited as fertility-affecting plants in Farnsworth et al. (1975). Daniel Moerman's database, Medicinal Plants of North America (1986), lists the following members of the Leguminosae as being used as emmenagogues or parturifacients by indigenous peoples of North America: Lotus humistratus (hill lotus); Astragalus pachypus (locoweed); A. purshii (wooly pod); Psoralea leucolata (scurf pea) and Prosopis pubescens (Fremont screwbean). All of the genera listed above have one or more species known to be toxic to either animals or humans (c.f. Lewis and Lewis 1977: 42-46). In terms of distinctive plant attributes, it is mainly those members of the Leguminosae which occur in the tropics and subtropics which possess distinctive features such as showy flowers, for example, the wildly shaped bird of paradise flowers (Caesalpinia spp.), or the puffy, sweet-smelling flowers of mimosa (Albizzia julibrissin). Some members of this family are armed with thorns, which tend to make them noticeable, eg honey locust (Gleditsia triacanthos), black locust (Robinia pseudoacacia) or mesquite (Prosopis spp.). According to Genders (1977: 73) almost all members of the Leguminosae bear flowers with a vanilla-lemon odor.

Genus Astragalus

The genus Astragalus numbers approximately 1600 species of annual or perennial herbs or subshrubs distributed worldwide, except for Australia (Genders 1977: 117). In North America, there are almost 200 species of Astragalus found mostly in the west (Saunders 1934: 247). Members of this genus are characterized by:

> odd-pinnate leaves, spikes or racemes of usually small, narrow flowers generally produced from the leaf axils, the seed pods mostly bladdery or swollen. These, when dry, have a habit of rustling noticeably in a passing breeze, whence another common name, rattleweed (Saunders 1934: 247).

The flowers of Astragalus are usually purple-blue, bee-pollinated flowers (Genders 1977: 114), although some arid-lands species have yellow flowers (Paris and Dilleman 1960: 76). Few species of Astragalus are scented; Genders (1977: 117) says that only two species, A. glycyphyllos (in the random sample for this study) and A. gummifera are scented. Both species have scented foliage, and Genders notes that A. gummifera may have been the "bed of spices" mentioned in the Song of Solomon.

Members of this genus , whose common names include the milk vetches, poison vetches, or locoweeds, contain a number of potentially toxic compounds (c.f. Lewis and Lewis 1977: 42). These compounds pose a particular threat to livestock:

> Astragalus is often abundant where horses and cattle graze, and certain species have been found to create serious trouble with animals that eat the herbage. They become afflicted with a sort of insanity, or as the Westerners say, they are 'locoed,' the victims of a slow poisoning Saunders (1934: 247).

Saunders' description of Astragalus indicates that some members of this genus, aside from being toxic, are common in disturbed places, such as areas affected by overgrazing.

Medicinal Uses

The major medicinal use category for this genus appears to be as a tonic: Perry (1980: 206) lists five species of Astragalus as medicinals in East and Southeast Asia, most of which are described as tonics. The roots of several species of this genus are said to have sweet, warming properties, and a root decoction is administered to treat night sweats, gastric and pulmonary diseases, diarrhea and nervous disorders (Perry 1980: 206). A. membranaceus, native to northern China and areas further north, is the species most often use medicinally in Asia, according to Perry (1980: 206). Other species which are used interchangeably with A. membranaceus include A. tongolensis, A. mongolicus, A. sinicus, and A. scaberrrimus. In addition to their use as tonics, the above-ground plant parts of A. sacberrimus are used to treat syphilis, scrofula and gall bladder trouble (Perry 1980: 206); A. sinicus is used to treat blenorrhea, as well as being part of the formula for an analgesic ointment for burns (Perry 1980: 206). Perry lists no fertility-related uses for Astragalus.

In North America, the uses of Astragalus are not as numerous as in Asia. Densmore's research on the medicinal plants used by the Chippewa reports on only one species, A. crassicarpus, with two medicinal uses. As part of a compound medicine, this herb was used as a treatment for the nervous system (Densmore 1928: 336-337) or as a tonic (Densmore 1928: 364-365). These uses parallel the medicinal uses of other species of Astragalus in Asia, as described above.

References to fertility-related uses of this genus are few. Aside from A. glycyphyllos, which will be discussed in the following section, Farnsworth et al. (1975: 565) report on only one other species, A. hamosus, with fertility-affecting properties. A. hamosus, a species commonly found in the drier parts of the world (c.f. Paris and Dilleman 1960), and used medicinally in India, exhibited both abortifacient and emmenagogic activity under experimental conditions (Farnsworth et al. 1975: 565). Moerman (1986) states that a root decoction of two species, A. pachypus and A. purshii, was employed by the Kwaiisu of North America for menstrual pain.

Astragalus glycyphyllos

Scientific name: Astragalus glycyphyllos
Synonym(s): Astragalus glycyphyllus
Common name(s): milk vetch; wild licorice
Distribution: native to the British Isles
References: Farnsworth et al. (1975); Genders (1977); Lewis and Lewis (1977); Paris and Dilleman (1960); Perry (1980); Radford et al. (1968).
Related species: A. adstringens Boiss. & Haussn.; A. gummifera Labill.; A. hamosus L.; A. heratensis Bunge.; A. membranaceus Bge.; A. mongolicus Bge.; A. scaberrimus Bge.; A. sinicus L.; A. tongolensis Ulbr. (Old World species); A. canadensis L.; A. michauxii (Kuntze) Hermann; A. mollisimus Torr.; A. villosus Michaux (New World species).

Astragalus glycyphyllos is a glabrous prostrate perennial native to the British Isles, where it is commonly found growing on "grassy banks" (Genders 1977: 117). As its common name, wild licorice, implies, the leaves of this herb possess a sweet, aromatic, licorice-like scent when crushed. In a genus containing very few members which are scented, only A. glycyphyllos and A. gummifera are scented (Genders 1977: 117). Typical morphological characteristics of this species include:

Leaves: large, pinnate, and scented;

Flowers: greenish yellow, scentless; flowering time is June;

Fruit: typically a legume.

Fertility-Related Uses

In a Soviet study evaluating its antifertility properties, a water extract of the whole plant of A. glycyphyllos was administered in a continuous oral dosage to rats. This resulted in an "increased duration of the estrous phase of the cycle (Farnsworth et al. 1975: 550). The effects of this herb on humans have not been experimentally evaluated.

Genus Pisum

Although there are many varieties of Pisum, (e.g., green, white, yellow, wrinkled, smooth, etc.) there appears to be only one species in this genus. Older sources identified P. arvense as a separate, species, but it has now been reduced to varietal status. Likewise, some older identifications of species of Pisum, such as Pisum maritimum L. (beach pea), are now subsumed under the genus Lathyrus (L. maritimus (L.) Bigel. (Britton and Brown 1970: 417). The wild progenitors of this cultivated specis, P. elatius, and P. humile, originated in the Near East, and are completely interfertile with P. sativum (Zohary 1989: 363-364).

Pisum sativum

Scientific name: Pisum sativum var. arvense (L.) Poiret
Synonym(s): P. arvense; P. majus
Common name(s): field pea; garden pea; arveja; alverja; guisante
Distribution: cultivated worldwide; in eastern North America, it has escaped from cultivation and is "... doubtfully established in fields and waste places" (Radford et al. 1968: 632)
References: Farnsworth et al. (1975); Hedrick (1972); Lewis and Lewis (1977); Oblitas Poblete (1969; Perry (1980); Potterton (1983); Radford et al 1968).

Pisum sativum is an "annual, glabrous, sprawling or climbing vine 0.5-2.0 m. long" (Radford et al 1968: 632). Typical morphological characteristics of this species include:

> Leaves: "pinnate, glaucous, with well-developed terminal tendrils; leaflets 2-6, ovate or oblong to widely elliptic, 2-6cm long" (Radford et al. 1968: 632).
>
> Flowers: in axillary racemes; flowers "butterfly-shaped", purple and violet in color, slightly vanilla-scented (Genders 1977: 73).
>
> Fruit: a flattened to rounded legume 3-6 cm. long; when dry, breaking into two, many-seeded valves.

Medicinal Uses

Ethnographic references concerning the medicinal uses of P. sativum are few. Both Lewis and Lewis (1977: 218) and Perry (1980: 229) report that the legumes of P. sativum are eaten as a treatment for diabetes in Asia. This medicinal use is supported by experimentation, which showed that the seeds of this plant exhibited hypoglycemic activity i.e., lowered the blood sugar levels of persons eating them (c.f. Farnsworth and Segelman 1971). Additional medicinal uses cited by Perry (1980: 229) for China include use as a "cooling" food for feverish conditions, and as a way to "increase flesh" (for overly thin individuals). Oblitas Poblete (1969: 79), in Plantas Medicinales de Bolivia, notes P. sativum is used for similar purposes among the Aymara, Quechua, and Hispanic populations of Bolivia. Peas are prescribed as a nutritional supplement, due to their high nutritional value; they are also held to be effective treatments for arteriosclerosis, upset stomach, rheumatism, kidney disorders, heart problems, poor circulation, and as a topical application for tumors (Oblitas Poblete 1969: 79).

Fertility-Related Uses

Farnsworth et al. (1975) summarize the results a number of studies on the fertility-related uses of Pisum sativum. For example, the seed oil of this plant is reportedly used for antifertility purposes in India (Farnsworth et al. 1975: 544). This folkloric use is supported by experimentation with human subjects: when an m-xylohydroquinone extract of the seed was administered by mouth to a female test group on days 16 and 21 of the menstrual cycle, a relative reduction in the number of actual vs. expected pregnancies resulted (Farnsworth et al. 1975: 551).

Non-Medicinal Uses

The many varieties of peas have been an important food source for humans for thousand years. Sturtevant (Hedrick 1972: 442) provides an amusing overview of the history of the pea in Europe, where it was not a common food item until the eighteenth century. Apparently, when peas began to become more generally available in late seventeenth century Europe, they became a status food item that only the rich could afford. A letter, written in

1696 by a Madame du Maintenon, a French noblewoman, shows the novelty of peas at this time (quoted in Hedrick 1972: 442):

> This subject of peas continues to absorb all others...the anxiety to eat them, the pleasure of having eaten them and the desire to eat them again, are all three great matters which have been discussed by our princes for four days past. Some ladies, even after having supped at the Royal table and well supped too, returning to their own homes, at the risk of suffering from indigestion, will again eat peas before going to bed. It is both a fad and a madness."

In summary, although P. sativum possesses several of the criteria of perceptual salience, such as being a "controlled" plant, and being faintly scented, its primary use is as a food item, rather than a medicinal. The dearth of information concerning the medicinal uses of this species bears out this assertion.

III. PLUMBAGINACEAE

LEADWORT FAMILY

The Plumbaginaceae, which is somtimes called the Armeriaceae, is a medium-sized family composed of approximately 10 genera and 500 species of perennial herbs, shrubs, and sometimes woody vines, which are widely distributed throughout the world (Benson 1979: 252-254; Bor and Raizada 1954: 11; Heywood 1978: 79). The center of this family's distribution is in the arid regions of the Eastern Hemisphere such as the Mediterranean region and Central Asia, although the Plumbaginaceae are "especially frequent in dry or saline habitats such as sea coasts and salt steppes (Heywood 1978: 78; also Benson 1979: 254; Li 1978: 90).

Few members of the Plumbaginaceae occur in the United States and Canada. Armeria maritima (thrift) is found in the north and along the Pacific Coast where it grows near the ocean. Several species of Limonium (sea-lavender) grow along both coasts of the United States, and one species of Plumbago, P. scandens (leadwort), "is native along the southern edges of Arizona, Texas, and Florida" (Benson 1979: 254).

Typical morphological characteristics of this family include:

Leaves: simple, entire, or rarely, lobed; alternate, often in rosettes; "characterized by the possession of many-celled glands, which secrete water, slime, or carbonate" (Bor and Raizada 1954: 11);

Flowers: inflorescence simple or compound; corolla tubular, 5-petalled; flowers red, white, or blue in color;

Fruit: an utricle or sometimes circumscissile but delayed in opening.

According to Heywood (1978: 79), the most common genera of the Plumbaginaceae include Limonium, with approximately 300 species; Acantholimon, with approximately 150 species; Limoniastratum, with 10 species; and Ceratostigma, with eight species. Other genera mentioned in the botanical literature include Armeria, Statice, and Plumbago.

Plumbago, which will be discussed in a separate section, is the genus most often used medicinally; the only other genus mentioned in the ethnobotanical literature is Limonium. Perry (1980) states that in Taiwan, L. sinense (Gir.) O. Ktze. (= Statice sinense Gir.) is employed as an antipyretic, hemostatic, and depurative. According to Heywood, (1978: 79), root extracts of the European species, L. vulgare, are "used to treat bronchial hemorrhages," and Lewis and Lewis (1977: 287) report that L. canadense, which is a powerful astringent, was used in 19th century North America as an antidiarrheal and medicine for dysentery.

Non-Medicinal Uses

The major non-medicinal use category for this family is as ornamentals. Because many species are low-growing, tufted, and adapted to drier environments, they are useful both as border plants and as members of a rock garden. Some of the more common low-growing ornamentals include Armeria (sea-pink or thrift); Limonium (sea-lavender); Acantholimonum glumaceum and A. venutum. Ceratostigma wilmottianum, a shrubby species, "is a popular ornamental garden shrub" (Heywood 1978: 79).

Genus Plumbago

There are approximately 12 species of Plumbago, which are mainly shrubs and subshrubs, distributed mostly in dry habitats and along seacoasts (Heywood 1978: 78-79). In North America, a single species, P. scandens, is found growing along the edges of Arizona, Texas and Florida (Benson 1979: 254). Only a few species of Plumbago are described at length in the literature.

According to Bor and Raizada (1954: 161), the generic name is derived from the Latin work for lead, plumbum, referring supposedly to the bluish, "lead-colored" flowers of some species. Bor and Raizada offer an alternate explanation for this plant's name:

> Pliny and Dioscorides, who wrote on medicinal plants in ancient times, prescribe decoctions of the plant Plumbago europaea as treatment for an affection of the eyes known in Latin as plumbum. The sap of the roots is also said to leave lead-grey colored flecks if applied to the skin (1954: 161).

Of all the species of Plumbago, only one bears scented flowers: P. capensis (Cape leadwort). Genders (1979: 520) likens the scent of its flowers to that of heliotrope (Heliotropum spp.-- Boraginaceae). For those unfamiliar with this scent, the flowers of heliotrope are often said to resemble either the smell of a freshly-baked cherry pie, or the odor of sweet almonds (Genders 1979: 240). P. capensis is "one of the few true blue-flowering plants to emit a powerful scent" (Genders 1979: 364). Heliotrope is one of the other rare, blue-flowered plants which is scented.

Medicinal Uses

The most common uses for species of Plumbago include (Bor and Raizada 1954: 162) externally: as a topical medication to "stimulate stagnant ulcers" and as a "counterirritant for toothache"; and internally: as a treatment for rheumatism and gladular swellings. Members of this genus also contain a bitter and vesicant (skin-irritating) principle, plumbagin, which causes painful blisters on the skin. Bor and Raizada comment concerning plumbagin:

> It is said to be identical with ophioxylin, which occurs in Rauwolfia serpentina, a species of the Apocynaceae, which is well-known in the Hindu pharmacopoeia. Plumbagin has vesicant properties and is said to be widely used in tropical countries as an abortifacient. As the juice causes large and painful blisters, its use for this purpose seems to be not unaccompanied by danger (1954: 161-162).

Windholz (1976) does not list ophioxylin in Merck's Manual; Bor and Raizada are probably referring to one of the alkaloids contained in Rauwolfia serpentina, which was formerly called Ophioxylon serpentarium. Vichkanova et al. (1973) determined that plumbagin, which they derived from P. europaea, exerted a broad-spectrum antimicrobial action against gram positive and gram negative bacteria. However, given the irritant properties of plumbagin, the utility of this principle is doubtful.

Species of Plumbago which are used medicinally include P. indica (= P. rosea; rose-colored leadwort), which is used for purposes similar to those of P. zeylanica, i.e., vesicant, rubefacient, and abortifacient. P. indica is regarded as a stronger (harsher) medicinal than P. zeylanica (Perry 1980: 317). The powdered root of P. capensis (Cape leadwort or wild plumbago) is used both in Africa (Watt and Breyer-Brandwijk 1962: 850) and India (Bor and Raizada 1954: 164) to remove warts. Given the highly caustic nature of the plant, this latter use is probably effective; also, P. capensis is also known to cause contact dermatitis (Hardin and Arena 1974: 15). In Africa, the roasted and pounded root of this species is applied topically as a remedy for "side stitches" and is rubbed into the scars over fractures (Watt and Breyer-Brandwijk 1962: 850). A decoction of P. capensis is also prescribed in Africa as a treatment for blackwater fever (Watt and Breyer-Brandwijk 1962: 850).

Fertility-Related Uses

Like P. zeylanica, which will be discussed at length in the following section, many other species of Plumbago are used as abortifacients. Farnsworth et al. (1975: 571) report that four species of Plumbago were experimentally evaluated for abortifacient, emmenagogic and uterine stimulant activity, all with positive results. For example, both P. capensis (leaves) and P.

indica (root; Farnsworth et al. refer to this species as P. rosea) exhibited uterine stimulant activity; P. indica and P. zeylanica (root and plant) also showed abortifacient activity. The active principle for all these species, plumbagin, was isolated from both P. europaea and P. zeylanica.

Non-Medicinal Uses

Watt and Breyer-Brandwijk offer an interesting discussion of the various magical uses of P. capensis in Africa:

> Both Xhosa and Zulu use the plant as a charm to ward off evil and the medicine man of the former uses it to confound an enemy in every sense of the word... An infusion of the root is emetic and this is probably why it is used for magical purposes. The plant is used to ward off lightning. Bantu evildoers also use the plant to confound an intended victim and his dog (Watt and Breyer-Brandwijk 1962: 850).

Watt and Breyer-Brandwijk also report that the death of an African woman resulted after her body was rubbed all over with the irritating powdered root-bark of P. capensis; whether this was intentional (murder) or not was not mentioned (1962: 850).

While P. capensis is not grown specifically as a fodder plant, poultry and other livestock eat the leaves, usually without ill effects. However, "under certain conditions, which are not properly understood, it becomes poisonous to animals" (Watt and Breyer-Brandwijk 1962: 850). It would be interesting to study this matter further to determine whether chemical changes are taking place in the plants themselves (as a response to herbivory, or changes in soil or moisture conditions, etc.), or whether the animals become sensitized to toxic compounds in the plants after eating these plants for a period of time.

Both P. capensis and P. indica are grown as ornamentals. P. capensis, originally native to the Cape of Good Hope area in Africa, is widely cultivated in India, as well as parts of North America. P. capensis is an evergreen bush which bears white or azure-blue, scented flowers, and is suitable as a hedge plant, or in borders, beds, or pots (Bor and Raizada 1954: 163-164). When this species is planted against a tree, it can climb up to 5 meters in height. P. rosea (= P. indica) is a "small shrub with pretty red flowers" (Bor and Raizada 1954: 165), which can be used a a bedding or potted plant. It is a native of India, but is cultivated in tropical areas throughout the world.

Plumbago zeylanica

Scientific name: Plumbago zeylanica L.
Synonym(s): none noted
Common name(s): leadwort; Ceylon leadwort
Distribution: "tropics of Asia and Africa, and east to Australia and Hawaii. Wild and extensively cultivated throughout India" (Bor and Raizada 1954: 153).
Related Species: P. auriculata; P. capensis Thunb.; P. europaea (the type species for the genus); P. micrantha; P. scandens
References: Bor and Raizada (1954); Heywood (1978); Li (1978); Perry (1980); Santapau (1967); Watt and Breyer-Brandwijk (1962).

Plumbago zeylanica, as its species name implies, is found in Ceylon (zeylanicus means "from Ceylon" in Latin), as well as southern India and other parts of the tropics. It is a shrubby plant which can be found growing both wild and cultivated throughout its range. In Khandala (a district of India), Santapau (1967: 140) notes that P. zeylanica is a common plant in that area, found mainly in the undergrowth of the forest or in forest openings and open country. In Taiwan, this species is commonly found in "thickets or grasslands at low elevations" (Li 1978: 93). Typical morphological features of P. zeylanica include (Bor and Raizada 1954: 162):

> Leaves: alternate, petiolate; leaf apex approximately 7 cm. long by 5 cm. broad, "ovate, acute, or obtuse, suddenly narrowed into a cuneate base, dark green above, rather pale below, glabrous, margin entire" (Bor and Raizada 1954: 162);
>
> Flowers: white, star-like, arranged in "terminal simple or branched racemes up to 12 in. (8 cm.) long; rachis very glandular and covered with a viscid exudation...Calyx 0.5-0.6 in. (1.25-2.0 cm.) long, conspicuously 5-ribbed, each rib ending in an acute calyx-lobe...covered all over with numerous stalked glands with spherical tips, very viscid" (Bor and Raizada 1954: 162). Flowering time: October-March.
> Fruit: the fruit is a capsule which is enclosed in a persistent calyx. Propagation is aided by the viscid, hairy calyx, which sticks to passing animals or humans. Fruiting time: December-March.

Medicinal Uses

The medicinal uses of P. zeylanica are related to the irritant and stimulant properties of its active constituent, plumbagin, which was described earlier in the section on the genus. Major therapeutic categories are divided between external and internal uses for this species. Externally, the irritant and vesicant properties are put to some advantage as treatments for skin disorders; internally, the bitter principle, plumbagin, is used to treat diarrheal complaints and as an abortifacient and emmenagogue.

References to the topical uses of this plant are frequent in the ethnobotanical literature; throughout Asia, the leaves and powdered root are decocted and applied as a vesicant, rubefacient, or counterirritant (Perry 1980: 317; Watt and Breyer-Brandwijk 1962: 850-851). The root and/or leaves of P. zeylanica, crushed and mixed with coconut oil, are employed in Asia as a topical ointment for "rheumatism, swollen glands, leprosy, headache, toothache, paralytic affections, tumor, ringworm, and all skin diseases" (Perry 1980: 317). In the Philippines, a root infusion is made into a wash for scabies; in Japan, a decoction of the plant, mixed with rice liquor, is a snakebite remedy (Perry 1980: 317). Watt and Breyer-Brandwijk (1962: 850-851) report similar uses for the plant in Africa. Additional medicinal uses for this species include its use as an anthelmintic for horses in Indonesia (Perry 1980: 317), and in Africa, a cold infusion is considered helpful in treating influenza and blackwater fever (Watt and Breyer-Brandwijk 1962: 850).

Fertility-Related Uses

The root of P. zeylanica, which is one of the postpartum "hot" medicines used by the Lua' peoples of Thailand (Kunstadter 1978: 191), is regarded throughout Asia and Africa as a dangerous, sometimes fatal, abortifacient (Perry 1980: 317). In the past, either P. zeylanica, or another species of

Plumbago, were used as a substitute for Rauwolfia serpentina (Apocynaceae), another well-known abortifacient plant (Bor and Raizada 1954: 161; Perry 1980: 317).

Watt and Breyer-Brandwijk's description of how this species is used as an abortifacient in India is frightening, given the powerful vesicant effects of plumbagin:

> The root is commonly used in India as an abortifacient either taken internally or as a local irritant to the os uteri. For the latter purpose a portion of the scraped root or of the twig is pushed into the vagina or sometimes even into the uterus. In other cases the end of an abortion stick is covered with a paste of the powdered root. Death has not infrequently resulted from the introduction of this highlu acrid material in any of these ways (Watt and Breyer-Brandwijk 1962: 850).

In addition to fertility-related uses in humans, Watt and Breyer-Brandwijk (1962: 851) report that the raw, bruised root is given to cattle and goats to make them "go into heat." Following the administration of P. zeylanica, the animals become restless and the desired effect occurs in a few days. Again, plumbagin, which is known to stimulate uterine tissue, may be responsible for the various fertility-related activities in both animals and humans.

Non-Medicinal Uses

In Africa, the irritating properties of Plumbago are employed in the practice of tatooing. In West Africa, the Sandwich Islands, and among the Masai of Africa, the skin surface is broken, and a paste of the powdered root is rubbed into the wound. Once the skin heals, a permanent design is left on the skin. No magical uses, similar to those recorded for P. capensis, were reported for P. zeylanica. P. zeylanica is a fairly common ornamental plant in India. Bor and Raizada (1954: 163) describe it as a "rambling...untidy shrub" whose appearance is aided greatly by "judicious pruning and training."

Summary

In summary, P. zeylanica exhibits four out of the five criteria of perceptual salience: it is a "controlled" plant (cultivated as an ornamental); it is highly irritant; its flowers, while not particularly showy, are considered attractive, and the sticky, hairy calyx is unusual-looking; it is used in veterinary contexts as a anthelmintic; and the plant is poisonous in sufficient doses. Although P. zeylanica is not scented like P. capensis, it is bitter-tasting.

IV. RUTACEAE

RUE OR CITRUS FRUIT FAMILY

The Rutaceae is a large family composed of approximately 110 genera and 900 species of shrubs, trees, or rarely, herbs which are found primarily in tropical and subtropical regions (Benson 1979: 204; Britton and Brown 1970: 443). Areas where this family are especially abundant are South Africa and Australia (Britton and Brown 1970: 443). In North America, there are very few native representatives of this family, although several species of Citrus were introduced into peninsular Florida and the Florida Keys by the Spaniards in the 17th century, and have become naturalized (Benson 1979: 204).

One distinctive characteristic of the Rutaceae is their foliage: the leaves are described by Britton and Brown (1970: 443) as "glandular-punctate." The glands which are also located on the fruits (except in Ptelea [hoptree]), contain essential oils, making the plants heavily-scented (Benson 1979: 204-205; Britton and Brown 1970: 443) Genders (1977: 73) characterizes the scent of members of the Rutaceae as "orange-lemon," although the scent of individual species may vary. Typical morphological features of the Rutaceae include:

Leaves: simple, palmate, or pinnate; arranged in an alternate or opposite manner;

Flowers: almost always radially symmetrical; white or greenish-white in color;

Fruit: "usually a berry with a leathery rind or separating into segements or a capsule, but sometimes a samara or drupe" (Benson 1979: 204).

Oranges, lemons, and other citrus fruits are important cultivated members of the Rutaceae; these will be discussed in the section on the genus Citrus. Other cultivated species in this family include rue (Ruta graveolens), gas plant or burning bush (Dictamnus dasycarpus) and many of the species described below.

Medicinal Uses

In Asia, where this family is most abundant, the medicinal uses ascribed to the Rutaceae are numerous. A review of Perry's (1980) compendium of medicinal plants of east and southeast Asia reveals that approximately 19 genera and many more species are used as medicinals throughout Asia. Major medicinal use categories include external uses as vulneraries (skin soothers), and internal uses as febrifuges, stomachics, carminatives, antidiarrheals, laxatives, vermifuges, insecticides, and to treat rheumatism and various fertility-related conditions. Most uses are related to the astringent properties and bitter taste of the medicinals, which are due to a number of essential oils and alkaloids contained in various plant parts. An abbreviated listing of Asian medicinal species and their uses includes the following plants condensed from Perry (1980: 361-372):

Acronychia pedunculata (L.) Miq.: the wood is regarded as an anodyne and styptic; the resin is used against rheumatism; the bark and leaves treat scabies; and the bark and leaves are made into a colic medicine.

Aegle marmelos Correa: the half-ripe fruit, which is very astringent, is given for diarrhea; the ripe fruit, however, is a laxative as well as a treatment for rectitis, tuberculosis, liver trouble and heart palpitations. The young leaves, crushed, are used to treat various skin irritations. Aegle marmelos contians marmelosin, a diuretic and laxative compound.

Clausena excavata Burm. f.: this bitter and astringent plant is used as a stomachic, emmenagogue, and post-partum medicine. The roots are sudorific, and the leaves are used as a vermifuge and insecticide.

Dictamnus dasycarpus Turcz.: this plant possesses an unusual "goat-like odor" (Perry 1980: 364) and preparations of the root are used internally for jaundice, headache, colds, rheumatism, and liver diseases. The plant are used externally to treat itching, scabies and boils.

Evodia spp. (=Euodia): members of this genus are most often used as febrifuges, and the leaves are vulnerary. E. rutaecarpa fruits are stimulant, astringent, deobstruent, carminative, stomachis, and anthelmintic. The roots are used to kill tapeworms. Perry states that the Solomon Islanders "use E. peekeli Lauterb. to counteract poisons, perhaps more on account of the odor of the leaves than any other reason" (Perry 1980: 365).

Micromelium spp.: M. falcatum (Lour.) Tan. leaves are considered emmenagogic and are also used to treat sores and insect bites. The root is a post-partum medicine. M. minimum (Forst. f.) W & A or M. pubescens Bl. is used as both a vulnerary and emmenagogue.

Murraya paniculata (L.) Jack: a leaf decoction is taken internally for stomachache, chronic dysentery, and as an emmenagogue and vermifuge; externally, for bruises and skin irritations Perry 1980: 367).

Ruta spp.: in Indonesia, Ruta "may be prescribed to treat tetanus, syncope, dropsy, neuralgia, and rheumatism, but it should not be given to pregnant women or to weak people....It has antispasmodic, emmenagogue, sudorific and anthelminthic properties" (Perry 1980: 368). Ruta has been used for similar purposes in Europe and

Mesoamerica (c.f. Luis Diaz 1976; Potterton 1983). Heywood (1978: 204) notes that rue is given to poultry to treat croup.

Zanthoxylum spp.: major uses of the many species of this genus include the use of the fruit to treat toothache; as an insecticide or vermifuge; as a stomachic and carminative; and as an emmenagogue. Of Z. nitidum (Roxb.) DC., Perry (1980: 369-370) says: "the pungent seeds will stupefy fish."

Additional members of the Rutaceae mentioned by Perry include Atalantia spp. (1980: 361); Feronia limonia (L.) Swingle (1980: 365); Fortunella japonica (Thunb.) Swingle (1980: 365); Glycosmis pentaphylla (Retz.) Correa (1980: 366); Phellodendron amurense Rupr. (1980: 367); Poncirus trifoliata (L.) Rafin. (1980: 368); Tiphrasia spp. (1980: 369) and Swingleya glutinosa (Blco.) Merr. (1980: 371).

Fertility-Related Uses

Farnsworth et al. (1975: 545, 553) have summarized the results of experimental investigations of the Rutaceae for antifertility, emmenagogic, abortifacient, and uterine stimulant effects. Many of the same species reported by Perry in the preceding section also appear in Farnsworth et al.'s listing. The following plants either demonstrated fertility-affecting properties experimentally, or also contained active constituents known to produce fertility-affecting activity:

Clausena anisata: both the leaf and the whole plant demonstrated abortifacient activity.

Dictamnus albus (= Dictamnus dasycarpus): both the leaf and the whole plant were abortifacient; the root exhibited emmenagogic activity. The active constituents dictamine and skimmianine were isolated from the plant.

Euodia hortensis f. hortensis (= Evodia): the bark juice exhibited emmenagogic activity, and the active constituent berberine (also found in Berberis vulgaris) was isolated.

E. inu-akend, E. roxburghiana and E. rutaecarpa: these species had either emmenagogic or uterine stimulant properties. E. roxburghiana also exhibited fertility-suppressing activity in experiments using mice.

Lunasia amara: the active constituent, lunamarine, known to have emmenagogue, abortifacient and uterine stimulant activity.

Pilocarpus jaborandi: the active constituent, pilocarpine, was isolated from the leaves of P. jaborandi.

Ruta graveolens: the active constituent skimmianine, was isolated; in experiments, the leaf, root, and whole plant demonstrated abortifacient, emmenagogic, or uterine stimulant activities.

R. hortensis: the plant exhibited uterine stimulant activity under experimentation.

R. montana: the leaf of theis species showed abortifacient activity under experimentation.

Non-Medicinal Uses

Aside from their uses as medicinals, members of the Rutaceae are widely cultivated as food, flavoring, or ornamental plants. For example, Ruta graveolens (rue) is cultivated worldwide not only as a medicinal herb, but as a culinary herb as well (Root 1980: 66), although the leaves have a rather bitter taste (Potterton 1983: 160). Sturtevant's Edible Plants of the World (Hedrick 1972: 515) says:

> Formerly the English as well as the Germans and Dutch used the green leaves of rue in their ragouts. The leaves are used as a pickle. The Italians are said to eat the leaves in salads.

According to Perry (1980: 368), the plant (minus the roots) is stir-fried with mung beans and eaten as a vegetable in China. Lust (1974: 517) notes that rue is a "favorite Balkan seasoning," and its leaves can be used sparingly as a flavoring for many foods, although he advises: "Rue can produce allergic reactions similar to poison ivy in some individuals, so it is best not to season dishes with it for company." Casimiroa edulis (white sapote or matasano) produces "a greenish, quince-like" fruit, which yields a "delicious, sweet, cream-colored pulp, a little more bitter than the marmalade fruit" (Calocarpum sapota- Sapotaceae) (Pesman 1962: 240). The fruit of Ptelea trifoliata, resembles hops (Humulus lupulus), as its common name, hoptree, implies. The bitter-tasting fruits of the hoptree have been used, like hops, to impart a bitterish flavor to beer (Hedrick 1972: 470). Perry (1980: 368) says that all parts of Toddalia asiatica Lamk. are aromatic, bitter, and pungent, and are used to flavor foods in Asia. Almost all species of Citrus, which will be discussed below, are cultivated for their edible fruits.

Members of the Rutaceae are also cultivated as ornamentals: the many species of Citrus, for example, are grown for their handsome, dark-green and glossy foliage, their flowers, fruit, and pleasant scent. Dictamnus dasycarpus, depite its unpleasant odor, yields attractive pinkish flowers, and is often grown as an ornamental (Bor and Raizada 1954). Poncirus trifoliata (trifoliate orange), a thorny shrub which bears small, hard and inedible green fruits, is "used in the United States and along both coasts as a hedge plant. It is also cultivated extensively to obtain root stock for citrus grafts" (Lampe and McCann 1985: 137).

Summary

It can be seen from the above discussion that members of the Rutaceae are among some of the most "noticeable" of plants. These herbs, shrubs and trees contain chemical compounds which have made them the target of human experimentation as medicinals, flavorings, perfumes, foods, and ornamentals.

For example, the essential oils which are secreted by glands in various plant parts are, for the most part, pleasantly scented. Oil of Portugal, which is used in perfumes, is derived from a variety of Citrus aurantium (Seville orange; in the random sample); Oil of Neroli is obtained from the blossoms of C. bigarradia (bitter orange) (Genders 1977: 154-155).

Humans have also discovered the piscicidal and insecticidal properties of the Rutaceae. Species which are used for these purposes include Clausena excavata and Zanthoxylum spp. The insecticidal activity of this family is largely due to the presence of limonoids, "a class of C-$_{26}$ bitter principles occurring in the Meliaceae, Rutaceae, and Simaroubaceae" (Mabry and Gill

1979: 531-532), which function as insecticides as well as feeding deterrents to herbivores.

The toxic properties of the rue family are not reserved solely for insects; humans are susceptible as well. For example, the fruit of Poncirus trifoliata, which is frequently grown as an ornamental and hedge plant, is toxic if consumed by humans. The factors which contribute to its toxicity are unknown, but may be due to a saponin (Lampe and McCann 1985: 137). Lampe and McCann also list the following plants of the rue family as causing phytophotodermatits (sun sensitivity): Citrus aurantiifolia (Christm.) Swingle (lime); Dictamnus dasycarpus, Ptelea anisata (= Clausena anisata (?); listed in Farnsworth et al. 1975: 574); and Ruta graveolens. Pammel (1911: 581) elaborates concerning the irritant properties of Ruta graveolens, saying that rue "has a strong disagreeable odor, and is so acrid that it will even blister the hands. It contains an acrid narcotic poison." Mechanical irritation can also occur as a result of contact with some species in this family: several species of Citrus, as well as Poncirus trifoliata are armed with spines (Genders 1977: 154).

Genus Citrus

Citrus is a relatively small genus, composed of approximately 12 species (and many varieties and hybrids) of trees and small shrubs native to China and Japan. Because many members of this genus are cultivated for their edible fruits, or as ornamentals, this species is found throughout the warmer parts of the world, either under cultivation, or naturalized (Genders 1977: 154). Roy Genders describes this genus as being:

> often spiny, with alternate leaves in certain species joined to the stem with a winged foot stalk. The flowers are extremely fragrant and are white, appearing in a never-ending succession at the same time as the fruit (Genders 1977: 154).

Members of the Citrus Family are cultivated for their fruits, which are eaten or used in the manufacture of perfumes. The flowers of several species are sources of essential oils used in the manufacture of both medicines and perfumes.

Medicinal Uses

Citrus is a well-known and well-documented genus, so the following discussion is an extremely abbreviated listing of some of this genus' most common medicinal uses. Although a multitude of uses are reported for Citrus, the most common therapeutic categories include uses as a febrifuge, carminative, and discutient. The latter uses may be, in part, related to the presence of volatile and essential oils, ascorbic acid, and citric acid.

Watt and Breyer-Brandwijk list a variety of medicinal uses for members of this genus. For example, they report that the leaf of Citrus aurantifolia (lime) is prescribed as a febrifuge in many parts of the world (1962: 914), probably as part of a tea. Additional internal uses for limes include the use of the fruit juice as a cough reliever, tonic and stomachic in Malaysia; and in Senegal and Sierra Leone the juice is mixed with oil to make a vermifuge (Watt and Breyer-Brandwijk 1962: 914). Externally, lime juice is used to clean wounds and stimulate healing, and "roasted cut lime is applied to chronic sores and yaws" (Watt and Breyer-Brandwijk 1962: 914). Use of lime as a topical treatment is rather surprising in light of the fact that its juice is known to cause photodermatitis is some individuals (Lampe and McCann 1985: 199; Watt and Breyer-Brandwijk 1962: 914). The leaf of C. grandis (shaddock or pummelo) is steeped in water to make a fragrant bath; the leaf, flower and pericarp of this same species are decocted or infused to make a sedative (Watt and Breyer-Brandwijk 1962: 915). In South Africa, C. limon (lemon) juice is mixed with salt to make a treatment for ringworm, and in the Transvaal region, lemon juice is part of a compound medicine for coughs and colds (Watt and Breyer-Brandwijk 1962: 915). Perry (1980: 361-363) reports that in Asia, C. aurantifolia and C. grandis are used for purposes similar to those given by Watt and Breyer-Brandwijk for Africa. She adds that the bark of C. limon is also used as a stomachic and bitter tonic in Asia. In China, C. medica (citron) and C. medica var. sarcodactylis are used as stomachics, febrifuges and vermifuges (Perry 1980: 363).

An interesting aspect concerning several species (and one hybrid) of Citrus is their ability to purify water. An effective germicidal activity is obtained when one part juice is mixed with 15 parts water and allowed to stand for a half hour: both typhoid and dysentery organisms are destroyed. A mixture of one part juice to 50 parts water will render cholera-infected water safe to drink as well (Perry 1980: 362-363). In parts of the world today, safe drinking water is scarce, and dysentery and other diarrheal complaints are extremely common (c.f. Logan 1973) . Public health offficials often recommend that unsafe water should be boiled, but when fuel is also a scarce commodity, this is impractical. Although Perry does not say how commonly citrus juice is used to purify water, the public health implications of her comments are obvious.

Fertility-Related Uses

Several species of Citrus are employed as fertilty-affecting plants. Perry (1980: 363) reports that the "root of the calamodin is an ingredient in medicine used at childbirth." The calamodin is a hybrid, Citrus x Fortunella, also known as C. mitis. Farnsworth et al. (1975: 545) say that two species, C. maxima (=C. paradisi-- grapefruit) and C. medica are used as antifertility agents in India. The fruit of C. medica is made into a water diciction and drunk; no information was provided concerning the preparation of C. maxima.

Two active constituents which may account for the uterine stimulant, abortifacient, or emmenagogic activity of this genus have been isolated from an unspecified species of Citrus: tyramine and hesperidin (Farnsworth et al.

574). The fertility-related uses of members of this genus, as well as other genera, have been linked to an idea prevalent in Mesoamerica: that is, bitter-tasting plants are "irritating" and thus should be effective as emmenagogues or abortifacients (Browner and Ortiz de Montellano 1986).

Non-Medicinal Uses

Because many members of this genus bear large, juicy, and edible fruits, the best-known non-medicinal uses for various citrus fruits are as sources of foods or beverages. The fruits of C. aurantifolia, C. grandis, C. limon, C. medica, C. nobilis (tangerine) and C. paradisi are all used to make beverages or preserves, or are used as flavorings. Genders reports that several species are sources of oils used in perfumery, especially C. bigarradia, whose flowers are the source for oil of Neroli. Many more species, which bear fragrant and attractive flowers as well as foliage, are grown as ornamentals. Several of the species listed above are also grown as ornamentals; other ornamental species include C. taitensis and C. trifoliata (Genders 1977: 155-157).

Summary

In short, members of this genus possess all of the traits proposed as contributors to perceptual salience. Species of Citrus are cultivated as food, medicinal, or ornamental plants; almost all species are scented; and the juice of at least one species, C. aurantifolia, is known to cause phytophotodermatitis. In addition, several species are used as vermifuges, and most species are armed with spines.

Citrus aurantium

Scientific name: Citrus aurantium L.
Synonym(s): none
Common name(s): Seville orange; bitter orange; sour orange
Distribution: native to Spain and Portugal, but widely cultivated elsewhere
Related species: (Many species may be hybrids, due to the long history of cultivation of this genus) C. aurantifolia (Christm.) Swingle; C. bigarradia; C. grandis (L.) Osbeck (=C. decumana L., C. maxima Merr.); C. ichangense; C. limon Burm. f.; C. medica L. and var. sarcodactylis (Noot.) Swingle; C. mitis (=Citrus x Fortunella); C. nobilis; C. taitensis; C. trifoliata
References: Bianchini and Corbetta (1977); Farnsworth et al. (1975); Genders (1977); Oblitas Poblete (1969); Perry (1980); Watt and Breyer-Brandwijk (1962).

Citrus aurantium, the Seville orange, is a native of Spain and Portugal. This species is a small tree which attains a height of approximately 1.2-1.3 m. The leaves of C. aurantium are oblong, its flowers "white and sweetly scented, and followed by small sour fruits with a reddish-orange skin" (Genders 1977: 155). The leaves are very aromatic as well.

Medicinal Uses

The medicinal uses of C. aurantium mirror those of the genus as a whole, that is, this species is used as a stomachic, febrifuge, and fertility-related medicine. The ethnographic literature from Asia, Europe, and South

America (Bolivia) indicate that the most commonly-mentioned therapeutic categories are as a diaphoretic, stomachic, purgative, febrifuge, and sedative (Bianchini and Corbetta 1977; Oblitas Poblete 1969; Perry 1980; Watt and Breyer-Brandwijk 1962). In addition to the latter uses, Perry says that the leaves are considered pectoral, and "helpful in treating bronchitis" (Perry 1980: 362). The leaves are mixed with other (unspecified) plants to make a medicine for influenza, and in the Philippines,

> The juice is taken as a laxative, with salt it is a remedy for ringworm; the essential oil is a useful liniment for gout and rheumatism; the roasted seeds are stimulant (Perry 1980: 362).

Fertility-Related Uses

Perry (1980), who has surveyed the ethnomedical literature for east and southeast Asia, lists no fertility-related uses for this species. There are few references to the folkloric use of this species as a fertility-affecting plant, although it has been chemically evaluated for such activity. According to Watt and Breyer-Brandwijk (1962: 915) and Farnsworth et al. (1975: 553) cirantin (a pyrone derviative of this species), or else a preparation of the fruit rind in cirantin, demonstrated an antifertility effect in experiments using rabbits. Oblitas Poblete (1969: 264-265) states that in Bolivia, a leaf infusion is used as an emmenagogue, and a tea made from the flowers is used as a parturifacient.

The active principle responsible for the contraceptive effect observed in the experiments using rabbits was cirantin. The fruit of C. aurantium also contains hesperidin, which is known to have uterine stimulant properties (Farnsworth et al. 1975: 574).

Non-Medicinal Uses

Like the other members of the genus Citrus, the fruit of C. aurantium is used to make preserves, marmalade (Watt and Breyer-Brandwijk 1962: 915) or perfume (Genders 1977: 155). The peel of the fruit of C. aurantium is used in Iran "to flavor rice and vegetables and in India in sauce, cream, jelly and honey" (Watt and Breyer-Brandwijk 1962: 915). C. aurantium is also grown as an ornamental, for its attractive and pleasantly-scented flowers and foliage (Genders 1977: 155).

Summary

Very little information is available concerning the medicinal uses of this species. Its principal uses are as a source of food, or of oils for perfumery, rather than as a medicinal. Nevertheless, like other members of its genus, it fits several criteria of noticeability: it is cultivated, and its leaves and flowers are scented. Although no ethnographic source reported the use of this species as an insecticide, insect feeding deterrents (limonoids) have been isolated from this and other species of Citrus (c.f. Mabry and Gill 1979).

V. UMBELLIFERAE

CARROT OR PARSLEY FAMILY

The Umbelliferae, also known a the Apiaceae or Ammiaceae, is a large family composed of approximately 300 genera and 2,500-3,000 species (Benson 1979: 329; Heywood 1978: 219). Members of this family are annual, biennial, or perennial herbs (although outside of North America, shrubby species occur), which are distributed mainly in upland, temperate regions of the Northern Hemisphere (Benson 1979: 329; Heywood 1978: 219). In North America north of Mexico, the family is represented by about 75 genera and 350 species. Heywood comments concerning this family:

> The Umbelliferae is one of the best-known famililes of flowering plants, because of its characteristic inflorescences and fruits, and the distinctive chemistry reflected in the odor, flavor and even the toxicity of its members (Heywood 1978: 219).

As Heywood mentions, it is easy to pick a member of the Umbelliferae out of a group of plants. The leaves of most umbels (as members of this family are called) are usually highly dissected and "feathery" looking; and the inflorescences are umbellate (umbrella-shaped):

> The characteristic umbel is a flat-topped inflorescence in which the individual flower stalks (pedicels) arise from the same point on the rays (peduncles), and are of different lengths so as to raise all the flowers to the same height (Heywood 1978: 219).

Inflorescences of the umbels are often compared to lace; for example, "Queen Anne's lace," a naturalized species found in waste places throughout North America, is an umbel, Daucus carota.

Medicinal Uses

The economic uses of this diverse family have been well-summarized by David French, in a paper entitled "Ethnobotany of the Umbelliferae" (French 1971). French asserts that few North American members of the Umbelliferae have become important sources of food or medicines; with a few exceptions, which will be noted below, this seems to be true. According to French, most of the economically important umbel species are from "North Africa, Europe, and western and southern Asia" (French 1971: 386).

The major therapeutic category of the Umbelliferae is for gastrointestinal complaints, such as upset stomach, nausea, diarrhea, or constipation. The abundant essential oils present in this family (and other families such as the Labiatae, mint family), are quite effective at expelling gas, soothing the stomach, and aiding digestion (Lewis and Lewis 1977: 272-273). Some of the plants French mentions in a general manner include Eryngium spp., used as diuretics; Foeniculum (fennel), for nausea; Cuminum cyminum (cumin), for diarrhea; and Ferula spp. (asafoetida) for constipation (French 1971: 388).

Several species of umbels are known to be poisonous; probably the most famous being Conium maculatum (poison hemlock), which the philosopher Socrates was compelled to drink as punishment in ancient Greece. Several species of Cicuta (water hemlock) and Oenanthe (dropwort) are also poisonous (French 1971: 389). French also mentions that Oenanthe crocata has been used to stupefy fish, and that "there are reports of arrow poison being made from one or another umbel" (French 1971: 389).

Fertility-Related Uses

This family is well-represented in listings of fertility-affecting plants. Farnsworth et al (1975: 576-577) alone list 23 genera and 43 species which produced abortifacient, emmenagogue, or uterine stimulant activity. The fruits, seeds, leaves, gums and resins of these plants were evaluated, and active principles responsible for these modes of action were isolated. For example, khellin (visammin) from Ammi visagna; coumingine from Daucus carota (carrot); and apiol from Petroselinum sativum (parsley).

Members of the Umbelliferae have been used throughout the world as emmenagogues and the like. In Asia, one of the best-known remedies is "dong-quai" or "tang-kuei" (Angelica spp.), the root of which is used to treat "gynecic disorders" (Mei-Ling: n.d.; Perry 1980: 410). In Mesoamerica, the root of a related plant, called osha (Ligusticum porteri) is a used as an emmenagogue (Morton 1981); Ligusticum (or Levisticum) scoticum (Scotch lovage) was used for similar purposes in Europe (Bunney 1984; Potterton 1983), as was Ligusticum canadense by the European settlers of North America (Scott 1982). The licorice-like scent and warm taste of the roots of Ligusticum and Angelica are similar; so similar in fact, that the European settlers called L. canadense "jellico" or "angelica" (Hamel and Chiltoskey 1975: 61; Scott 1982). Other genera and species used for fertility-related purposes include:

> Conioselinum: the rhizome of C. univittatum Turcz. is "considered to be a fragrant emmenagogue" in China (Perry 1980: 414); in North America, C. scopulorum was used as a postpartum blood purifier by the Kayenta Navajo (Moerman 1977).
>
> Foeniculum vulgare (sweet fennel): an introduced species, F. vulgare was used by the Cherokee as a tonic and parturifacient (Hamel and Chiltoskey 1975: 33; Moerman 1986).
>
> Lomatium nudicaule (Indian consumption plant): a seed infusion was used by the Kwaikiutl as a parturifacient (Moerman 1986).
>
> Pastinaca sativa (wild parsnip): an introduced species in North America, the root of this plant was used by the Ojibwa as part of a compound medicine for "female trouble" (Moerman 1977: 131).
>
> Sanicula: S. canadensis (bur snakeroot) was used as part of a compound medicine given to women during confinement (Moerman 1986); the Micmac of North America used the roots of S. marilandica (black snakeroot) to make a medicine for menorrhagia and as a parturifacient (Moerman 1986).

Of the fertility-affecting medicinals listed in Moerman's database, several, like Foeniculum, Pastinaca, and Sanicula, are considered "weedy"; they may also be cultivated as food or flavoring plants; and all are aromatic.

Non-Medicinal Uses

Many members of this family which are used for medicine are also food plants: major food plants of the Umbelliferae include Daucus carota and Pastinaca sativa, root crops which are cultivated worldwide. Other species which produce edible roots include Carum carvi L.(caraway), Chaerophyllum bulbosum L.(chervil), Conopodium majus (Gouan) Loret., Cymopterus spp., Eryngium campestre L. and Petroselinum crispum (Miller) A.W. Hill (French 1971: 386). In the New Worl, several species have been either cultivated or collected as staple foods: Arracacia xanthorrhiza Bancroft, in Peru; Perideridia spp.; and Lomatium spp., in North America (French 1971: 386).

The Umbelliferae are perhaps best knwown as a source of spices or flavorings. Some of the more important genera include Pimpinella (anise); Foeniculum; Anethum (dill); Apium (celery); Coriandrum (coriander, Chinese parsley, or cilantro); and Cuminum (cumin or comino); all of which are also used as medicinals (French 1971; Oblitas Poblete 1969; Root 1980).

Very few species of umbels are grown expressly as ornamentals. According to Heywood (1978: 219), Heracleum mantegazzianum (giant hogweed), Astrantia spp. (masterwort) and Eryngium gigantium are considered ornamentals. However, several species are grown as sources of scents for perfumes and other products. For example, Angelica archangelica, Carum carvi, Cuminum cyminum, Daucus carota and Ferula sumbul (sumbul, or musk root) are sources of essential oils used commercially as scents

(French 1971: 390). The resins exuded by some species of umbels are burned as incense, most notably Dorema ammoniacum, Ferula galbaniflua and F. sumbul (French 1971: 390).

Summary

As Heywood noted in the beginning of this section on the Umbelliferae, the members of this family are some of the most easily-recognized plants in the world, due to their characteristic flowers, tastes, and odors. In addition, while umbels are rarely true staple food plants, they are among some of the most often-used root crops, and are a major source of flavorings for other foods.

This economic importance as foods or flavorings is not, however, reflected in the number of major medicinal plants which come from the Umbelliferae. French attempts to delineate some of the reasons for why few umbels have become major medicinals. One possible reason is that this family contains few alkaloids, and alkaloids are most commonly associated with bioactivity in plants. French also observes, as was stated earlier in the section concerning the Leguminosae, if a plant family acquires a reputation for high toxicity (however ill-deserved), experimentation may be hindered:

> The fact that there are poisonous plants in the family is frightening enough to cause some people to avoid any umbel they do not know well (French 1971: 389).

Genus Carum

There is considerable confusion concerning the actual number of species within this ill-defined Old World genus. Plants which are assigned to the genus Carum by some researchers are assigned to a number of other related genera such as Ligusticum, Perideridia, Trachyspermum by others. Accordingly, it is impossible to give an accurate estimate of the actual number of species attributed to this genus. Carum is a genus originally native to Europe and Asia, but is now widely cultivated or naturalized as a "weed."

Medicinal Uses

Members of this genus (and related genera) are used in such a variety of ways that Perry (1980: 417) has described one species as a "panacea." These medicinal uses are no doubt related to the chemicals which give all parts of this plant a warm taste and aromatic scent. The soothing effects of aromatic essential oils, as has been observed for other aromatic genera in the random sample (such as Citrus or Ocimum), make these plants ideally suited for use as carminatives, digestives, and stomachics.

Although native to Asia, this genus is not prominently represented in Perry's compendium of east and southeast Asian medicinal plants (Perry 1980). When it is used, Carum is generally a second choice or substitute for a more popular medicine (usually also in the Umbelliferae). For example, the root of Carum buriaticum Turcz. is used as a substitute for Angelica decursiva

(Miq.) Franch. & Sav., a medicine sold commercially in Asia as an anodyne, bechic, expectorant and analgesic. This species is also used as a treatment for bronchitis, and is applied externally to treat neuralgia and rheumatism (Perry 1980: 411-412). C. copticum (L.) Benth (=Trachyspermum ammi [L.] Sprague) is used in a manner similar to C. buriaticum/Angelica decursiva. In fact, it is used to treat so many ailments that Perry (1980: 419) described it as a panacea. French (1981: 396) lists similar uses for the seeds of C. roxburghianum (i.e., carminative, stimulant) in Asia. In Africa, C. capense Sond. (=Chamarea capensis E & Z) is "heated and applied externally to relieve pain" (Watt and Breyer-Brandwijk 1962: 1036).

Fertility-Related Uses

Few fertility-related uses are reported for Carum spp. In North America, where the genus Carum is represented by another genus, Perideridia (French 1971: 405-406), no medicinal uses of any kind were reported by Moerman (1986). Farnsworth et al. (1975 576) report two species as being abortifacients or emmenagogues: C. copticum and C. roxburghianum. The active constituents responsibe for these modes of action was not identified.

Non-Medicinal Uses

Like the caraway of commerce (Carum carvi), other species of Carum are often used as foods or flavoring. For example, the seeds of C.

roxburghianum are used as a condiment in Asia (French 1971: 396). Several species have edible roots (much like parsnip or carrot): in North America, the roots of C. oreganum S. Wats. and C. gairdneri (both actually species of the genus Perideridia), were eaten by the Indians of California and British Columbia (French 1971). In Africa, the roots of C. capense (Thunb.) Sond., although soapy, are eaten (French 1971: 396; Watt and Breyer-Brandwijk 1962: 1036).

Summary

Despite the taxonomic problems involved in researching this genus, it is still apparent that species of Carum are perceptually salient. The leaves, seeds, and root possess characteristic odors and tastes; many species are "weeds" or cultivated species; and like other umbels, they bear the distinctive, umbrella-like flowering heads.

The fact that species of Carum are considered interchangeable with other medicinals of the Umbelliferae (c.f. Perry 1980) is significant. The implications of Perry's observation is that peoples in Asia (and probably other parts of the world) have made a connection between odor, taste, and appearance and potential medicial uses.

Carum carvi

Scientific name: Carum carvi L.
Synonym(s): Apium carvi Crantz; Seseli carvi Lam.
Common name(s): caraway
Distribution: originally native to Europe and Asia; now widely cultivated and naturalized
Relates species: C. buriaticum Turcz.; C. copticum (=Trachyspermum ammi); C. gairdneri (=Perideridia gairdneri [Hook & Arn.] Mathias); C. oreganum S. Wats. (=Perideridium oregani); C. roxburghianum; C. verticillatum (L.) Koch.
References: Bunney 1984; Farnsworth et al. (1975); French (1971); Genders (1977); Lust (1974); Root (1980); Watt and Breyer-Brandwijk (1962).

The common name for this species is from an Arabic word, karawya, which is the name of the seed (Genders 1977: 140). Caraway is a biennial or perennial plant which can grow from 60 cm.-1 m. in height, and is foud growing in open, sunny places throughout its range (Bunney 1984: 98; Lust 1974: 146; Root 1980: 50). Typical morphological features of the species include:

> Leaves: "bi- or tripinnate and deeply incised, the upper ones on a sheath-like petiole" (Lust 1974: 146);
>
> Flowers: white or yellowish in color, arranged in a compound umbel. Flowering time: May-June;
>
> Fruit: "dark brown, oblong, flattened, and two-seeded" (Lust 1974: 146-147.

All parts of the plant of C. carvi are aromatic, due to the presence of carvol, which gives the plant a parsnip-like scent.

Medicinal Uses

Numerous medicinal uses are reported worldwide for this species. The primary therapeutic categories for C. carvi are similar to those of the genus in general i.e., carminative and stomachic. In Bolivia, it is used as a carminative an diuretic as well as being part of a compound medicine employed as a vermifuge (Oblitas Poblete 1969: 52). In Asia, Perry (1980: 417) reports that C. carvi can be substituted for Ledebouriella seseloides Wolff (Umbelliferae); the roots are considered sudorific, and helpful in the treatment of influenza, headache, fever,joint pain, tetanus, convulsions, or spasms (Perry 1980: 417). In Indonesia, the leaves of C. carvi are chewed with garlic and spat upon the skin to treat inflamed eczema (Perry 1980).

The major medicinal use categories for this species are supported by empirical evidence. As Genders (1977: 141), Lust (1974) and Lewis and Lewis (1973: 272-273) have stated, the aromatic essential oils in C. carvi make them effective as carminatives, stomachics and antiflatulence medicines.

Fertility-Related Uses

Several sources mention the use of this species for fertility-affecting purposes. Farnsworth et al. (1975: 546) say that a traditional antifertility treatment in India is a water extract of the fruit of C. carvi; however, when the seeds of the same species were fed (with ration) to rats and guinea pigs, no antifertility effects were observed (Farnsworth et al. 1975: 554). On the Malay Peninsula, C. carvi is one component of a compound medicininal decoction of nine different herbs which is traditionally given to women during confinement (Perry 1980: 420).

The paucity of information concerning the medicinal uses of this species may be attributed, in part, to several factors. First, the fact that C. carvi is often a second choice or substitute for other plant drugs might indicate that there are a number of other medicinals which work as well, or better, from which to choose. Perhaps C. carvi is thought of as primarily a food or flavoring plant, rather than a medicinal.

Non-Medicinal Uses

The leaves, seeds, and roots of C. carvi are all edible. The novelist Sigrid Undset wrote a delightful article on uses of herbs in her native Norway, describing the various uses of caraway, or karvekral (Undset 1945). In Northern Europe, this herb is commonly found in pastures and meadows, and its young leaves are among the first plants to come up in the spring. After the long, cold winters in that area, a source of greens is prized, and caraway is cooked as a potherb, in soups, in sauces and in omelets (Undset 1945: 228). When the plants mature and the seeds ripen, the tops of the plants are collected and dried, and the seeds are used to flavor pastries and a liqueur, kummel.

Summary

Carum carvi exhibits all of the criteria which contribute to perceptual salience. It is cultivated as well as "weedy"; all parts of the plant are aromatic; the umbellate flowers are distinctively-shaped; and it is used as a vermifuge. Caraway oil is also known to cause contact dermatitis, caused by the presence of a ketone, carvone (Lewis and Lewis 1973: 83).

VI. VERBENACEAE

VERVAIN FAMILY

Members of the Verbenaceae are typically leafy annual or perennial herbs, shrubs, or rarely, trees found mostly in the tropical and subtropical regions of both hemispheres (Benson 1979: 276; Hsiao 1978: 410; Radford et al. 1968: 887). Bor and Raizada (1954: 137) observe, however, that this family is poorly represented in Africa. The Verbenaceae is composed of approximately 90 genera and 2,600 species, the largest genus being Verbena (vervain) (Benson 1979: 276; Hsiao 1978: 410).

Typical morphological characteristics of the Verbenaceae include (Benson 1979: 276; Radford et al. 1968: 887):

Leaves: usually simple, sometimes pinnate to palmate; opposite or whorled;

Stems: quadrangular or rounded in cross-section;

Flowers: arranged in an inflorescence of cymes, spikes, or racemes, often head-like;

Fruit: a schizocarp, utricle or drupe.

Although the Verbenaceae is mainly a tropical family, some genera are native to the temperate regions of the Western Hemisphere, especially the southern portions of North America. Some of the native and introduced genera commonly found in the southern U.S. include (Benson 1979: 276-277; Britton and Brown 1970: 94-98; Radford et al. 1968: 887-895):

Verbena (verbena or vervain): distributed widely in the southern parts of North America.

Lippia (fog fruits): matted plants "... sometimes used for lawns and often carpeting large areas of moist low land" (Benson 1979: 276-277).

Callicarpa (French mulberry or beautyberry): commonly found in rich woods and thickets in the southern states.

Lantana (lantana or curse of Barbados): A single species of Lantana, (Lantana horrida), "occurs on the bank of a stream near Sells in south central Arizona. The same species is native and also introduced on the Coastal Plain from Texas to Georgia and Florida" (Benson 1979: 276-277).

Benson (1979: 276-277) lists several other genera or species which are either native or introduced in Florida and other parts of the South, for example: Citharexylum (zither wood or fiddlewood); Duranta (golden dew-drop); Clerodendron (glory-bower), which was introduced from China; Siphonanthus (Turk's turban), naturalized from the East Indies (S. indicus, however, is classified as Clerodendron by Radford et al. 1968: 895); and Vitex agnus-castus (monk's pepper), introduced from the Eastern Hemisphere.

Of the six genera of Verbenaceae listed in Radford et al. (1968: 887), four contained species most commonly found in disturbed habitats. For example, of the 16 species of Verbena listed, 11 were commonly found in disturbed habitats such as old fields, waste places, and along roadsides. All three species of Lantana listed were also common in waste places. Both Vitex and Clerodendron, each represented by a single species, were also found in disturbed habitats. This may be explained, in part, by the fact that many of these plants are introduced ornamentals which have escaped into such disturbed habitats. Within their native range, however,members of these genera are also common to disturbed areas, in addition to being cultivated as ornamentals, e.g., Clerodendron spp. and Callicarpa spp. (Bor and Raizada 1954: 136-155; Hsiao 1978: 410-435).

This plant family contains too many species used medicinally to allow a complete enumeration. Generally speaking, the three main use categories for members of the Verbenaceae are:

1. as topical treatments for wounds and skin disorders;

2. as fertility-related medicines, especially abortifacients, emmenagogues and post-partum depuratives;

3. as insecticides, piscicides, or insect repellents.

Examples of the topical uses of members of the Verbenaceae include: a poultice of the green fruit of Avicennia officinalis is used to treat boils in India (Lewis and Lewis 1977: 352); Lippia pringleyi sap is used to treat dental diseases in Mexico; a bark decoction of Vitex simplicifolia is used on the Ivory Coast for dental diseases (Lewis and Lewis 1977: 257); and a leaf paste of Clerodendron buchananii is used to treat burns in Malaya and Indonesia (Lewis and Lewis 1977: 344). The root of C. buchananii is also reported to be a snakebite remedy (Lewis and Lewis 1977: 347).

The fertility-related uses of members of the Verbenaceae are considerable. In many cases, the same plants which are used as emmenagogues, etc. are also employed as vermifuges and insecticides. The possible reasons for this overlap in medicinal use categories will be discussed below. A partial listing of the plants used as fertility-affecting medicines as well as insecticides, vermifuges, etc. includes:

Callicarpa longifolia Lamk.: On the Malay Peninsula, a leaf decoction is a post-partum medicine; in Indonesia, the same plant is sued as a fish poison (Perry 1980: 424). C. formosana Rolfe. is used as an emmenagogue as well as to stun fish and repel insects in Taiwan and the Philippines.

Lantana camara L.: Originally native to tropical America, it is now a pantropic species following its introduction to the East. The leaves of this plant are said to be a stimulant, vermifuge, and emmenagogue in Indochina (Perry 1980: 428). The berries of L. camara, however, are poisonous to humans (Lampe and McCann 1985; Lewis and Lewis 1977: 56).

Lippia nodiflora (L.) Michaux: In China, this herb is used as a vermifuge for hookworm infestation; in Taiwan, it is reported to be an emmenagogue (Perry 1980: 428).

Stachytarpheta indica (L.) Vahl: The root is considered an abortifacient in IndoChina; a leaf decection is also prescribed as a purgative and vermifuge (Perry 1980: 429). Farnsworth et al. (1975: 577) list another species, S. jamaicensis, as an abortifacient.

Vitex trifolia L.: In Indonesia, V. trifolia is reported to be both an emmenagogue and insect repellent (Perry 1980: 430). Farnsworth et al. (1975: 577) list it as having both emmenagogoc and abortifacient properties; they also list four other species of Vitex, including V. agnus-castus, which exhibited similar activity under experimental conditions. Lewis and Lewis (1977: 332) also comment that Vitex agnus-castus has been prescribed as an anaphrodisiac; the fruit of the plant was dried, cracked and sprinkled on food as a seasoning. This latter use may have contributed to this species' common name: "monk's pepper."

These two use categories did not always overlap; many other species within the Verbenaceae were used primarily to treat fertility-related disorders, or primarily as insect repellents etc. In addition, the pleasant lemony scent and taste of members of the Verbenaceae e.g., Lippia spp., Verbena officinalis (vervain) and Stachytarpheta jamaicensis (bastard vervain) have led to their use as stomachics and herbal teas (Lewis and Lewis 1977: 370, 391).

The seemingly disparate uses of members of the Verbenaceae may be explained by the chemical composisiton of these plants. The same essential oil which contains the active principle verbenalin (a glycoside [Windholz 1976: 1278] which gives members of this family their fertility-affecting properties [Farnsworth et al. 1975: 577]), also provides the lemony odor which humans-- but not insects-- find pleasing. As Lewis and Lewis say in their chapter entitled "Deterrents: Antibiotics, Antiseptics and Pesticides" (1977: 370):

> In addition, many insects, including mosquitos, are repelled by the lemony or citronella herbs (lemon verbena, lemon balm, pelargonium), which are pleasant to smell or to have as herb teas; a garden well-stocked with these plants is not only utilitarian, it also deters pests without danger to people, their pets, or the wild creatures of the area.

Summary

Thus, members of the Verbenaceae possess many of the criteria proposed in this thesis to contribute to the perceptual salience of plants. Several genera are either commonly found in disturbed habitats or are cultivated as ornamentals or as flavoring herbs; they are scented; and they are also used as insecticides, piscicides or vermifuges.

Genus Clerodendron (Clerodendrum)

This genus is composed of approximately 400 species of deciduous or evergreen trees, shrubs, shrubby or twining plants, or rarely, herbs. Several species are scented (Bor and Raizada 1954: 143; Genders 1977: 159; Hsiao 1978: 410). Members of this genus, commonly called the glory-bowers, are "native to the equatorial forests of South America, central Africa, and the Far East" (Genders 1977: 159). They are widely cultivated outside their natural range for their attractive foliage and flowers (Anderson 1986: 446). The generic name, Clerodendron, comes from the Greek kleros (chance) and dendron (tree), perhaps referring to the variable medicinal properties of this genus (Bor and Raizada 1954: 143; Perry 1974: 76).

According to both Bor and Raizada (1954: 143) and Perry (1980: 425), members of this genus are used throughout Asia and India as medicinals, although their primary use in the Malay Peninsula is as megical herbs. However, neither source elaborates on the magical uses of these plants, although one might speculate that the showy and fragrant flowers are contributing factors.

Medicinal Uses

The medicinal uses of this genus are too numerous to fully enumerate. Perry (1980) describes the medicinal uses for 23 Asian species of Clerodendron and found few commonalites in the therapeutic uses of the various species. She comments:

> Of the species, eight are considered to be febrifuges, with C. trichotomum Thunb....and var. fargesii (Dode) Rehd.,...and C. cyrtophyllum Turcz....mentioned for malaria. Some have both internal and external uses, others only the second, such as washes and poultices for sores, boils, and skin diseases; they have perhaps depurative, resolvent, and vulnerary properties, or are anodyne to relieve rheumatism or pain. It has not been easy to correlate uses of the various species, hence it seems as if one might question the real medicinal value (Perry 1980: 425).

Bor and Raizada (1954: 143-155) list a similar range of uses for this genus in India, as do Watt and Breyer-Brandwijk (1962: 1047-1048) for Africa.

Fertility-Related Uses

Farnsworth et al. (1975: 546) mention two species of Clerodendron which are reportedly used for fertility-affecting purposes in India: C. phlomidis and C. serratum. Traditionally, the root of C. serratum is made into a decoction and drunk; when this species was evaluated experimentally, it demonstrated abortifacient activity (Farnsworth et al. 1975: 577). The leaf of another species, C. inerme, was evaluated experimentally, and demonstrated uterine stimulant activity (Farnsworth et al. 1975: 577).

Perry (1980: 427) lists three fertility-affecting species of Clerodenron which are used in Asia. The leaves of C. brachyanthum are decocted to make an abortifacient medicine in the Philippines; C. serratum is used to treat "gynecic ills" in Indonesia (Perry 1980: 427); and in Taiwan, a root decoction of C. umbratile is prescribed for the fevers associated with childbirth. According to Perry, the therapeutic use of C. serratum is supported by its high potassium content, which gives the plant diuretic properties (Perry 1980: 427). If the "gynecic ills" Perry is referring to are the water retention and bloating associated with the menstrual period, the diuretic action of C. serratum would indeed be a helpful treatment. In Africa, the Haya and Shambala tribes use C. myricoides to treat dysmenorrhea and female sterility (Watt and Breyer-Brandwijk 1962: 1048).

The active constituent which may be responsible for the various fertility-related uses (aside from the diuretic action of potassium) has not yet been identified. Given the pungent odor of the foliage of some species of Clerodendron, it is possible that the active compounds are a component of the essential or volatile oils contained in members of this genus.

Non-Medicinal Uses

Several species of Clerodendron are eaten as a green vegetable. Nakao reports that in Malaysia and Indonesia, the leaves of C. calamitosum are chewed; in the Himalayan region, the young leaves of C. Colebrookianum are eaten; and the young leaves of C. inerme are eaten as a vegetable in Malaya, India, and Micronesia (Nakao 1976: 191). The fruit of C. umbratile is used as a flavoring agent in the eastern portion of tropical Asia (Nakao 1976: 191).

In China, the pounded stems and leaves of C. trichotomum are rubbed on animals to kill lice, and in Taiwan this same species is used as an insecticide (Perry 1980: 426). Perry (1980: 426) attributes this insecticidal activity to the active constituents friedelin and epifriedelinol. Mabry and Gill (1979: 525) have identified a bitter-tasting diterpinoid, clerodin, as an insect feeding deterrent in the species C. calamintosum, C. fragrans, and C. trichotomum.

A final non-medicinal use for this genus is as ornamentals. Their often shrubby or twining habit and fragrant, showy white, yellow, blue, or red flowers make them ideal garden plants. Bor and Raizada, in Some Beautiful Indian Climbers and Shrubs (1954), list 12 species of Clerodendron which are grown in India and elsewhere as ornamentals.

Summary

Members of the genus Clerodendron fit many of the criteria for perceptual salience. They are often cultivated as ornamentals, medicinals, or magical plants; their flowers and foliage are scented; several species are used as insecticides or vermifuges; and almost all species have "showy" flowers.

Clerodendron uncinatum

Scientific name: Clerodendron uncinatum Schinz.
Synonym(s): Clerodendrum uncinatum Schinz.; C. spinescens Guerke; C. spinescens (Oliv.) Guerke; Kalaharia uncinata (Schinz) Moldenke.
Common name: glory bower
Distribution: native to the tropical areas of Africa; cultivated in Africa and elsewhere
Related species: C. calamitosum L.; C. capitatum Schumach and Thonn.; C. Colebrookianum Walp.; C. cyrtophyllum Turcz.; C. glabrum E. Mey.; C. johnstoni Oliv.; C. myricoides R. Br.; C. sativum L.; C. trichotomum Thunb.; C. umbratile King et Gamble
References: Bor and Raizada (1954); Moldenke 1959; Nakao (1976); Watt and Breyer-Brandwijk (1962).

Very little descriptive information could be found concerning this species. According to Harold Molkenke, C. uncinatum is sufficiently morphologically distinct from other species of Clerodendron to justify its designation to another genus, Kalaharia (Moldenke 1959: 411). The major characteristics which Moldenke used to separate Kalaharia from Clerodendron are the spininess of the stems of Kalaharia, as well as the location of the spines on the leaves of Kalaharia. The stems of C. uncinatum are spinose, with the spines axillary to the leaves; in contrast, other members of the genus are unarmed, or if armed, the spines are formed by the petiole base (Moldenke 1959: 411).

Whatever the name of this species, little information could be found concerning its morphology, chemistry or medicinal uses. According to Farnsworth et al. (1975: 554), a water extract of C. uncinatum, when administered to rats, demonstrated an antigonadotrophic effect. Watt and

Breyer-Brandwijk list two medicinal uses for C. uncinatum in its native Africa. The root of this species is made into a cold infusion and drunk as a contraceptive by women of the "Bemba and related tribes" (Watt and Breyer-Brandwijk 1962: 1048). The prescribed dosage is a pint of the infusion, taken twice a month. The same groups use a root decoction of C. uncinatum as a gargle to relieve the discomfort of a sore throat. Watt and Breyer-Brandwijk also note that this species has reportedly caused poisonings in cattle (1962: 1048).

Because so little information was available on C. uncinatum, the type species, C. infortunatum L. (Phillips 1951), was examined for characteristics which might lend this species noticeability. C. infortunatum (commonly called pinna kole in India), is a deciduous shrub found throughout India, which can attain a height of 4 m. in some habitats. Typical morphological characteristics of this species include:

> Leaves: arranged in an opposite manner, oval in shape; rounded at the base and pointed at the tip and covered with rough hairs on the upper surface. The lower surface of the leaves is covered with "small round glands" (Bor and Raizada 1954: 150). Leaves measure approximately 2-4 cm. in length by 1-3 cm. in width.
>
> Flowers: "arranged in a broad and long terminal panicle; panicle branches trichotomous, each ending in three flowers, covered with a yellowish pubescence" (Bor and Raizada 1954: 150). Flowers white in color, with a hint of red, and sweetly scented. Flowering time: January-April.
>
> Fruit: a round, black, drupe which is located atop the red calyx. Fruit ripens during the rainy season.

Within its natural range, C. infortunatum ia considered as a "weedy" plant, often found as one component of the understory vegetation in "salt forest habitats" (Bor and Raizada 1954: 152).

Medicinal Uses

In Asia, the bitter juice from the leaves of this species is considered a tonic. It is prescribed to treat fevers caused by malaria, and as a anthelmintic (Bor and Raizada 1954: 152). "The leaves warmed with ghee (clarified butter) are applied to the head for catarrhal colds" (Bor and Raizada 1954: 152). No references to the use of this species for antifertility purposes could be found.

Non-Medicinal Uses

Only one non-medicinal use was recorded for this species. Bor and Raizada note that even though this species is generally regarded as a weed, that it is attractive enough in bloom that it could be grown as an ornamental (Bor and Raizada 1954: 152).

Summary

The species selected for inclusion in the random sample from Farnsworth et al. (1975), Clerodenron uncinatum, was not well-described in the botanical or ethnographic literature. According to at least one researcher, this species is sufficiently distinctive morphologically to be reclassified as a completely different genus (Moldenke 1959). A survey of contemporary botanical sources (c.f. Bailey and Bailey 1976; Steentoft 1988) shows that Moldenke's reclassification has not been generally followed. However, Moldenke's description of Clerodendron uncinatum/Kalaharia uncinata includes one of the criteria of noticebility: spininess. No other criteria, such as scent or irritant properties, could be inferred from the available literature.

In contrast, the type species, C. infortunatum, exhibits most of the criteria of noticeability: it is "weedy"; it bears showy, scented flowers; and the bitter-tasting juice expressed from the leaves is used as a vermifuge. One might also add that the leaves of this species are notably rough-hairy.

VII. LABIATAE

MINT FAMILY

The Labiatae, also called the Lamiaceae, is a large family of herbs, shrubs, or very rarely trees or woody vines, many of which are scented. This family includes approximately 200 genera and 2,500 species with a worldwide distribution. The Mediterranean area is one of the areas of greatest diversity of the mint family, and in North America, it is one of the most common families of plants (Benson 1979: 276).

Typical morphological characteristics of the Labiatae include:

Leaves: simple and sometimes pinnate;

Flowers: sometimes with hypogynous discs, in dense clusters in the leaf axils, appearing to be in dense whorls (Benson 1979: 277);

Fruit: composed of four nutlets.

Medicinal Uses

Since three genera (*Ocimum*, *Orthosiphon*, and *Marrubium*) and their related species will be discussed in detail, a lengthy description of the medicinal uses of this family will not be provided. In general, because many members of this large family contain aromatic oils, the most common therapeutic category for the Labiatae is digestive disorders (used as carminatives, stomachics, etc.).

According to Lyman Benson in *Plant Classification* (1979: 277), the Labiatae "includes large numbers of well-known plants, some of them used in medicines or for various other purposes." Some of the species which are listed by Benson include: pennyroyal (Hedeoma spp.); blue-curls (Tichostema dichotomum L.); bugle-weed (Lycopus spp.); germander (Teucrium spp.); skullcap (Scutellaria spp.); horehound (Marrubium spp.); hyssop (Hyssopus officinalis L.); catnip (Nepeta cataria L.); dragonhead (Dracocephalum spp.); self-heal (Prunella vulgaris L.); hedge-nettle (Stachys spp.); sage (the true sages, Salvia spp., as opposed to sagebrush, Artemisia spp.); savory (Satureja spp.); thyme (Thymus spp.); stoneroot (Collinsonia candensis L.); henbit (Lamium spp.);and peppermint (Mentha piperita L.) (Benson 1979: 277; Britton and Brown 1970).

Non-Medicinal Uses

The many members of the mint family are used most often as culinary (flavoring) herbs, e.g.: Ocimum, Origanum (oregano or marjoram), Thymus (thyme), and Salvia (sage). Less well-known genera which are used as flavorings or foods include Sideritis, used to make a tea in Turkey; Zizyphora, used to flavor yogurt in Iran; and in India and Southeast Asia, the tubers of Coleus rotundifolius (hausa potato) are eaten as a potato substitute (Heywood 1978: 239).

Perfumes are also made from the aromatic Labiatae, including Lavandula (lavender); Ocimum; and Pogostemon (patchouli). Perilla is grown as a source of perilla-oil, which is used in the manufacture of paints and printing inks (Heywood 1978: 239). Members of the Labiatae commonly grown as ornamentals include Lavandula, Salvia, Leonotis, and Coleus.

Genus Marrubium

Members of the genus Marrubium number about 40 species, all native to the Old World (Britton and Brown 1970: 110). The generic name is derived from the Hebrew word meaning "bitter juice" (Balls 1962: 93); horehound is one of the bitter herbs traditionally used in the Jewish ceremony (seder) commemorating the hastily prepared last meal eaten before the flight of the Israelites from captivity in Egypt.

Marrubium spp. are perennial, branching, mostly wooly, herbs with petiolate, rugose leaves with dentate margins, and small white or purplish flowers in dense axillary clusters. As mentioned above, the juice of these herbs is bitter-tasting (Britton and Brown 1970: 110). The type species for this genus is Marrubium vulgare L. (white or common horehound). The medicinal uses for species of Marrubium are essentially the same throughout the genus, so this discussion is subsumed within the description of M. vulgare.

Marrubium officinalis

References to Marrubium officinalis could not be found in the botanical or ethnographic literature except in Farnsworth et al. (1975: 550). Therefore, discussion will refer to the type species for this genus, M. vulgare L.

Marrubium vulgare

Scientific name: Marrubium vulgare L.
Synonym(s): none
Distribution: native to the Old World, but widely naturalized in the New World
Related species: Marrubium incisum Bth.
Common name(s): hoarhound; horehound; white or common horehound; houndbene; houndsbane; marrube; marrhue; marvel; marrubium; marrubio; toronjil; melisa; mastranzo; concha
References: Balls (1975); Britton and Brown (1970); Farnsworth et al. (1975); Krochmal and Krochmal(1973); Lust (1974); Moerman (1977; 1986); Moore (1979); Oblitas Poblete (1969); Pammel (1911); Perry (1980); Watt and Breyer-Brandwijk (1962).

Marrubium vulgare is a wooly perennial herb which grows to approximately .75m in height. Its habit is erect and rather bushy, the stems are white and wooly-looking, and the leaves are downy, giving the plant a frosty or "hoary" appearance. Saunders says of the plant: the ".grayish, roundish leaves (are) prominently veined and wrinkled, and the small white flowers (are) densely clustered in the leaf axils" (1934: 186). The calyx of the flower of horehound is 10-toothed, with each tooth hooked at its end, so that the calyx sticks to any human or animal brushing past the plant. In this manner, the propagation of the plant is aided (Britton and Brown 1970: 110; Saunders 1934: 186).

Originally a native of Europe and Asia, M. vulgare was introduced into North America as a garden herb. It has since escaped from cultivation and is a common North American (except in the most arid regions) and South

American weed, found in waste places, upland pastures and along roadsides (Wilkinson and Jaques 1972: 125). It also occurs in disturbed habitats in Europe, and is cultivated worldwide as a flavoring herb e.g., for horehound candy.

Medicinal Uses

The major medicinal uses for M. vulgare are as a treatment for "coughs and colds, as an expectorant and aromatic stimulant, a diaphoretic, and an irritant" (Spoerke 1980: 89). The bitter taste of the herb, which is due to the bitter principle, marrubiin (Pammel 1911: 709), contributes to its use as a tonic as well. If taken in sufficiently large doses, the herb can also have a laxative and emetic effect (Saunders 1934: 186; Spoerke 1979: 186). John Lust (1974: 231) says that a tea from the plant, or a poultice of the crushed leaves, is an effective topical treatment for skin irritations. In North America, the herb has been used as a vermifuge (Watt and Breyer-Brandwijk 1962: 521).

Fertility-Related Uses

Farnsworth et al. (1975: 550) report that M. officinalis was evaluated experimentally for antifertility activity, and a water extract of the plant exhibited antigonadotrophic activity in rats. Additional experimentation by researchers in Africa, India, and Europe (summarized by Farnsworth et al.

1975: 564), showed that M. vulgare demonstrated abortifacient, emmenagogic, and uterine stimulant properties.

Ethnographic references to the use of Marrubium as a fertilty-affecting agent are few. Oblitas Poblete (1969: 241-242) lists the plant as as an emmenagogue in Bolivia, Moerman (1977: 114) says that the Ramah Navajo used the root of M. vulgare as a medicine both before and after childbirth, and Krochmal and Krochmal (1973: 145) say the the herb was used to treat menstrual irregularities in North America, but do not provide details. In China, another species, M. incisum, is decocted and mixed with fermented rice as a remedy for amenorrhea in women close to the age of menopause (Perry 1980: 195).

The dearth of information concerning fertility-related uses for this plant in the New World may be attributed, in part, to its relatively recent introduction to this area. That it is also seldom used for such purposes in the Old World may be due to a variety of reasons; there may be other, more effective or readily available medicines, and horehound is better suited to treating ailments such as coughs and colds.

Non-medicinal uses for this herb include its well-known use as a flavoring agent in horehound candy. This candy is also seen as medicinal, and many people today use it as a cough lozenge. Both Saunders (1934: 86) and Balls (1962: 93) state that horehound has been used as a substitute for hops in beer making. Horehound ale or beer is still made in England and Europe, the herb giving the brew a bitter taste that some people prefer. Spoerke (1979: 89) also notes that in the past, horehound was regarded as an "anti-magic" herb.

Genus Ocimum

Ocimum is a widespread genus of aromatic herbs native to tropical areas such as the East Indies, tropical Africa and the Near East. In these areas it is found both as a cultivated plant, and as an escape from cultivation ("weed"). Outside of their natural range, members of this genus are widely cultivated as culinary and medicinal herbs (Perry 1980: 189). The name Ocimum comes from a Greek verb which means "to be fragrant" (Webster 1936: 34). According to Genders (1977: 330), Ocimum is a genus of only a few true species, but many horticultural varieties. These herbs may be divided into three distinct forms based on their scent (Genders 1977: 331):

1. plants with a mint-like aroma and purple stems e.g., O. sanctum;
2. plants with a lemon scent e.g., O. pilosum;
3. plants with a peppermint scent.

Webster (1936) lists seven distinct species of Ocimum: O. sanctum L. (East Indian basil; holy basil; tulasi; tulsi); O. suave Willd. (fever bush); O. micranthum Willd. (mosquito bush); O. minimum L. (bush basil); O. canum Sims (hoary basil; Ran tulsi); and O. indicum. Perry (1980) and Watt and Breyer-Brandwijk (1962) list several of these species, and add the following:

O. gratissimum L.; O. americanum L.; O. nakurense Guerke.; and O. viride Willd., but some of these may represent horticultural varieties.

The medicinal uses of species of basil, as this genus is commonly called, are quite varied. Below is a partial listing of species and their medicinal uses in different parts of the world.

> O. basilicum: An annual plant growing wild in the tropics and subtropics, but cultivated elsewhere, this bushy plant is quite aromatic (Lust 1974: 108). The essential oil which produces this aroma contributes to the medicinal uses of the herb ie., as a carminative and stomachic; for stomach cramps; gastric catarrh; vomiting; intestinal catarrh; constipation and enteritis (Lust 1974: 108). In China, this species is used for similar purposes (Perry 1980: 189), and in Malaysia, a decoction of the leaves of O. basilicum and O. sanctum is considered an emmenagogue and post-partum treatment (Perry 1980: 189). In Africa, O. basilicum is used as a "hair application" (Watt and Breyer-Brandwijk (1962: 524).
>
> O. americanum: This species probably represents a horticultural variety. Watt and Breyer-Brandwijk report that in Africa, the Southern Sotho burn the leaves of this herb and inhale the smoke for nosebleeds (1962: 524). They also use another species, O. viride for the same purpose. An ointment is made from the powdered leaves of O. americanum to treat nosebleeds. In Tanganyika, the leaf of this herb is used to treat snakebite and bilharziasis, but no details of its prepartation or administration are given (Watt and Breyer-Brandwjk 1962: 524). In both Tanganyika and West Africa, the plant is reputed to be a mosquito repellent (Watt and Breyer-Brandwijk 1962: 524).
>
> O. suave: This herb, which Webster calls the "fever bush from Abyssinia" (1936: 36), is a bushy annual with "broad wooly dentate leaves and long spiked, close-set flowers" (Webster 1936: 36). As its common name implies, it was probably employed as a febrifuge and "cooling medicine," as several species of Ocimum are (c.f. Perry 1980 189-190). Watt and Breyer-Brandwijk do not report that this species is used as a febrifuge, but say that the Masai used the leaf of this herb to perfume chewing tobacco and snuff, and that the whole plant is burned to repel mosquitos. They also say that the herb is also used as a perfume and stomachic in Africa (1962: 524).

> O. gratissimum: According to Perry (1980: 190), this species is used as a stomachic, antipyretic, and pectoral medicine in Indochina. The seeds, like those of other species of basil, have a mucilaginous quality when mixed with water, and are used as a laxative and treatment for gonorrhea on the Malay Pensinsula. This species is also one of the postpartum "hot" medicines listed by Kunstadter (1978: 191).

Non-medicinal uses of Ocimum include its use as a culinary herb (almost every species of basil, as well as the many varieties), and as an ornamental. Again, almost every species, especially those with a bushy habit, such as O. minimum (bush basil or lesser basil) and O. gratissimum (tree basil), are used as ornamental plants (Webster 1936: 35-37). The Masai of Africa use the aromatic plants of O. filamentosum Forsk. to fill their sleeping cushions; this herb may serve as an insect repellent in the sleeping area, although Watt and Breyer-Brandwijk do not say so (1962: 524). From the above discussion, it is apparent that peoples in Africa, at least, have disovered the insect repelling qualities of the aromatic basils. In a region where malaria is often endemic, it is not difficult to see why this use of basil is often mentioned in ethnographic sources.

As an aside, avoidance of basil by animals has been noticed by other observers. In Helen Webster's article Seven Basils (1936: 36), she discusses some of the folklore surrounding basil:

> Concerning all the basils there is pleasant humor in the exuberance of exaltation with which the ancient authors proclaim or denounce the virtues of this herb. 'Even,' says Cassius, 'the malignant quality of the herb is indicated by the fact that a she-goat that browses on everything, avoids Ocimum alone.'

While some may find such casual references quaint or humorous, as Webster apparently does, it is just these kinds of casual observations of avoidance behavior which may have contributed to further experimentation with basil, as well as other plants, as potential medicinals.

Ocimum sanctum

Scientific name: O. sanctum L.
Synonym(s): none
Common name(s): holy basil; East Indian basil; tulasi; tulsi; sacred basil
Distribution: native to Malaysia, Australia, India, and Western Asia, but widely cultivated elsewhere
Related species: O. americanum L.; O. basilicum L.; O. canum; O. gratissimum L.; O. micranthum Willd.; O. minimum L.; O. nakurense Guerke.; O. suave Willd.;
O. viride Willd.
References: Farnsworth et al. (1975); Genders (1977); Perry (1980); Simon et al. (1984); Webster (1936).

Webster (1936: 35) describes Ocimum sanctum as:

> a pretty, little, single-stemmed shrub, topped with three spikes of crowded soft purple flowers, the middle spike being always the longest. The whole plant is hairy, quite different from the basils of the O. basilicum group, and has a curious resistance to frost which by all rights it should not exhibit.

Webster also notes that while all varieties of Ocimum are self-sowing, O. sanctum does this in an unusual manner. The seeds of the herb, which are rather sticky, fall and adhere to the leaves. When the leaves fall, they are blown away by the wind, and the plants are spread to other areas in this manner. This self-sowing ability contributes to basil's spread as a "weed" in many areas of the world.

Typical morphological characteristics of O. sanctum include:

Leaves: downy, broad, elliptic; "This species is characterized by the leaves having a rounded base and apex" (Huang and Cheng: 1978: 493);

Stems: square, purple-hairy;

Flowers: in spikes, lavender in color;

Fruit: a nutlet, the seed coat being rather mucilaginous.

In areas where it is native, such as Australia, Western Asia, India and Malaysia, O. sanctum is a short-stemmed woody perennial or annual plant (Simon et al. 1984: 8). Its odor has been variously described as "strong, pungent, (and) clove-like" (Simon et al. 1984: 8), or as a mixture of "clove, lemon and cinnamon" (Webster 1936: 35). The fragrance of the plant is largely due to its high eugenol content (Simon et al. 1984: 8), but it also contains many other aromatic substances such as pinene, cineole, thymol, citral and camphor (Perry 1980: 189). Because this species includes many cultivars (Simon et al. 1984: 8), the chemical composition and thus the fragrance (and medicinal properties) varies from area to area. This may also account for the differing descriptions of the herb's odor.

According to several sources, including Simon et al. (1984: 8) and Webster (1936: 35), the scientific name Ocimum sanctum (holy or sacred basil), derives from this herb's exalted position in the Hindu religion:

> Its precious sanctity assures entrance into the Hindu heaven and homes are guarded by the protective spirit of this herb (Webster 1936: 35).

In addition to its religious importance, O. sanctum has been used for many medicinal purposes.

Medicinal Uses

The major medicinal use categories for this herb are similar to those for the genus as a whole (febrifuge, stomachic and fertility-related). According to Perry (1980: 189), a leaf decoction is used in Burma as a "mild febrifuge and carminative for infant diarrhea,"

and the seeds are used for many purposes: in Burma, the sticky quality of the seeds is used to advantage as a way to "carry dust or cinders from the eye" (Perry 1980: 189), and in the Philippines, a seed decoction is regarded as demulcent (Perry 1980: 189).

External uses of the plant include use of sprigs in Indochina as a cure for headache: the sprigs are placed on the temples of the headache sufferer (Perry 1980: 189). On the Malay Peninsula, a root infusion is employed to treat skin diseases, headache and earache (Perry 1980: 189). In Indonesia, the leaves are placed in the bath as a refrigerant and sedative (Perry 1980: 189). In part, these external uses, such as the as a sedative or headache remedy, may be related to the aromatic qualities of the herb.

Internal uses of the herb include the use of a decoction of the herb in Indochina for "sunstroke, cholera, nosebleed and dropsy" (Perry 1980: 189); the use of an infusion of the leaves on the Malay Peninsula to treat respiratory disorders (Perry 1980: 189); and as part of a compound medicine employed as a galactagogue in Indonesia (Perry 1980: 189). A decoction of the roots and leaves is prescribed to treat gonorrhea in the Philippines (Perry 1980: 189).

Fertility-Related Uses

O. sanctum is used as an emmenagogue, abortifacient and post-partum medicine (Farnsworth et al. 1975: 564; Perry 1980: 189). Experimentation with various types of extracts of the leaf of O. sanctum demonstrated antifertility effects in rats as well (Farnsworth et al. 1975: 550).

According to Perry (1980: 189), the medicinal uses of O. sanctum and O. basilicum are interchangeable, at least on the Malay Peninsula, and these two species are considered superior to all others. A decoction of the leaves of either species was used as a post-partum treatment and also as an emmenagogue. Another species, O. canum, is used in New Guinea as an abortifacient (Perry 1980: 190).

As Kunstadter (1978:191) said in his paper on the medicinal plants of the Lua' of Thailand, use of O. sanctum and other species of basil, as post-partum treatments in Asia is probably related to the fact that such spicy-smelling (and tasting) herbs are regarded as "hot medicine". Such aromatic herbs, and O. sanctum is one of the most pungent of the basils, are emically considered ideal for treating women whose bodies are regarded as very "cold" after giving birth.

Genus Orthosiphon

Members of the genus Orthosiphon are hairy herbs of subshrubs native to the temperate and tropical areas of the Old World (Huang and Cheng 1978: 494-496). There are about 40 species of Orthosiphon, some growing wild and several species cultivated as ornamental, medicinal, or culinary plants. Stirling Macoboy (1986: 294) describes this genus, whose members are commonly called cat's whiskers or whisker plants (because of their unusually long stamens):

> Unusual shrubs and perennials from Africa, Asia and Australia, the cat's whiskers are attenuated members of the mint family growing to more than 1 meter and bearing spidery, whorled racemes of pale lilac-blue flowers.

Typical morphological characteristics of this genus include (Huang and Cheng 1978: 494-496):

> Leaves: petiolate, with an ovate to rhomboid blade. Base of leaves wedge-shaped, rounded or truncate; leaf tips obtuse or acute, the leaf marigins serrate or crenate;
>
> Flowers: the inflorescences are arranged in verticillate cymes, which often form loose terminal racemes;
>
> Fruit: a nutlet, spherical to ovoid, the surface smooth to slightly reticulate.

Although Farnsworth et al. (1975) report the results of evaluation for two species of Orthosiphon (O. stamineus and O. pallidus), for antifertility activity, the major medicinal use category listed in the ethnographic literature for this genus is as a diuretic. Both Perry (1980: 190-191) and Lewis and Lewis (1977: 316) state that these herbs are used as diuretics, and for kidney and bladder problems. According to Perry (1980: 190-191), a leaf infusion of either wild or cultivated O. stamineus, (also called O. aristatus or O. grandiflorus) is used as a diuretic in Taiwan and other parts of Asia. The same plant is used in Java for kidney and bladder disorders (Lewis and Lewis 1977: 316). According to Watt and Breyer-Brandwijk (1962: 524), another speices, O. welwitschii Rolfe, is used as a medicinal in Angola, but no details are provided.

The use of Orthosiphon spp. as diuretics is supported empirically by the pharmacologic literature. The leaves and stem not only have a high potassium content, like Clerodenron serratum (Verbenaceae), they also contain urea and ureids (Perry 1980: 191). According to Merck's Index (Windholz 1976: 1266), the therapeutic category of urea is as a diuretic.

Non-Medicinal Uses

Only one non-medicinal use for this genus was noted in the literature. O. rubicundus Bth., a species which forms tubers, is used both as a food item and as a source of starch in Indonesia, Burma, Madagascar, and tropical Africa (Nakao 1976: 511).

Orthosiphon stamineus

Scientific name: Orthosiphon aristatus (Bl.) Miq.
Synonyms: Clerodendranthus stamineus Benth.; O. grandiflorus Bold.; O. stamineus Bth.; Nautochilus Bremk.
Common name(s): cat's whiskers; whisker plant
Distribution: southeastern Asia and northern Australia; also cultivated in areas outside its natural range.
Related species: O. pallidus; O. rubicundus Bth.; O. welwitschii Rolfe.
References: Farnsworth et al. (1975); Huang and Cheng (1978); Lewis and Lewis (1977); Macoboy (1986); Nakao (1976); Perry (1980); Phillips (1951); Watt and Breyer-Brandwijk (1962).

According to Huang and Cheng in their section on the Labiatae in Flora of Taiwan (1978: 495-496), O. aristatus, as this plant is properly called, is "an erect herb, up to 50 cm. high, covered with septate hairs, and the stems much branched." Typical morphological characteristics of this species include:

> Leaves: leaves on a petiole, 2-5 cm. wide, rhomboid in shape, the base of the leaf wedge-shaped, the apex acuminate, and the leaf margins deeply serrate. Both the top and bottom surfaces of the leaves are hairy;
>
> Flowers: flowers arranged in verticcilate cymes which form loose terminal racemes. Flowering times: August-November;
>
> Fruit: a spherical to ovoid nutlet, the sufrace smooth to slightly reticulate.

Medicinal Uses

O. aristatus occurs in the wild, but is also cultivated in Taiwan and other parts of Asia. As discussed above in the description of the genus, the major medicinal use category for this plant is as a treatment for kidney and bladder disorders. For example, the herb is prescribed for "nephritis, nephrolithiasis, hydronephrosis, vesical calculi,...and gout" (Perry 1980: 191), as well as arteriosclerosis, diabetes, gallstones, and rheumatism (Perry 1980: 191). The crude herb of O. aristatus is reported to cause vomiting. The herb is used as a medicinal throughout Asia, "from Taiwan south to Palau, throughout Indonesia, the Malay Peninsula, and in parts of the Philippines" (Perry 1980: 190).

Fertility-Related Uses

Although Farnsworth et al. report that two species of Orthosiphon, O. pallidus and O. stamineus (=O. aristatus) were evaluated for antifertility, uterine stimulant, and other fertility-related properties, the ethnographic references consulted for information on this genus listed no fertility-related uses. Farnsworth et al. (1975: 564) report that O. pallidus demonstrated uterine stimulant activity, but provide no other details. An aqueous extract of O. stamineus, when administered to rats, demonstrated an antigonadotrophic effect (Farnsworth et al. 1975: 550).

Summary

This herb, then, possesses several of the criteria selected as significant in making plants "noticeable": like all members of the mint family (Labiatae), it is aromatic; it is cultivated for its showy, unusual, lilac-blue flowers as well as for its edible tubers; and its foliage (like the other members of the Labiatae selected in the random sample, *Marrubium vulgare* and *Ocimum sanctum*), is distinguished by being covered by hairs.

VIII. SOLANACEAE

NIGHTSHADE OR POTATO FAMILY

According to Bor and Raizada (1954: 113), the Solanaceae derives it name from Solanum dulcamara L. (deadly nightshade), the type-species. According to Charles Heiser in his book, The Fascinating World of the Nightshades (1987), the generic name is derived from the Latin word,

> solamen meaning "quieting," alluding to the sedative properties of some of its species. Many members of this family produce alkaloids, which do have a quieting effect; in fact, somtimes a permanent one" (Heiser 1987: 1-2).

The Solanaceae is a large family, composed of approximately 75 genera and 2,000 species distributed worldwide, with the greatest concentration of species in Latin America (Benson 1979: 270; Heiser 1987: 2). In North America, native members of the Solanaceae are especially abundant in the southern parts of the United States, e.g., from Arizona east to Florida (Benson 1979: 271). In addition, a great many species have been introduced into North America, as well as other parts of the world, as cultivated food plants, ornamentals, medicinals, and naturalized "weeds." The largest genus in the Solanaceae is Solanum, which subsumes approximately 75% of all the species.

Members of the Solanaceae are typically herbs or shrubs, but sometimes small trees (especially in the tropics), or woody vines (Benson

1979: 270; Heiser 1987: 2). Typical morphological characteristics of this genus include:

> Leaves: simple, or sometimes pinnate, usually arranged alternately; sometimes (on the upper part of the plant) arranged in an opposite manner;
>
> Flowers: radially, or rarely bilaterally symmetrical
>
> Fruit: a berry, but sometimes a capsule; the seeds flattened; seeds round or kidney-shaped.

Concerning the characteristics of Solanum, the largest genus in this family, Pesman asserts:

> It is not difficult to tell a solanum from other plants; the flowers are more or less wheel-shaped, with five well-defined lobes, often white, sometimes purple or yellow. The fruit is a roundish berry with two distinct cells (Pesman 1962: 150).

According to Lyman Benson,

> The nightshade family is one of the leading sources of food, drugs, and ornamental plants. The underground stems of a series of species of Solanum form tubers or potatoes;...tomatoes (Lycopersicon esculentum), groundcherries or tomatillos (Physalis), eggplant (Solanum melongena), and red peppers (Capsicum)...Drugs include the nicotine of tobacco (Nicotiana), belladonna (Atropa), henbane (Hyoscyamus) and stramonium (Datura). Many of the genera are cultivated for their showy flowers (Benson 1979: 271).

Medicinal Uses

Medicinal uses of the Solanaceae are too numerous to list completely. Heiser's book on the nightshades (Heiser 1987) provides a good overview of the history and economic uses of members of this large family. The most common use-category of these plants is as narcotics, but members of the Solanaceae are used for a variety of other medicinal uses.

Some of the better-known medicinals from the Solanaceae include belladonna (from Atropa belladonna), which contains the drug atropine. Atropine is used today to treat opthalmic disorders (when dropped in the eye, it dilates the pupil for therapeutic and diagnostic procedures); it also treats neuralgia and is considered a " valuable antidote in opium poisoning" (Bor and Raizada 1954: 113). The alkaloids in henbane (Hyoscyamus niger L.) were used in the past, and are still used today, to make narcotic and antispasmodic drugs (Hocking 1947: 313-315). The genus Datura (jimsonweed or thornapple) also contains atropine and hyoscyamine, as well as the alkaloid scopolamine. While scopolamine can be used for therapeutic purposes similar to atropine or hyocyamine, it can cause hallucinations and even death in humans who consume the leaves or seeds of Datura (Bor and Raizada 1954: 114). Several species of Duboisia (common name: pituri) also contain narcotic alkaloids; in the 19th century, the native inhabitants of Australia chewed the leaves and twigs of one species, D. hopwoodii, as a narcotic (Heiser 1987: 156). Pituri was such a valued item in Australia that Yen notes that it was "a principal item of trade networks that were virtually transcontinental" (Yen 1989: 60). Mandragora officinarum (mandrake), whose root looks vaguely anthropomorphic, was a valued panacea, narcotic and reputed aphrodisiac in the Middle Ages in Asia and Europe (Heiser 1987: 131-136), although it is seldom used at the present. The alkaloids in mandrake have been identified, and include hyoscyamine, scopolamine and mandragorine (Heiser 1987: 133). Withania somnifera (in the random sample) contains the potentially toxic alkaloid, tropine (Lewis and Lewis 1977: 15) as well as the antineoplastic agent, withaferin-A (Lewis and Lewis 1977: 136; Windholz 1976: 12). Another member of the Solanaceae, Acnistus arborescens, also contains withaferin-A (Heiser 1987: 157). Several solanaceous plants are also used as anthelminthics, for example: Nicotiana tabacum (Perry 1980: 393) and Scopolia parviflora (Perry 1980: 394).

Fertility-Related Uses

The many alkaloids contained in the Solanaceae also contribute to their uses as contraceptives, emmenagogues, abortifacients and post-partum treatments. Farnsworth et al. (1975: 546; 553; 574-575) list seven genera and 13 species which were evaluated for fertility-affecting activity. Some of the same genera in Farnsworth et al. are mentioned in ethnographic sources from Asia and North America (Moerman 1977; Perry 1980). A partial listing of fertility-affecting solanaceous plants, their uses, and the geographical areas in which they are used include:

> Capsicum: the sap of the raw leaves of C. annuum is used as a parturifacient in Indonesia (Perry 1980: 391). Farnsworth et al. (1975: 574) report that the leaf and stem of another species, C. frutescens, demonstrated uterine stimulant effects under experimental conditions.

Datura: D. discolor was used by the Pima Indians of southwestern North America to ease the pains of chilbirth (Moerman 1986); D. metel and D. stramonium are used interchangeably in Asia for relief of menstrual pain (Perry 1980: 392); a water decoction of the leaf and fruit of D. metel is used in India for antifertility purposes (Farnsworth et al 1975: 546); and experimentally, D. tatula (more correctly, D. stramonium var. tatula) showed uterine stimulant activity (Farnsworth et al. 1975: 574).

Lycium: Lycium barbatum demonstrated both abortifacient and emmenagogic activity experimentally (Farnsworth et al. 1975: 574).

Nicotiana: Moerman (1977: 122-123) mentions two species of Nicotiana: N. attenuata and N. bigelovii. The leaves of the first species were used by the Tewa Indians of North America to make a snuff, which was given to women in labor (perhaps to make them sneeze and speed the delivery of the child ?). The second species was used by the Kwaiisu Indians: a poultice made from this plant was placed on the abdomen of a woman during parturition. Farnsworth et al. (1975: 553) report that smoking N. tabacum (tobacco) alters the human ovarian cycle; further, the nicotine (an alkaloid) in tobacco produces uterine stimulation in vitro and in vivo, and the leaf of N. tabacum contains abortifacient principles (Farnsworth et al. 1975: 574).

Physalis: in China, the seeds of P. alkekengi (Chinese lantern) and P. franchetti are used to make a medicine which promotes labor (Perry 1980: 393). Experimentation with the whole plant of P. minima demonstrated abortifacient activity (Farnsworth et al. 1975: 574).

Solanum: an undetermined species of Solanum was evaluated chemically and contained tyramine and 5-hydroxytryptamine, both of which have abortifacient and uterine stimulant properties (Farnsworth et al. 1975: 546). Other species of Solanum which have abortifacient and uterine stimulant properties include S. nigrum, S. paniculatum; S. variabile and S. verbascifolium (Farnsworth et al. 1975: 575). The leaves of S. verbascifolium are used as an abortifacient and the leaves, mixed with salt, are eaten as a postpartum treatment on the Malay Peninsula (Perry 1980: 395).

The spicy or burning flavors of many of these species may have contributed to their use as postpartum medicinals in Asia. In Asia "hot" medicines (which includes many spices) are seen as therapeutic to treat the "cold" bodies of postpartum females; the same quality of "heat" also makes these plants valued as emmenagogues and other fertility-affecting medicines (c.f. Kunstadter 1978: 191).

Non-Medicinal Uses

The Solanaceae contain many economically important food plants; for example: potatoes (white potatoes, Solanum tuberosum; not sweet potatoes, Ipomoea batatas, which are in the Convolvulaceae); chili peppers (Capsicum); tomatoes (Lycopersicon esculentum); and eggplant (Solanum melongena). Tobacco (Nicotiana), which is still used for magical (as well as medicinal) purposes in many parts of the world, is also an important economic plant; it leaves are made into a variety of products such as ciagarettes, cigars, chewing tobacco, and snuff. The magical uses of the members of the Solanaceae are well-summarized in Heiser's book on the Solanaceae, in a chapter entitled "Black Magic to Modern Medicine" (Heiser 1987: 129-157).

Many ornamental plants come from this family of plants. For example, petunias (Petunia), matrimony vine (Lycium), and butterfly flower (Schizanthus) (Bor and Raizada 1954: 113; Heiser 1987: 179-189). Species commonly considered medicinals or food plants which are also grown as ornamentals include Datura and Nicotiana (for their showy flowers); and Capsicum and Physalis (for the colorful and attractive fruits).

The alkaloids present in many of the Solanaceae have led to their cultivation for the production of insecticides. The alkaloid nicotine is an especially effective insecticide, and the species Nicotiana rustica an excellent source for the alkaloid (Heiser 1987: 175; Perry 1980: 399). Other solanaceous plants with insecticidal properties include the cultivated tomato, Lycopersicon esculentum (a leaf infusion is sprayed onto cabbages to fight caterpillars; Perry 1980: 392-393); and cultivated tobacco, Nicotiana tabacum (Perry 1980: 393). Duboisia hopwoodii F. Muell., which contains the alkaloid nor-nicotine, is toxic to a number of species of aphids, mites, and other insects which infest cultivated plants (Roark 1947: 438).

The toxic properties of the alkaloids in this plant family are used to advantage on creatures other than insects. Ethnographic reports dating from the nineteenth century in Australia state that an undetermined species of Duboisia (native name: pituri), a shrubby plant which contains narcotic alkaloids, was used by the native inhabitants to hunt emus. When the plant was placed in waterholes where the large birds were known to drink, Duboisia stupefied the emus so that they could be easily caught (Heiser 1987: 156).

Summary

The members of this large and varied family are among the most eminently noticeable plants in the world. Many solanaceous plants are staple foods (e.g., white potatoes) or flavoring plants (e.g., chili peppers). The seeds of chilis have been found in coprolites in contexts dated to 8000 BP in Mexico (Heiser 1987: 16) and are an integral part of the diet in Mesoamerica today. Heiser observes:

> Today the pepper is nowhere more appreciated and more widely used than in Mexico and certain other Latin American countries, which together form the original home of all the peppers. Both at morning and at evening, practically every dish the Indians eat includes Capsicum, just as their food did 2000 years ago. The diet of the Indians was, and still is, rather bland-- maize, beans, squash, pumpkin, yuca, potatoes-- little wonder that they did not know it, the peppers were a wonderful source of essential vitamins in a diet otherwise largely lacking them (Heiser 1987: 16).

Heiser's statement echoes the observations made by Etkin and Ross (1982) on the use of condiments in Africa, where "food is medicine, and medicine is food."

Aside from the spiciness of chili peppers, other members of the Solanaceae possess alkaloids which give them characteristic tastes or odors. For example, Walter Pesman (1962: 150), referring to the foliage, perhaps, says that "many species have a distinctive 'solanum' odor. The common 'Irish' potato is typical."

The flowers of some members of the Solanaceae are scented: for example, Cestrum (night jessamine), a night-blooming shrub bears scented flowers. In fact, they are so heavily scented that it is recommended that the shrub not be planted too near one's house as an ornamental (Heiser 1987: 187). While some species of Datura have fragrant flowers, all plant parts of this genus are usually described as "rank smelling."

Mechanical or chemical irritant injury may result from contact with some solanaceous plants. Spiny or prickly members of this plant family include: Solanum rostratum (buffalo-bur); S. torvum; S. hispidum; S. refractum and S. tequilense (Pesman 1962: 151). Datura stramonium is characterized by its spiny fruits, hence its common name "thorn-apple." Walter Pesman (1962: 151) says that Standley's Trees and Shrubs of Mexico (1920-1926) lists 23 prickly and 33 non-prickly species of Solanum.

Members of the Solanaceae capable of causing skin irritations or allergic reactions by chemical means include Capsicum frutescens (cayenne pepper), Datura spp., Lycopersicon esculentum, Solanum carolinense (horse nettle) and S. tuberosum (Lampe and McCann 1985: 194-195; Lewis and Lewis 1977: 85-86). While the compounds responsible for the irritant properties of Datura have not been identified, capsaicin (an oleoresin) is responsible for the burning sensation produced by parts of the Capsicum plant, especially the seeds. Heiser (1987: 8) comments:

> Some varieties of Capsicum are so hot as to have produced burns requiring medical attention, and reputedly peppers have been used for torture in both the Old and New Worlds.

In addition to cultivated and wild species, some members of the Solanaceae are considered "weedy". Britton and Brown (1970: 154-171) list the following genera (all native to North America) as having one or more species commonly found in disturbed habitats: Datura; Hyoscyamus; Lycium; Lycopersicon; Nicotiana; Petunia; Physalis and Physalodes.

A final characteristic of the Solanaceae which contributes to their perceptual salience is their potential toxicity. The same compounds which give these plants their medicinal properties also render them toxic to humans or animals. Poisonous members of this family include: Atropa belladonna, whose purplish-black and sweet-tasting berries are often eaten by children, with fatal results; Cestrum spp.; Datura spp. (also called Brugmansia spp. in some parts of the world); Lycopersicon esculentum (leaves and stems are toxic); Nicotiana spp.; Solandra spp.; and Solanum spp. (Lampe and McCann 1985: 36; 53-54; 70; 194; 123; 157-158; Lewis and Lewis 1977: 54-55). Fortunately, the alkaloids in most of these plants make them taste so objectionably bitter to humans and livestock, that it is rare that sufficient amounts of the plant is ingested to producee fatalities.

All of the characteristics discussed above make members of the Solanaceae noticeable to humans. Despite the potential toxicity of many solanaceous plants, human manipulation of these plants has resulted in the development of important food and condiment crops, as well as medicinals and ornamentals. The toxicity of these plants has been turned to advantage by judicious use of the plants for medicinals and insecticides.

Genus Withania

Very little descriptive material is available (at least in the U.S.) on this genus, which was named for the 19th century paleobotanist, H.T.M. Witham.

According to Steentoft (1988: 233), Withania is a small genus, comprised of approximately 10 species distributed from South America to India. W. somnifera is the species most often reported in the ethnobotanical literature; references to other species are few.

Besides W. somnifera, W. obtusifola T.Tackh. and W. coagulans Dunal. are the two other species most often mentioned in reference sources. Bor and Raizada (1954: 113-114) say that W. coagulans is found in the Punjab, Sind and Baluchistan, and that "the seeds have the interesting property of being able to coagulate milk, and hence can be used as a substitute for rennet." This milk-coagulating property is also commented on by Watt and Breyer-Brandwijk, although they add that "the enzymes responsible for this have not been isolated" (1962: 1012).

Medicinal uses for species other than W. somnifera are rarely mentioned. Three different medicinal use-categories were mentioned in the literature. Watt and Breyer-Brandwijk note that the fresh fruit of W. coagulans has emetic properties (1962: 1012). W. coagulans, like W. somnifera, also contains withanolides, compounds which erportedly have antineoplastic (antitumor) properties (Lewis and Lewis 1977: 136). The only fertility-related use cited was for W. coagulans: according to Farnsworth et al. (1975: 575), the seed (and possibly other plant parts) was tested for potential antifertility activity. Although the active constituents were not specified, this plant demonstrated both abortifacient and emmenagogic activity.

Withania somnifera

Scientific name: Withania somnifera Dunal.
Synonym(s): Withania ashwagandha Kaul. (cultivated variety); Physalis somniferum Link.
Common name(s): ashwagandha; kuthmithi: the common name may also refer to the drug derived from different parts of the plant eg, "ashwagandha" refers to the drug made from the leaves; "kuthmithi" to the roots.
Distribution: India (both wild and cultivated varieties); also Pakistan, Afghanistan, Middle East, Spain, Canary Islands, south and east tropical Africa.
Related species: W. coagulans Dunal.; W. obtusifolia T. Tackh.
References: Atal and Schwarting (1961); Bor and Raizada (1954); Emboden (1972); Farnsworth et al. (1975); Nakao (1976); Pammel (1911); Watt and Breyer-Brandwijk (1962); Windholz (1976).

Because Withania somnifera has been under cultivation for many years, there are morphological differences between the wild and cultivated varieties of the herb. According to Kaul (cited in Atal and Schwarting 1961), the cultivated variety should be assigned to a different species, W. ashwagandha. The wild specimens of W. somnifera are "generally erect branching shrubs, up to one meter in height" (Atal and Schwarting 1961: 257). The entire plant is covered with fuzzy hairs. Atal and Schwarting describe W. somnifera thus:

> The leaves on vegetative shoots are alternate and large while those on floral branches are opposite, arranged in pairs of one large and one small leaf and the members of the pair, arranged somewhat laterally, have in thier axil a cymose cluster of 5 to 25 inconspicuous pale green flowers (1961: 257).

The entire plant is covered with fuzzy hairs. Atal and Schwarting's only comment on the morphological characteristics of the cultivated species, W. ashwagandha, is that the cultivated plant is much shorter than W. somnifera, rarely exceeding 30 cm. in height. A more complete description of the morphology of the cultivated species could not be found.

Typical morphological characteristics of the uncultivated species, W. somnifera, include (Atal and Schwarting 1961: 257):

> Leaves: simple, petiolate, ovate, exstipulate, entire, acute and glabrous (except for the veins, which are sparsely tomentose);
>
> Flowers: inconspicuous, pale-green in color, in clusters of 5-25; 4-6mm. in diameter;
>
> Fruit: "in the fruiting stage the calyx becomes enlarged, inflated, and completely encloses the fruit" (Atal and Schwarting 1961: 257). Fruit is a berry, 5mm. in diameter, orange-red when ripe, containing many seeds.

This herb is commonly cultivated; outside of cultivation, it is found in open places, disturbed areas, etc. (Emboden 1972: 160).

Medicinal Uses (internal)

Withania somnifera is a drug plant long used in the Ayurvedic system of medicine, one of the major systems of medicine in India. The major therapeutic category for this herb is as a tonic: it is regarded as a rejuvenator, aphrodisiac, and analgesic for rheumatism and joint inflammation, and a sedative (Atal and Schwarting 1961: 257; Bor and Raizada 1954: 114). Atal and Schwarting (1961: 257) observe that ancient Indian medical texts prescribed W. somnifera for a wide range of complaints; for example, "hiccup and in female disorders." Whether the latter two use categories were in some way related is unspecified.

Internal uses for the herb in Africa, as in India, were quite varied. According to Watt and Breyer-Brandwijk (1962: 1010-1012), W. somnifera was used in the following ways: as a vermifuge: in Basutoland, the herb was used by the Sotho tribe to expel "...intestinal parasites introduced by witchcraft" (Watt and Breyer-Brandwijk 1962: 1010); and for respiratory ailments: the Southern Sotho administered a bark infusion to treat asthma, and European Africans reportedly used the herb for respiratory ailments. Atal and Schwarting report that a plant extract of W. somnifera has demonstrated respiratory stimulant activity (1961: 257). Additional uses for this plant in Africa include its use throughout Africa as a treatment for syphilis and typhoid; the Swati tribe used a root and leaf decoction for smallpox; and in the southern and eastern portions of Africa, a medicine is made form the root for the treatment of diarrhea and proctitis, while the leaf is made into a medicine for nausea and rheumatism.

The roots of W. somnifera are used as a hypnotic and tranquilizer in both Africa and India (Atal and Schwarting 1961: 257; Emboden 1972: 160; Watt and Breyer-Brandwijk 1962: 1012). The active constituent responsible for the sedative effects of this herb is the alkaloid, somniferine (Emboden 1972: 160).

Medicinal Uses (external)

Topical uses of W. somnifera involve use of the root bark, leaves, stems, and green fruit for a variety of skin lesions and inflammations (Atal and Schwarting 1961: 256; Watt and Breyer-Brandwijk 1962: 1010-1012). Emboden (1972: 136, 160) reports that the whole herb, when crushed and mixed with oils, can be used as a poultice for boils and swellings. Watt and Breyer-Brandwijk (1962: 1010) say that the leaf is mixed with fat and made into an ointment by several groups in Africa. A root infusion, mixed with the root of Pentansia variabilis (Rubiaceae), is used as an enema by the Zulu to treat "gangrenous rectitis" (Watt and Breyer-Brandwijk 1962: 1010). The green (unripe) fruit is bruised and applied topically to treat ringworm in both humans and animals; the leaf juice is used by the Masai tribe to treat pink-eye and conjunctivitis (Watt and Breyer-Brandwijk 1962: 1010-1011).

The antiseptic properties of the plant are employed in other ways. For example,

> The Xhosa apply the fresh juice of the leaf to an anthrax pustule (on cattle) and use the plant for disinfecting anthrax-infected meat. The Pedi use the plant to treat meat of an animal, which has died a natural death and of an animal infected with disease, even anthrax (Watt and Breyer-Brandwijk 1962: 1010).

Other veterinary applications include the use of a paste made from the unripe fruits, the leaves and "small twig(s)" to treat saddle sores and girth gall in horses (Watt and Breyer-Brandwijk 1962: 1010).

Withania somnifera is also reported to be an insecticide. Emboden (1972: 136, 160) says that the leaves have been used to kill lice, and Watt and Breyer-Brandwijk (1962: 1012) note that the herb has been used as an insecticide, but do not elaborate. The active constituent responsible for the insecticidal action is not identified by either Emboden or Watt and Breyer-Brandwijk.

Fertility-Related Uses

Withania somnifera has been used in India, Asia, and Africa as an abortifacient, emmenagogue and post-partum treatment. Although Atal and Schwarting (1961: 257) say only that this plant has been used to treat "female troubles" in India, Watt and Breyer-Brandwijk state that "In Punjab and Sind (India) the root has been used to produce'criminal abortion'" (1962: 1010). In Africa, the Transvaal Sotho take a decoction of the root to "tone up the uterus in a woman who habitually miscarries and in order to remove retained conception products" (Watt and Breyer-Brandwijk 1962: 1010). In Tanganyika, the Sukuma tribe reportedly uses the herb as an abortifacient (Watt and Breyer-Branwijk 1962: 1011). Pammel (1911: 855) says that W. somnifera has been employed as an abortifacient in the Mediterranean area as well as the Orient. Farnsworth et al. (1975: 553) report that the roots, leaves and whole plant was evaluated experimentally using mice as subjects and demonstrated fertility-reducing activity.

This herb is reputed to have aphrodisiac qualities as well: Watt and Breyer-Brandwijk (1962 1011) report that the Nyamwezi tribe of Tanganyika use it as an aphrodisiac; Atal and Schwarting (1961: 257) and Bor and Raizada (1954: 114) confirm W. somnifera's use as an aphrodisiac in India. Lewis and Lewis (1977: 331) elaborate, saying that in India, the root of this plant is mixed with honey and butter to treat "sexual debility."

Chemical information concerning W. somnifera indicates that most of the folkloric medicinal uses for this herb are empirically sound. This herb contains over 12 alkaloids, including nicotine, withanine, somniferine and tropine, in its leaves and roots (especially in the root bark), and the berries contain saponins (Emboden 1972: 136, 160; Lewis and Lewis 1977: 15, 136, 364: Windholz 1976: 1295). Withaferin-A, or withaferin, has been isolated for the leaves of W. somnifera: this substance is classified as an antineoplastic (antitumor) agent, as well as a broad-spectrum antibiotic and antifungal agent, effective against many bacteria and viruses (Lewis and Lewis 1977: 136, 364; Windholz 1976: 1295). Emboden (1972: 136, 160) adds that withanine, and alkaloid isolated from the herb, is a sedative.

Any (or all) of the many biologically-active, potentially toxic, alkaloids which W. somnifera contains may account for its uses as a fertility-affecting plant. For example, Farnsworth et al. (1975: 575) identify nicotine, which stimulates uterine tissue, as one of the active constituents. The antifungal and antibacterial action of withaferin accounts for the many topical uses of this herb, on both humans and animals. Likewise, several of the alkaloids, most notably nicotine, are undoubtedly responsible for its use as a vermifuge and insecticide:

nicotine is "a deadly poison and one of man's best insecticides" (Heiser 1987: 173).

Summary

Withania somnifera possesses several of the traits which were proposed as contributing to the perceptual salience of plants. For example, it is a "controlled" plant: Atal and Schwarting (1961) indicate that not only is the herb found growing wild, but that human genetic manipulation of this plant for desired morphological and chemical traits has resulted in the emergence of a separate species, W. ashwagandha Kaul. Emboden (1972: 136, 160) also indicates that W. somnifera is considered "weedy" in some areas, where it is found in open places and in disturbed areas. Atal and Schwarting (1961) note that a great deal of variation exists among the "wild" forms of Withania somnifera, depending upon soil type, moisture and so on; it may be that in areas where this herb has been cultivated for many years, that the observed variation in this plant may reflect introgression and cross-breeding between the cultivated and "wild" varieties.

Other characteristics which lend this plant perceptual salience include the bitter taste of the herb, produced by the many alkaloids which it contains;

the wooly appearance of the plant, and the fruit, which is red when ripe. Finally, the ethnographic literature mentions that W. somnifera is used both as an insecticide and as a vermifuge.

IX. ACANTHACEAE

ACANTHUS FAMILY

The Acanthaceae is composed of approximately 250 genera and 2,000 species of herbs, shrubs, or sometimes trees or woody vines. The family is pan-tropical in distribution (e.g., Cuba, tropical Asia, tropical Africa, and tropical America), rarely occuring in the United States (Benson 1979: 283; Heywood 1978: 250-251). Members of the Acanthaceae are most commonly found in Central America and Mexico. According to Benson, "The genus best represented in the United States is Ruellia, a perennial herb which occurs from Arizona to the eastern half of the continent" (1979: 283). This family's name is derived from the Latin word for "thorn" (acanthus), as some genera are prickly (Bor and Raizada 1954: 101).

Typical morphological characteristics of the Acanthaceae are:

Leaves: simple, opposite, or rarely, whorled;

Flowers: with a hypogynous disc, subtended by bracts and bracteoles;

Fruit: a capsule or, in a few genera, a drupe;

Stems: often quadrangular in cross-section.

The leaves of members of the Acanthaceae are unusual in that they possess cystoliths (crystals of calcium oxalate), "which sometimes appear as translucent streaks on the fresh leaves, or raised lines in the dried leaves" (Bor and Raizada 1954: 101; also Heywood 1978: 251). Calcium oxalate crystals, or raphides, were mentioned earlier in this paper as causing irritation of the mouth if ingested.

Medicinal Uses

Heywood mentions several genera of the Acanthaceae which are used as medicinals (Heywood 1978: 251): Acanthus ebracteatus (sea holly) a cough medicine is made from an extract of the boiled leaves, is used in parts of Malaya; A. mollis (bear's breech) is an antidiarrheal medicine in some parts of Europe; and the leaves and flowers of Blechium pyrimidum are used as a diuretic, cough medicine and antipyretic in "parts of Central and South America" (Heywood 1978: 251).

According to Pammel, of six genera and nine species of Acanthaceae examined for poisonous or toxic properties, five species were reported to have abortifacient or emmenagogic properties (1911: 804). One species was reported to be a fish poison.

Non- Medicinal Uses

Bor and Raizada (1954: 101) and Heywood (1978: 251) comment that many members of the Acanthaceae are cultivated for their showy, colorful flowers. Some of the ornamental species include: Aphelandra squarrosa, which has yellow flowers and conspicuous bracts; Crossandra nilotica, which has red flowers; and Thunbergia alata (black-eyed Susan), which is purple in color with a black "eye." This latter plant is not the black-eyed Susan most Americans are familiar with; the North American black-eyed Susan is Rudbeckia heliopsidis

(Asteraceae).

Adhatoda vasica

Scientific name: Adhatoda vasica Nees
Synonym: Justicia adhatoda L.
Common name(s): Malabar nut tree; arusa; vasaca; adhatoda; bakash
Distribution: native to India but widely cultivated in the tropics (Perry 1980)
Related species: Adhatoda engleriana; Justicia gendarussa Burm. (J. nigricans Lour.; Gendarussa vulgaris Nees); J. procumbens L.; J. ventricosa Wall.; J. bracteata Ridl.; J. ptychostoma Nees; J. uber C.B.Cl.
References: Patel (1986); Perry (1980); Santapau (1967).

According to Santapau (1967) in the Flora of Khandala (India), A. vasica was not a common species in the district of Khandala. His description

> in full bloom it is a fine shrub, but generally it looks rather rugged and bare with flowers and leaves only near the ends of the branches. It is often used as a hedge shrub (1967: 210).

Peter Kunstadter (1978: 191) also states that A. vasica occurs deliberately planted around Lua' villages in Thailand, or is found growing wild.

Medicinal Uses

Other medicinal uses of A. vasica include a decoction of the leaves and roots as a treatment for coughs, and of the leaf extract as an antiseptic. The alkaloid resposible for both modes of action is vasicine, which not only produces a "slight, but persistent broncho-dilator effect" (Perry 1980: 1), but is also responsible for the antiseptic properties of the plant. Patel, in a paper on Indian ayurvedic medicine, says that A. vasica is prescribed as as an antitussive, antiasthmatic and antispasmodic medicine (Patel 1978: 53). Perry (1980:1) and Patel (1978: 53) also state that the leaves (which contain vasicine) are purported to have insecticidal properties.

Perry (1980:1) also reports that a number of other species of Adhatoda (the genus is also called Justicia) are used as regional substitutes for A. vasica: J. gendarussa; J. procumbens, J. bracteata, J. ptychostoma, and J. uber. Watt and Breyer-Brandwijk (1962: 1) state that a leaf decoction of Adhatoda engleriana C.B.Cl. is used by the Bondei of Africa to relieve pain in childbirth.

Fertility-Related Uses

This plant, which was listed among the "hot" medicines in Kunstadter (1978: 191) as treatments for postpartum women, is prepared for use as a postpartum medicine by slicing, drying, and pounding the roots for making a tea. The entire plant is also used as a "cure for excessive menses" (Perry 1980: 1). Farnsworth et al. state that experimentation showed that a leaf extract of A. vasica had an abortifacient and emmenagogic effect, but that it did not demonstrate an antifertility effect (1975: 547). The active constituent responsible for the emmenagogic and abortifacient action was not specified. Bingel and Fong (1988) conducted in vivo and in vitro experiments on laboratory animals using extracts of A. vasica, with results similar to those reported by Farnsworth et al in 1975. The active consituent was identified as the alkaloid vascicine. Experiments conducted with human volunteers were less conclusive; however, Bingel and Fong observe that the dosages given to the human subjects were too low to produce significant effects.

Summary

Adhatoda vasica fits several of the criteria for noticeability: it is a controlled species, being grown as a hedge shrub; its leaves are unusually, if faintly, striped due to the presence of oxalic acid crystals; these crystals may also irritate the mouth if the leaves are ingested; and it is used as an ornamental.

X. ASTERACEAE

SUNFLOWER FAMILY

Because three genera of the Asteraceae are represented in the random sample, this discussion of the Astereaceae will be brief. Also known as the Compositae or the Carduaceae, the Asteraceae is an extremely large and varied family composed of approximately 15,000-20,000 species distributed worldwide (Benson 1979: 295). Members of the Asteraceae are most often herbs, but sometimes shrubs. Typical morphological characteristics of the Asteraceae include (Radford 1968: 1009):

> Leaves: simple, although often deeply dissected and appearing compound;
>
> Flowers: highly modified; borne in heads surrounded in an involucre of bracts; color of petals is varied;
>
> Fruit: a one-seeded nutlet.

Pammel (1911: 814-816) reports that chemical analysis showed that 62 genera of the Asteraceae (106 species) had evidence of toxicity. Four genera (five species) were listed as emmenagogues or abortifacients: Elephantopus tomentosus L. (North America); Grindelia tournefortii L. (no area given), Senecio Grayanus Heimsl. (Mexico), Tanacetum umbelliferum Boiss. (Afghanistan), and T. vulgare L. (Europe, N. Asia). One species, Ichthyothere Cunabi Mart., was listed as being a fish poison (Brazil), and two species were listed as having insecticidal properties: Chrysanthemum cinerariaefolium Vis. (Dalmatia) and Pulicaria dysinterica Gaertn. (Europe). In addition, nine species were listed as having irritant properties.

Genus Artemisia

Members of the genus Artemisia are typically biennial or annual, erect, generally hairy herbs or sub-shrubs which prefer open, sunny habitats and well-drained soils. The flowering heads of members of this genus tend to form large panicles (Britton and Brown 1970: 522; Radford et al. 1968: 1137). The artemisias, or wormwoods, are odorous herbs: plants which grow in areas with poor, dry, soils tend to accumulate more secondary compounds in their leaves; consequently, their scent is even more pronounced (Genders 1977: 113).

There are approximately 225 species of Artemisia, widely distributed in the northern hemisphere and southern South America (Britton and Brown 1970: 522). This genus is especially well-represented in the western part of North America, where over 60 species of Artemisia are found. Common sagebrush, a typical part of the scenery in many a B- Western movie, is Artemisia tridentata.

Artemisia vulgaris (mugwort, the type species for this genus) has the widest range of any species in this genus; it is found throughout Asia and Europe (Perry 1980: 84), and is naturalized in North America. Radford et al.

do not list A. maritima (selected in the random sample) in their flora of the Carolinas and surrounding areas. The three species that they do list are naturalized: A. vulgaris L., A. ludoviciana Nuttall. (white sage) and A. caudata Michaux. The first two species are noted to occur frequently in sceondary habitats, such as in old fields, roadsides, hedgerows and the like; A. vulgaris is termed a "noxious weed" (Radford et al. 1968: 1137).

All three species have fragrant foliage; that of mugwort is said to have an odor similar to that of the garden crysanthemum (Radford et al. 1968: 1137). Artemisia caudata, however, is most commonly found in thin rocky or sandy woodland soils, rather than in secondary habitats, in this part of eastern North America. Wilkinson and Jaques (1972: 169-170) list three species of Artemisia as being common weedy plants in North America: A. tridentata Nutt. (big sagebrush); A. annua L. (annual sagebrush) and A. biennis Willd. (biennial wormwood, bitterweed, or false tansy).

Several components of the essential oils of members of this genus have also been known to cause contact dermatitis. For example, A. absinthum contains thujone and phellandrene, which can cause a reaction in some people (Lewis and Lewis 1977: 84). Other species contain lactones which may cause skin reactions; these include A. tridentata, A. vulgaris, as well as A. absinthum (Lewis and Lewis 1977: 84).

Medicinal Uses

Michael Moore, in his book Medicinal Plants of the Mountain West, summarizes the genus Artemisia in a manner especially pertinent to this thesis:

> This family is large, varied, and multipurpose, but several characteristics which make it fairly easy to identify are nearly universal. Plants which don't meet these criteria are usually useless as remedies. The leaves tend to be noticeably hairy, either on the underside of the leaf or on both sides; usable species are strong-scented when crushed, like a cross between sage and camphor; the flowers are round and slightly tubular balls found along extended flower stems in unleafed, generally one-sided rows. The leaves may be lance-shaped but more often are deeply cleft or irregularly fingered (1979: 162; emphasis added).

Pammel (1911: 815) lists five species of Artemisia which reportedly have toxic effects: A. abrotanum L. (southernwood), which is used as an "inebriant" in Europe and temperate Asia; A. arenaria D.C., also reportedly used as an inebriant in the Caucasus; A. mexicana Willd. and A. pontica L., used as anthelmintics in Mexico; and A. trifida, used as a diaphoretic in western North America.

Of all the species of Artemisia it is perhaps A. absinthum (wormwood), which has received the most treatment in the literature. The liqueur absinthe, made famous by the author Oscar Wilde, but now illegal in the U.S., is flavored with this species. Wormwood is a bitter-tasting herb found growing throughout Europe in dry waste places and along roadsides (Bunney 1984: 75; Lust 1974: 409). Actually, many other species of Artemisia besides A.

absinthum are commonly called "wormwoods." The common name derives from this genus' ability to expel or inhibit roundworm and pinworm infections (Moore 1979: 162). The chemicals responsible for these vermifugal properties are found in nearly all of the wormwoods, and include santonin and artemisin, both lactone glycosides (Moore 1979: 162). In India, Pakistan, and the Soviet Union, fields of Artemisia are grown to provide large quantites of santonin for the pharmaceutical industry (Chaudhri 1955). Artemisin is found especially in the dried, unexpanded flowerheads of A. maritima and A. cina, and is useful as an anthelminthic for both humans and animals (Windholz 1976: 109). A. absinthum, A. abrotanum, A. japonica, and A. vulgaris var. indica as well as A. maritima and A. cina are reportedly used as anthelmintics in Europe, North America and Asia (Bunney 1984: 75; Moore 1979: 162; Pammel 1911: 815; Perry 1980; Windholz 1976: 109).

Additional medicinal uses for members of the genus Artemisia include the use of the aromatic herb in sweat baths and saunas, especially A. tridentata (sagebrush), A. dracunculus (mugwort or false tarragon) (Moore 1979: 162). The essential oils which lend members of the genus their aromatic scent also give them a bitter taste (e.g., A. absinthum); accordingly, these herbs are also prescribed as stomachics.

Elsie Densmore, who worked with the Chippewa Indians of the Great Lakes region of North America in the early 1900's, recorded multiple uses for four species (Densmore 1928):

1. A. absinthum: the tops of the plant were boiled to make a warm compress for strained or sprained muscles (Densmore 1928: 362-363). Interestingly, one of the chief ingredients in the modern muscle-soothing liniment, Absorbine, Jr. (Absorbine, Sr. being a stronger version usually employed in veterinary medicine), is A. absinthum (Clark 1939: 19).

2. A. drancunculoides: the dried leaves and flowers were steeped in water and drunk to treat circulaory problems. The fresh leaves were also chewed for the same purpose (Densmore 1928: 338-339). The fresh root was chewed, or the dried root prepared, to make a poultice which was applied externally for hemorrhaging (Densmore 1928: 356-357). The root of this herb was also made into a strong decoction used to bathe children and weak adults (Densmore 1928: 365-357).

3. A. frigida (prairie sage): the root of this herb was used as part of a compound medicine for both hemorrhage (Densmore 1928: 356-357) and as a tonic for the nervous system (Densmore 1928: 336-337). The leaves were burned and the vapor inhaled, or the leaves were decocted to make a stomachic medicine; and the leaves were dried, crumbled, and placed on a hot stone to make a fumigant (Densmore 1928: 364-365).

4. A. gnaphalodes (white mugwort): the flowers of this herb were dried and placed on a hot stone to make a fumigant/disinfectant for the body and clothing (Densmore 1928: 364-365).

Fertility-Related Uses

Many species of Artemisia are reported ethnographically throughout the world as being abortifacients, emmenagogues, parturifacients, or post-partum medicinals. Farnsworth et al. (1975: 559) summarized reports on the fertility-related uses of six identified species and one undetermined species of Artemisia. All six species demonstrated abortifacient, emmenagogic, uterine stimulant, or other antifertility effects in experiments with both human and animal subjects. The species, and the plant parts tested for fertility-affecting activity were: A. abrotanum (leaves, flowers and seeds); A. absinthum (leaves and flowers); A. maritima (no plant parts specified); A. pontica (leaves and flowers); A. siversiana (no plant parts specified); A. vulgaris (no plant parts specified).

Perry (1980: 84-86) lists several species as being used in Asia for various fertility-related purposes. For example: A. annua: "The plants are collected before flowering in summer (sometimes after) and dried" (Perry 1980: 84). The herb is prescribed as a digestive and aperient for pregnant women, and also as a post-partum appetizer. Perry also notes that other species are acceptable as substitutes for A. annua: A. argyi, A. capillaris and A. scoparia. Additional species listed by Perry included A. vulgaris, which is used throughout Asia as an emmenagogue or parturifacient; the stems and leaves of A. dubia are used to treat women postpartum in Korea; and in China, A. anomala is used to treat "thin women without menstrual function but with a feeling of fullness in the abdomen" (Perry 1980: 85).

The genus Artemisia is prominently represented in Frances Densmore's 1928 Bureau of American Ethnology report, Uses of Plants by the Chippewa Indians (Densmore 1928). Among the many medicinal uses for A. dracunculus (mugwort), Densmore lists several fertility-related uses. A decoction of the roots of a sterile specimen of this herb was administered for both menorrhagia (excessive menstruation) and amenorrhea (stoppage of menstruation). The leaves and stalk together, or the root alone, were made into a decoction to aid difficult labor (Densmore 1928: 356-357).

Artemisia is likewise well-represented in the "gynecological aids" section of Daniel Moerman's Medicinal Plants of North America (Moerman 1986). Ten species of Artemisia are represented from indiginous groups such as the Karok, Cherokee, Thompson Indians, Paiute, and Navajo. Species of Artemisia used as emmengogues include: A. biennis (Cherokee) and A. ludoviciana (Paiute and Shoshone); as parturifacients and postpartum treatments: A. canadensis (Okanagan and Thompson Indians), A. douglasiana (Kwaiisu, Mendocino Indians, Yuki), A. dracunculus (Shuswap), A. filifolia (Comanche), A. ludoviciana (Paiute), A. tridentata (Navajo, Ramah Navajo, Paiute, Shoshone) and A. vulgaris (Karok).

The medicinal uses of this genus are summed up by Moore, who asserts:

> Nearly all species (of Artemisia) are intensely bitter and strongly aromatic, making them useful either to stimulate sweating in dry fevers or for indigenstion and stomach acidity. A classic stomach tonic and bitter tonic. In addition, the hot tea (rounded teaspoon to a cup of water) has a stimulating effect on uterine circulation and will help in suppressed, crampy menstruations, particularly following illness or some emotional or physical trauma".

The emmenagogic effects of these herbs is attributed to two components of the aromatic essential oil, thujone and phellandrene.

Non-Medicinal Uses

In addition to their uses as medicinals, some species of Artemisia were used as flavorings for food. For example, both A. frigida (prairie sage or estafiate) and A. franseroides (altamisa):

> have been used on occasion as a spice for corn and posole but must be used with the lightest of hand...their bitterness can overpower easily (Moore 1979: 162).

A. dracunculus (tarragon) is a well-known culinary herb in Europe, and A. abrotanum is used as a flavoring for meats and cakes as well (Clark 1939: 20). The use of A. absinthum to make the liqueur absinthe has already been mentioned; the same herb is also used to flavor vermouth.

Several species of Artemisia are also popular ornamental plants, where they are prized for their silvery-gray foliage, form, and fragrance. These characteristics, which they share with Solidago (goldenrod; also in the random sample), they make good border plants (Clark 1939: 22). Ornamental species of Atremisia include A. tridentata, A. gnaphalodes, A. purshiana (cud-weed), A. maritima, and A. Stelleriana
(beach wormwood, often likened to Cineraria maritima [dusty miller], another popular ornamental).

In addition to their use as vermifuges, species of Artemisia are reported to have insecticidal properties. For example, Bunney (1984: 75) states that A. abrotanum (southernwood) is used as an insect repellent in Europe; Bianchini and Corbetta (1977: 54) report that in 16th century

Europe, A. absinthum was strewn on chamber floors as a preventative against fleas; and Perry (1980: 85) lists A. argyi as being used as an isecticide in Asia. Watt and Breyer-Brandwijk (1962: 202) report that two African species, for which they only have common names, which possess insecticidal properties: "wild lavender" (possibly A. afra), used in the Bulawayo area as a moth repellent; and "southwood variety", used as a flea repellent in kennels. Since the many species of Artemisia contain a great number of different chemicals and essential oils (Perry 1980: 84), some of these substances may account for their use as insecticides (c.f. Rosenthal and Janzen 1979).

Artemisia maritima

Scientific name: Artemisia maritima L.
Synonym(s): none
Common name(s): sea wormwood
Distribution: native to England; Europe; cultivated in India
Related species: A. abrotanum L.; Artemisia absinthum L.; A. annua L.; A. anomala Moore; A. arenaria DC; A. argyi Levl.; A. capillaris Thunb.; A. cina; A. dracunculus Pursh.; A. dracunculoides Pursh.; A. dubia Wall. ex DC.; A. frigida Willd.; A. gnaphalodes Nutt.; A. mexicana Willd.; A. pontica L.; A. scoparia Waldst. & Kit.; A. trifida Nutt. L.; A. vulgaris L.
References: Farnsworth et al. (1975); Genders (1977);
Lewis and Lewis (1977); Potterton (1983);

Artemisia maritima is native to Europe, where its natural habitat is in coastal areas, salt marshes and along sea walls (Potterton 1983: 204). Genders (1977: 114) states that this species is common along the coast and on cliffs in southeast England. In Pakistan, where this species is cultivated for the anthelmintic chemical, santonin, A. maritima is apparently naturalized. Chaudhri (1955: 224) says that this species "grows wild throughout Pakistan and surrounding areas." A. maritima seems to be common in disturbed areas outside its natural range; Chaudhri describes if as a pioneer plant which "like(s) stony places and soil erosion seems to help its spread" (1955: 226).

In appearance, A. maritima is similar to A. absinthum, except that it is smaller. A. maritima is a small perennial herb standing about 61 cm. in height (A. absinthum is approximately 91 cm. in height), "with a white stalk and irregular branches. The yellowish brown flowers hang down from drooping shoots" (Potterton 1983: 204). The entire plant has a "sweet aromatic scent" and is often cultivated as an ornamental (Genders 1977: 114). Chaudhri's description of this plant as it grows in Pakistan is somewhat less than ornamental:

> A. maritima is a perennial herb with a deep, well-developed tap root...the branches are erect, woody at the base, with color varying from different shades of of purple to green. The leaves are very much dissected with linear segments and have varying shades of green, depending on the tomentum...The color of the flower varies from yellow to purple. By the time flowering starts, most of the leaves have fallen from the branches (Chaudhri 1955: 224-225).

The rather unlovely picture that Chaudhri paints of this species probably represents A. maritima's adaptation to an environment which is more arid than its native habitat (seacoast of England).

Typical morphological characteristics of this species include (Genders 1977: 114):

Leaves: twice-pinnatifid with numerous blunt segments, covered in down;

Flowers: bright orange in color (Culpeper says "yellowish brown"; Potterton 1983: 204; in Pakistan, color ranges from yellow to purple), borne in heads, either erect or drooping. Flowering time July-Sept.;

Fruit: an obovoid nutlet.

Because A. maritima is found primarily in England, there is little cross-cultural information concerning the medicinal uses of the plant. Nicholas Culpeper, author of The Complete Herbal, which was written in 1649, provides information concerning the uses of A. maritima in England (Potterton 1983).

Medicinal Uses

Medicinal uses for this herb were described above in the discussion of the genus Artemisia; the uses for A. maritima are similar to those of the genus i.e.., as a stomachic, emmenagogue and vermifuge. As was the case in Asia (c.f. Perry 1980), David Potterton, who updated and revised Culpeper's herbal, states that several species of Artemisia may be used interchangeably as medicinals. Of A. maritima he says:

> This possesses similar properties to the two former wormwoods (A. absinthum and A. pontica), but is not as potent as the first. It is usually used as a substitute by country people who realise its virtues. The flowering tops are collected and dried and given as an infusion for digestive problems. It is also useful for intermittent fever. Prolonged use is not recommended (Potterton 1983: 204).

Culpeper does not say that any of the three species of Artemisia are used to treat fertility-related disorders, although he does say that a brandy tincture of the flowering tops and the young leaves and shoots could cure "hysteric complaints," which may be a euphemism similar to "female trouble," although it might also denote nervous conditions. However, A. absinthum, for which A. maritima is a substitute, is known to be an emmenagogue (Potterton 1983: 203). Farnsworth et al. (1975: 543) report the results of experimentation with this herb, where it demonstrated an anti-implantation effect, but provided few other details.

Summary

Despite the relative paucity of information concerning this particular species of Artemesia, one can still see that A. maritima, like most of the other species of Artemisia, possesses many of the objective criteria of perceptual salience. Outside its natural range, A. maritima is a pioneer species found in disturbed habitats. In addition, it is often grown as an ornamental for its attractive, downy, foliage, habit, and scent; its' flowers and leaves have a bitter taste, and the leaves a characteristic odor; and the herb is recognized as having vermifugal properties.

Genus Cnicus

According to Britton and Brown (1970: 560), Cnicus is a montypic genus of the Old World; Radford et al. subsume a number of species, including Cnicus benedictus, under the genus Centaurea. This discussion will follow Britton and Brown's taxonomic classification.

Cnicus benedictus

Scientific name: Cnicus benedictus L.
Synonym(s): Carduus benedictus; Centaurea benedicta (L.) L.
Common name(s): blessed thistle; holy thistle; bitter thistle; bitterweed; blessed carduus; carduus; cursed thistle; our-lady's thistle; St. Benedict's thistle; spotted carduus; spotted thistle; sweet-sultan.
Distribution: originally found only around the Mediterranean; now naturalized throughout the world.
Related species: although Cnicus is a monotypic species according to Britton and Brown, Perry (1980) lists what may actually be varieties of the same species: C. japonicus and C. spicatus.
References: Bianchini and Corbetta (1977); Britton and Brown (1970); Bunney (1984); DeLaslow and Henshaw (1954); Krochmal and Krochmal (1973): Radford et al. (1968); Potterton (1983); Spoerke (1980).

Cnicus bendictus is a winter annual which grows to approximately 61 cm. in height, with spiny, toothed, lobed leaves. The plant produces many-flowered yellow heads. Originally, C. bendictus was found only in the Mediterranean area, but is now widely naturalized, especialy in North America and South Africa (Bianchini and Corbetta 1977: 16). In North America, it is found in fields, along roadsides, and in waste places in the eastern part of the United States and in parts of the Southwest. Typical morphological characteristics of this plant include:

Leaves: crowded, lanceolate to elliptic; spiny, toothed, and lobed;

Flowers: discoid, perfect; yellow;

Fruit: an achene; lustrous, obovoid, yellowish-brown with bristles at one end.

Medicinal Uses

Cnicus bendictus, blessed thistle, received its name from its reputation as a "cure-all, even for plague" (Bunney 1984: 114). The medicinal uses reported for this herb are many, and are well summarized by Watt and Breyer-Brandwijk (1962) in their book, The Medicinal and Poisonous Plants of Southern and Eastern Africa. Watt and Breyer-Brandwijk describe the odor of this herb as "feeble and unpleasant" and that it has an "intensely bitter taste" (Watt and Breyer-Brandwijk 1962: 219). The bitter taste of the herb is due to a bitter principle, cnicin (Spoerke 1980; Windholz 1976: 2382-2383). The medicinal uses listed by Watt and Breyer-Brandwijk (1962: 219) include: an infusion of the herb is used as an anti-cancer agent by European South Africans; Europeans in South Africa also use a brandy tincture or an infusion of the herb for "abdominal troubles." Since cnicin is a crystalline substance that dissolves more freely in alcohol than water (Windholz 1976: 2383), the brandy tincture mode of preparation may be more effective. In southern

Rhodesia (now Zimbabwe), the herb is used as an emetic; it is also used as a bitter tonic and emetic in Europe (Bianchini and Corbetta 1977: 16); in Italy, C. benedictus is used as a diuretic, tonic, sudorific and vermifuge. In the United States, it has been used as a bitter tonic, and as a treatment for fevers and dyspepsia (indigestion). In Germany, it is prescribed as an emetic and as a topical treatment for frostbite.

Krochmal and Krochmal, in reference to the United States, reiterate many of the uses listed by Watt and Breyer-Brandwijk:

> In the last century, people used such an infusion (of the leaves and flowering tops) to treat internal cancer, to increase sweating and urine flow, to expel worms, and to treat fever, hysteria, liver ailments, and inflammations of the respiratory system (Krochmal and Krochmal 1973: 75-76).

The primary medicinal use of C. benedictus, as can be seen from the list above, is as a "bitter to increase gastric secretions" (Spoerke 1980: 16). Bunney (1984: 114), however, cautions against excessive use of this herb, as "large doses irritate the mouth, digestive tract, and kidneys, and may cause vomiting and diarrhea. Internal use of blessed thistle should therefore be professionally supervised."

Fertility-Related Uses

Cnicus bendictus has been used for fertility-related purposes in both the Old and New World. References to the contraceptive uses of this herb include: DeLaslow and Henshaw (1954) report that a water decoction of the whole plant was taken as an antifertility medicine in North America; and Krochmal and Krochmal (1973: 75) say that only the tops of the plant were infused to make a contraceptive medicine by the Indians of North America. Watt and Breyer-Brandwijk (1962: 219) say that an infusion of C. benedictus was taken as a contraceptive by the Quinault Indians of North America. Farnsworth et al. (1975: 549) report that experimentation with an aqueous extract of the herb demonstrated antigonadotrophic activity in vivo in rats.

The ethnographic literature also contains references to the abortifacient and emmenagogic properties of C. benedictus. Culpeper's Complete Herbal, published in England in 1649, prescribes the whole herb, infused in boiling water, as a stimulant to menstruation (Potterton 1983). Watt and Breyer-Brandwijk (1962: 219) report that the leaf and flowering tops were infused to make a "uterine tonic" in North America. Bunney (1984: 114) cautions that the herb "should never be taken during pregnancy," as spontaneous abortion may occur.

Although Britton and Brown (1970) assert that Cnicus is a monotypic genus, Perry (1980: 91) lists two additional species, C. japonicus (also called Cirsium japonicum) and C. spicatus (also called Cirsium spicatum). Both species are employed for fertility-related purposes. C. japonicus is prescribed in China as a remedy for menorrhagia: "The branches, leaves, and flower heads are collected in late summer or early autumn at anthesis" and a decoction of the leafy brancehes is mixed with a type of yeast culture called lau-ts'ao to make the medicine (Perry 1980: 91). C. spicatus is used for similar purposes. Farnsworth et al. (1975: 549) report the results of experimentation with C. spicatus on mice, where administration of a water extract of the entire plant resulted in a decreased number of litters, indicating a contraceptive effect.

Non-Medicinal Uses

Aside from its medicinal uses, Cnicus benedictus has been used as a food and flavoring plant. For example, the herb has been used to flavor beer, imparting to it a bitter taste many beer drinkers enjoy; also, the young shoots and leaves can be eaten as a vegetable (Bunney 1984: 114). Nakao (1976: 194) says that C. benedictus has been used as a "spice" in Iran, Caucasia, Asia Minor, the Mediterranean area, and Germany.

Genus Solidago

This genus consists of approximately 125 species of tall-growing perennial herbs or woody shrubs, native primarily to North America (Britton and Brown 1970: 380). About half of the approximately 100 species native to North America are found in the northern states east of the Missouri River (Pammel 1911: 744). As Saunders, in the 1934 book, Useful Wild Plants of the United States and Canada says, this genus is so plentiful in the United

States "as to be almost the national flower" (Saunders 1934: 209). (Undoubtedly, many hayfever sufferers would agree with Saunders' assessment of the ubiquity of goldenrod, although it is doubtful that they would elevate it to national flower status). Only two or three species of Solidago are native to Europe, a few more are found in Mexico and South America (Britton and Brown 1970: 380).

The rhizomes of many species, when short, form "tufts of stems and when long, often form extensive colonies, stems erect to arching (and) solid" (Radford et al. 1968: 1084-1085). The leaves of Solidago are usually alternate, lanceolate to lance-elliptic, simple-toothed or entire. The flowering heads contain few to many flowers, arranged in corymbs or panicles (Radford et al. 1968: 1085). The flowers are discoid, perfect, and yellow or white in color. Genders describes the scentless, autumn-flowering blooms of Solidago as "mimosa-like" (1977: 447).

Members of this genus, commonly called goldenrod, are found in a variety of habitats, ranging from balds, bogs, wet meadows, and streambanks (e.g., S. glomerata Michaux) to woodlands and bluffs (e.g., S. sphacelata Raf.) (Radford et al. 1968: 1084-1085). Many other species, however, are common to disturbed habitats: for example, out of 39 species listed as occuring in the Carolinas and surrounding areas, 17 were found along roadsides, in ditches, old fields, and pastures.

Medicinal Uses

The type species for this genus is Solidago virgaurea L. (European goldenrod; sometimes called S. virga-aurea), so named by Linnaeus as a tribute to the reputed healing powers of the plant: "solidago" is derived from the Latin meaning "I make whole" (Saunders 1934: 209). The primary medicinal uses of this genus fall into two therapeutic categories: one, externally or internally for wounds and hemorrhaging (due to astringent properties); and two, internally as a stomachic or tonic (Solidago is bitter-tasting).

Lewis and Lewis list the uses for S. virgaurea in Europe and England, where it was used as a tea, tonic, and in a decoction to help "fasten loose teeth" (Lewis and Lewis 1977: 261, 389). An unspecified species of Solidago was reportedly used in the American Ozarks to treat cavities in the teeth: a piece of the root was placed in the cavity (Lewis and Lewis 1977: 258).

Densmore, in her survey of the medicinal plants of the Chippewa Indians, listed medicinal uses for four species of Solidago. The uses Desnmore lists for native North America are similar to those in Europe i.e., tonic and astringent. For example, a root decoction of S. rigidiscula (slender showy goldenrod) was used to treat lung hemorrhage; a root decoction of S. flexicaulis was gargled for sore throat; and several other species were cited as topical agents for sprains or burns (Densmore 1928).

In Asia, the medicinal uses of Solidago are used for purposes similar to their medicinal uses in Europe and North America. For example, Perry (1980: 103) gives the following uses for S. virgaurea in China: the seeds are used to help expel flatus, to check hemorrhaging and diarrhea, and to treat cholera. Additional uses include external use of the plant to make a wash for swellings, and internal use as a remedy for diseases of the kidneys and bladder (Perry 1980: 103).

Fertility-Related Uses

Solidago is not prominently represented in the literature concerning fertiity-related plants. Only two species, S. odora, and S. virgaurea L., are commonly listed for these purposes; coincidentally, the latter species ar the only two species of Solidago which have strongly-scented foliage. This tends to indicate that the scented essential oils contribute to the bioactivity of S. odora and S. virgaurea.

In China, the seeds S. virgaurea are used to treat menstrual disorders, among many other uses (Perry 1980: 103). In North America, the root of S. rigidiscula was steeped in water and taken to ease difficult labor (Densmore 1928: 358-359).

Non-Medicinal Uses

The ethnographic literature lists only a few non-medicinal uses of this genus. Lewis and Lewis (1977) say that S. virgaurea is made into a tea in England; Pammel (1911) and Genders (1911) state that several species of Solidago are suitable as ornamentals; and finally, an oil used in perfumery is extracted from the scented foliage of S. odora and S. virgaurea (Genders 1977).

Solidago odora

Scientific name: Solidago odora Aiton.
Synonym(s): Solidago odora inodora
Common name(s): sweet- or anise-scented golden-rod; fragrant goldenrod; blue mountain tea; true golden rod; mountain tea; bohea
Distribution: native to North America; apparently introduced in Asia
Related species: a partial listing of North American species includes: S. arguta Ait.; S. caesia L.; S. californica Nutt.; S. flexicaulis L.; S. racemosa Greene; S. rigida L.; S. rigidiscula Porter; S. tortifolia Ell.; S. ulmifolia Muhl.
References: Britton and Brown (1970); Densmore (1928); Farnsworth et al. (1975); Genders (1977); Lust (1974); Pammel (1911); Saunders (1934); Wilkinson and Jaques (1972).

Britton and Brown (1970: 389), describe Solidago odora as a slender herb 60 cm.-1.3 m. in height, with a simple stem, smmoth to minutely hairy above. Typical morphological characteristics include:

Leaves: lanceolate to lance-elliptic, entire;

Flowers: yellow, discoid; arranged in racemes on a panicle;

Fruit: a small nutlet.

In North America, S. odora is commonly found in woodlands, along road banks, in savannahs, and pine barrens (Radford et al 1968).

Roy Genders (1977) terms this species the most ornamentally and economically important species of Solidago. This is due to the essential oil contained in the minutely-dotted leaves, which smell like a mixture of aniseed and sassafras (Genders 1977: 447; Saunders 1934: 147). Only one other species, S. virgaurea, has scented foliage.

Medicinal Uses

Since there is so little information on the medicinal uses of this species, all therapeutic categories, including fertility-related ones, will be considered here. The most common uses for this species, like the genus, are as carminatives, tonics, and stomachics. For example, Pammell (1911: 755) says that the leaves of S. odora are made into a stimulant or carminative, and are also used to relieve colic. This flowers were made into a lotion by the North American Indians to relieve the pain of beestings (Lust 1974: 215).

The few references to the use of this herb as an fertility-affecting agent come from Farnsworth et al. (1975: 549), who reported the results of experimentation where a leaf extract of S. odora demonstrated an anovulatory effect. None of the ethnographic sources consulted mentioned fertility-related uses for this species.

Non-Medicinal Uses

The non-medicinal uses for this species include its use as a substitute for tea (Saunders 1934: 147); as a source of essential oil for perfumery (Genders 1977); and as an ornamental plant (Pammel 1911).

Summary

Solidago odora, then, possesses several of the characteristics which contribute to the perceptual salience of plants. It is cultivated as an ornamental, or grows as a "weedy" species in North America; it is strongly scented; and its flowers are considered "showy."

Its primary use category is not as a fertilty affecting medicinal, but as a carminative, tonic, or stomachic.

Summary

The characteristics related to perceptual salience for plants in the random sample are summarized in Table (1). Every plant in the random sample is a "controlled" plant; that is, considered "weedy," common to secondary habitats, cultivated, or domesticated. A third (34%) of the controlled species could also be found growing in undisturbed ("wild") contexts within their range. Ten of the fifteen plants (67%) in the random sample are known to be toxic to humans, insects, fish, or other animals, or are used as anthelmintics. Six species (40%) are armed with spines or thorns, or else contain irritating substances. Eight of the 15 species (80%) have flowers, leaves, roots, or other plant parts which are scented (pleasantly or unpleasantly). If characteristic taste, as well as odor, is considered (given that the two senses are closely related), this percentage increases to 93%, with 14 of the 15 species possessing a characteristic odor, taste, or both. The single exception to this was the garden pea, Pisum sativum. Although peas are characteristically flavored inasmuch as they are food plants, they do not taste bitter, sharp, or spicy, as do the rest of the species in the random sample. The presence of distinctive physical features, or "showiness," was somewhat harder to define. However, 10 of the 15 species (67%) in the random sample are often described as having attractive flowers, foliage, or fruit, and are grown as ornamentals, in addition to their uses as medicinal or food plants.

Although distinctive odor, taste, and appearance are all important features of the species contained in the random sample, it appears that no single characteristic stands out as being of overriding importance. With the wild/controlled dichotomy set aside, nine of the 15 species (60%) possess three or more of the other characteristics proposed as contributing to perceptual salience (odor, irritating qualities, toxicity or showiness). Of the six remaining species which exhibited two or fewer characteristics, five species share a common trait: they are all aromatic. This suggests that odor, and probably taste, are key factors in the initial "noticeability" of all 15 plants, followed by experimentation with these plants and their subsequent incorporation into human cultural systems as insecticides, piscicides, vermifuges, medicines, foods, or ornamentals. In fact, the toxic, irritant and medicinal qualities of these plants (and perhaps even the appearance or "showiness") are directly related to the same chemicals which give these plants their characteristic odors and tastes, as both Heywood (1978: 219) and Genders (1977: 49) have noted.

Several criteria affecting noticeablility which were not originally considered at the beginning of this project emerged during the course of this thesis. One is the relative hairiness of plants. The significance of this characteristic is complicated by several factors: first, little information exists concerning what proportion of the world's plants are hairy as opposed to smooth; and second, the same plant species may express this trait to different degrees in different parts of its range in response to environmental factors. Nevertheless, relative hairiness of plants does seem to be an important discriminating factor in selection of medicinal plants. Almost half of the species in the random sample are noticeably hairy: e.g., Ocimum sanctum, Marrubium vulgare, Artemisia maritima, and Withania somnifera.

Hairiness in plants, as mentioned above, is related to a number of factors, such as adaptation to arid environments where the hairs (called trichomes in plants [they are not analagous to hairs in animals]) aid in moisture retention and as feeding deterrents to herbivores. Significant for this thesis, however, is that some types of plant hairs, called glandular trichomes, which originate from glands on the surface of the plant, are associated with concentrations of secondary metabolites (Esau 1977: 201-203). Secondary metabolites, such as essential oils, serve no known basic metabolic function within a plant; however, they do serve a protective function (as noted above) and such metabolites are a main source of medicinals for humans. These secondary plant substances are stored within plants in specialized cells (oil cells), in glands, and in glandular trichomes. Trichomes are essentially like glass vials storing these products; when the leaf of a hairy plant such as Ocimum sanctum is crushed, the aromatic oils are liberated from the hairs on the plant surface, as well as from within the leaf (vacuoles and glands). Thus, it would seem that hairy plants, such as O. sanctum or Marrubium vulgare ("hoarhound"), may have prompted human curiosity and investigation not only because of their unusual appearance, but also because hairiness may indicate a greater concentration of potentially bioactive compounds.

The second criterion of perceptual salience which emerged during the course of this research supports, in part, an assertion made by Nancy Turner, quoted elsewhere in this thesis:

> Almost all of the highly visible trees and shrub components of the flora are recognized nomenclaturally and cognitively as distinct types by native consultants....The herbaceous, bryophyte, fungal, and lichen components are less universally recognized (Turner 1988: 277).

Although Turner's focus with the Lilooet and Thompson Indians is whether plants are named or not, her observations are pertinent to the acquisition of medicinal plant knowledge. That is, which plant forms are most often represented in collections of medicinal plants? Are medicinals most often "herbs" as the name for most medicinal plants implies? The random sample data in this thesis do not conclusively support either contention: 53% can be considered subshrubs, shrubs, or small trees, and the remaining 47% are herbs or vines. No fungi, bryophytes (mosses) or pteriodophytes (ferns) were represented in the random sample. However, all the plants in the random sample were relatively small life forms- no large trees, for example, were represented. Citrus is the only tree species in the sample; most of the entries are shrubby plants or herbs.

When the plants in the random sample are considered in this manner (as smaller life forms), one possible explanation can be offered for their inclusion as medicinals. According to research done in the 1940's and 1950's, it is precisely these smaller forms of plants which contain the highest concentrations of bioctive substances typically associated with utility as medicinals. In an article entitled "Alkaloid Hunting," Willaman and Schubert (1955) discuss the importance of the research done by J.B. McNair on the chemistry of plant life forms to their research focus: targeting specific plant families for alkaloid identification. Willaman and Schubert comment on the work of McNair:

> Since electrolytes, including nitrogen compounds, are far higher in herbs than in trees and shrubs, he (McNair) postulates that the law of mass action would indicate a greater number of organic compounds formed in herbs than in trees. After surveying the information available in 1941, he states 'Alkaloids have been found in three times as many herb families (19 vs six). The average molecular weight of alkaloids from tropical trees is much lower than that from tropical herbs.' From this viewpoint the herbaceous families in the above list would offer the best hunting (Willaman and Schubert 1955: 147).

The list alluded to by Willaman and Schubert (1955: 147) includes four families found in the random sample as being the most promising for alkaloidal research (based on previous rates of testing, they estimate that on average, only 2% of species within most plant families have been tested for alkaloidal content). The four families are the Compositae (Asteraceae), Leguminosae, Rutaceae, and Solanaceae. Because the focus of this thesis is not specifically a phytochemical one, further testing and elaboration of the statments made by Willaman and Schubert in 1955 will be left to those more well-versed in phytochemistry. For the purposes of this thesis, however, McNair, Willaman, and Scubert's observations concerning the relationship between life form and chemical content of plants is intriguing. It would be interesting to see if not only herbs, but shrubby plants as well, contain significantly larger amounts of bioactive chemicals. If this is the case, shrubs may be regarded as "noticeable" not only because of relative size, but because they contain the secondary substances also found in herbs. Finally, while not all herbaceous plants may be universally recognized by humans, herbs which are considered "weedy" or "controlled" are eminently noticeable, as this research shows.

Table 1
Criteria of Perceptual Salience in the Random Sample

Taxa	Criteria* 1	2	3	4	5	6
Adhatoda vasica		x	x	x		x
Astragalus glycyphyllos	x	x			x	
Artemisia maritima		x	x	x	x	x
Berberis vulgaris	x	x	x	x	x	x
Carum carvi		x		x	x	
Citrus aurantium		x	x	x	x	x
Clerodendron infortunatum		x	x		x	x
Cnicus benedictus		x	x	x	x	x
Marrubium vulgare		x	x		x	
Ocimum sanctum		x	x		x	x
Orthosiphon stamineus		x			x	x
Plumbago zeylanica		x		x		x
Pisum sativum		x			x	
Solidago odora	x	x	x		x	x
Withania somnifera	x	x	x			

* 1= wild; 2= "controlled"; 3= toxic (insecticide, poison, etc.); 4= irritant; 5= aromatic; 6= "showy".

CHAPTER 4

DISCUSSION, CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Discussion

The phytogeographic, phytochemical, and cross-cultural ethnographic data concerning fertility-related plants presented in this thesis are brief and certainly do not exhaust all available information. However, the impression that one gains from the literature is that this class of medicinal plants is extremely important. For example, Perry's inventory of the medicinal plants of east and southeast Asia (Perry 1980), totaling over several thousand plants, lists 190 plants used as emmenagogues, 192 postpartum herbal medicines, 182 parturifacients, and 62 abortifacients. Although there is some overlap beteen the species represented in the four categories listed above, the emphasis on fertility-affecting plants is nonetheless apparent. The reasons for the importance of this medicinal use category are outlined below.

Ethnographic data from hunting and gathering societies contain little information on fertility-affecting plants. This may be due to the fact that in small, hunting and gathering societies, population control and fertility regulation are achieved by other means, as the ethnographic data clearly suggests. Bodley (1985), Howell (1979), and Wood (1979) have identified several of the biocultural constraints on population growth in hunting and gathering societies, where large populations are truly maladaptive. Practices such as induction of abortion through the use of physical violence (e.g., pummelling the abdomen of the pregnant women until abortion results), infanticide (usually of female infants), prolonged lactation, post-partum sexual taboos, and fission of groups to reduce pressure on resources all act to maintain small populations. In such societies, age at menarche in girls is also delayed (varying from ages 13-15 or more, reducing the potential childbearing years for women. In contrast, age at menarche in agricultural societies is usually lower, and potential chilbearing years are lengthened (for example, in the United States at the present time, some girls reach puberty at age nine, although the average age is about 12). While infanticide and group fission also occur in agrarian societies, (e.g. the horticultural Yanomamo [Chagnon 1968]), the shift to a primarily agrarian economy favored the growth of large families, which in turn provided the labor pool necessary for intensive agricultural activity. Mechanical means of fertility regulation, such as long postpartum taboos and infanticide, are typically not socially approved in agrarian societies. Therefore, emphasis on fertility regulation usually involved the use of medicinal plants as contraceptives, emmenagogues, abortifacients, parturifacients and postpartum medicinals.

Frequent childbearing has an extremely deleterious effect on maternal health, as Wood (1979: xiv-xv, 154-155), and Frisch (1974) have noted. As births are more closely spaced, a woman's body has less and less time with each subsequent birth to recover important nutrients diverted to the infant. Less time is also available to recover from the physical stresses related to carrying a baby to term. The effect on infants born to women who are physically depleted by frequent childbearing should also be apparent, where premature delivery, low birth weight, and other complications are common. Further, it may be more difficult to provide food for children born closely together. Kwashiorkor, a protein-deficiency disease, often occurs in children who are weaned early, "generally because another child has arrived or is on the way" (Wood 1979: 73). According to Wood, the word "kwashiorkor" is a Ghanaian term which literally means "second-child disease" (Wood 1979: 73).

An agrarian lifeway is also associated with an overall greater disease load, as Cohen and Armelagos (1984), Dunn (1978), Robbins (1977), and Rubel et al. 1984) have demonstrated for both prehistoric and contemporary populations. This situation probably also contributed to greater experimentation with medicinal plants. As Logan (1973) has shown for Mesoamerica, many herbal remedies exist to treat diseases common to the agricultural groups in that area (and worldwide): upper respiratory complaints, diarrhea, and dysentery.

The "domestication of the landscape," as Yen (1989) has termed the process of the increasingly obligate relationship between humans and plants, also produced conditions conducive to the acquisition of medicinal plant knowlege. While hunting and gathering populations produce environmental disturbances which are conducive to the growth of "weedy" type plant species (c.f. Chase 1989; Harlan 1989), the activities associated with horticulture and agriculture have encouraged the growth of weedy annuals and "edge" species (c.f. Crites 1987; DeWet and Harlan 1975; Harris 1989).

Agronomists presently conduct extensive research on the physiology and distribution of weedy plants, albeit with the intention of eradicating such species (c.f. Duke 1985). Among many human groups, however, these weedy plants serve as medicinals, foods, or flavorings, as Alcorn (1984), Crites (1987), Etkin and Ross (1982), Logan (1989) and others have shown. If, as Etkin and Ross (1982), and others feel, medicinals were intially adopted by human groups as flavorings or condiments in an otherwise bland diet of starchy staples, such as potatoes, rice, or maize, one possible mechanism for their use as medicinals can be proposed. The long-term physiological effects of an herb could be readily observed, an observation incidental to the plant's use as a culinary item.

The medicinal use category examined in this thesis also suggests an important route for the acquisition and cultural transmission of medicinal plant knowledge: women. Females are most directly concerned with fertility related matters. Menstruation, childbearing and the postpartum period lie, for the most part, within the female domain. Women are usually, but not always, midwives. Women also consciously protect any information concerning plants with contraceptive, emmenagogic or abortifacient properties in societies where such practices are frowned upon.

The research of Carole Browner, and others, in Mesoamerica (Browner 1980, 1985a, 1985b; Browner and Perdue 1988), amply demonstrates this point. Early abortion of an unwanted pregnancy can be achieved by the use of easily obtained and "innocuous" plants, such as lemon (Citrus spp.) or cinnamon (Cinnamomum zeylanicum); use of these plants does not provoke suspicion. While abortion is not the stated goal, having regular periods is seen as a sign of health, and is thus pursued. Even though the emmenagogic effects of these plants are seen as essential to good health, early abortions are often the actual result (Browner 1980).

In a recent article, Browner and Perdue report that women's "secret knowledge" of fertility-affecting plants may not be true in all cases (Browner and Perdue 1988). Browner and Perdue conducted a survey in a traditional, Chinantec-speaking village in Mexico, asking the married and unmarried men and women (separately, so married women would not be reticent around their husbands) to name as many fertility-affecting plants as they could. The results showed that men could name at least as many plants as women, and Browner and Perdue concluded that because large families are the ideal in this community, a man may closely monitor his wife's use of potential abortifacients or contraceptives. It should be noted, however, that although the men may be able to name as many plants as the women, they may not always know how to use the plants. Also, the men have little control over the behavior of thier wives. First, the plants often used for fertility control purposes are commonly used foods or spices, and are unlikely to arouse men's suspicions. Second, many men are away at work most of the day, and are thus unable to exert much control over their wives. Only further research can clarify whether these assertions are valid.

Women's roles in most traditonal societies place them in many contexts where the acquisition and development of plant-based knowledge is favored. It has already been mentioned that women are usually the midwives; women are also the "first line of defense" in treating the common illnesses and injuries within the family (Finerman 1989; Wood 1979: 325). Women are the primary preparers of food, and are able to observe any physiological effects the foods and culinary herbs may have (interestingly, over half of the plants in the random sample for this thesis are also either culinary herbs or foods) over long periods of time. In addition, culinary herbs are usually "on hand" in the house, or found growing nearby the house, where they may be obtained with a minimum of difficulty. Therefore, if a child or family member becomes ill (and it always seems to be in the middle of the night), the medicines to treat the ill person are quickly found. Alcorn (1981a: 406) mentions this in her description of the plants growing in the ele:b and wal ele:b zones among the Huastec. Medicinal plants are kept in an otherwise clean-swept area (ele:b) surrounding Huastec houses, where the plants can easily be found, especially at night. The expressed food preferences and the effects of foods on individual family members may be yet another way in which medicinal knowledge accumulates. Johns' work on maca (Tropaeoleum tuberosum) provides a good illustration of this point (Johns 1986, 1989). Maca is a favored food item among women in Andean communities, yet it is vehemently avoided by men, who feel it "saps" their virility. Men are also suspicious of women who serve it to them, feeling that the women are attempting to undermine their health.

Finally, as Ester Boserup (Boserup 1970), as well as ethnographic sources such as Hudson (1976), Le Page du Pratz (1947) and Swanton (1928) have pointed out, women in agricultural societies do most of the weeding and "lighter" work in gardens and agricultural fields. Men do the heavier work such as felling trees, clearing fields, and plowing. For example, when Patricia Bridges (1989) compared arm and leg dimensions of skeletal remains of males and females in Archaic (hunting and gathering) Period vs. Mississippian (agricultural) Period populations in the southeastern United States, her findings confirmed a shift in the division of labor over time. The arm measurements of Mississippian Period females showed an increase in overall strength, as well as a tendency for bilateral symmetry, over females from the Archaic Period. Bridges tied these changes to the greater demands placed on women by agricultural activities, especially the practice of pounding maize in wooden mortars (Bridges 1989: 392). The skeletal measurements of males, like those of the females, showed an increase in overall strength over time, which Bridges attributed to the variety of activities associated with agriculture. However, the major changes observed by Bridges in males included a tendency towards greater forearm strength in Mississippian males, which she relates to the use of the bow and arrow, rather than the atlatl in hunting activities (Bridges 1989: 392). In general, women's activities, such as weeding, planting, and food preparation, placed them in daily contact with a variety of plants, most notably crop plants and any associated "weeds." Knowledge concerning the fertility-affecting properties and other medicinal uses of plants is typically passed down from one generation of women to another, from mother to daughter, from sister to sister, and from a midwife to her apprentice or patient, and so on.

The factors outlined above describe some of the possible avenues for the acquisition of medicinal plant knowledge. Because the medicinal use category chosen for study in this thesis was fertility-affecting plants, some of these factors are specific to women and their roles in traditional societies. Only further research will show the many ways in which knowledge concerning other classes of medicinal plants accumulates within human societies. The objective criteria outlined in this thesis, and by other researchers such as Alcorn (1981, 1984), Johns (1986, 1989), Logan (1989) and Turner (1988), were presented as general principles which may have guided the selection of fertility-affecting plants by human groups. Intuitively, it would seem that these objective criteria apply to other classes of medicinal plants as well, since no plant in the random sample was exclusively used for fertility-related purposes, but for many additional uses as well. Again, only further research will show the general applicability of the criteria of noticeability chosen for the research in this thesis.

Conclusions

The problem addressed by this thesis was to outline some of the processes which contribute to the acquisition and organization of medicinal plant knowledge. The assumption implicit in much of the botanical and anthropological literature (c.f. Kidwell 1973: 46; Krochmal and Krochmal 1973: 5; Wood 1979: 326) has been that medicinal plant knowledge accumulated gradually over generations of trial and errror sampling of the available flora. The data presented in this thesis, when taken collectively, show conclusively that the patterns of medicinal plant use observed today are not the result of random processes. If selection of plants as medicinals resulted from a truly random process, one would expect many more wild plants to be seen in medicinal plant lists. Just the reverse, though, was observed, and seems to be a function of the ecological and cultural conditions surrounding an agricultural lifeway.

A random sampling strategy was chosen as the best way in which to generate a body of data against which hypotheses concerning the aquisition of medicinal plant knowledge could be tested. An approximately 10% random sample was taken from Table III in Farnsworth et al.'s article "Potential Value of Plants as Sources of New Antifertility Agents I" (1975: 547-554). In this manner, potential sources of bias were eliminated. Smaller sample size also reduced the amount of research necessary to adequately describe the taxonomy, phytogeography, morphological characteristics, and ethnographic contexts of each plant within the sample.

Five objective attributes were isolated as being potentially significant in contributing to the "perceptual salience" of plants:

1. wild vs. controlled plant species;

2. toxic properties of plants (e.g., insecticides,piscicides, vermifuges, or poisons);

3. irritant properties;

4. aromatic or characteristic odors and tastes;

5. unusual or significant physical characteristics.

If one or more of these attributes was reported for a species in the random sample in relevant botanical, chemical or ethnographic literature, it was regarded as one of the significant characteristics of that plant. A single class of medicinal plants, fertility-affecting plants (emmenagogues, abortifacients, parturifacients and postpartum medicinals), was chosen for study. The reason for choosing a single class of plants was due to the possibility that the factors which lend one class of medicinal plants perceptual salience may not apply to other classes. Proving the empirical "efficacy" of the plants contained in the random sample was not a major focus of this thesis; however, if efficacy was mentioned, this fact was included in the dicussion of each plant. A literature search methodology was chosen to determine whether these objective attributes were applicable in cross-cultural contexts.

Examination of the botanical, ethnographic, and phytochemical literature concerned with the 15 plants in the random sample confirmed the hypotheses set forth in this thesis. Most of the plants in the sample shared a number of characteristics: they were common in disturbed habitats, they possessed characteristic odors and tastes, they contained irritating substances, they often were armed with spines or thorns, and they often had unusual or "attractive" foliage and flowers. Further, in addition to their use as medicinals, many were used as insecticides, anthelmintics, foods, or condiments. One proposition which was not wholly confirmed by the data in this thesis is that fertility-related plants possess characteristics peculiar to that medicinal use category. The 15 plants in the random sample were used for a variety of medicinal purposes aside from their uses as emmenagogues, abortifacients, and so forth. Thus, the attributes selected as contributing to the perceptual salience of fertility-affecting plants may apply to medicinal plants in general.

A cross-cultural survey revealed that the same or similar species of plants were used in different parts of the world for similar purposes. In some cases, diffusion of information was clearly the cause for such parallels; in others, knowledge appears to have arisen independent of diffusion. The fact that geographically, historically, and culturally independent groups have selected the same or closely-related species of plants for the same purposes also suggests that humans key in on the same traits in potential medicinals. A clear example of this is the use, by peoples throughout the world, of species of Sambucus as a fertility-affecting plant, as described by Logan (1989) and Moerman (1989). In the random sample itself, genera with wide distributions, such as Artemisia or Solidago, showed a similar pattern of cross-cultural use.

It is difficult to say exactly how the medicinal properties of these plants were determined. One likely route, as Etkin and Ross (1982) suggested, is that many medicinals were initially food or flavoring plants. Over time, the physiological effects of the ingestion of these plants became apparent through casual observation. Indeed, 10 of the 15 plants in the random sample were used as food or flavoring plants in addition to their use as medicinals. One other possible route of acquisition of knowledge, as Rodriguez (1982) and Siegel (1989) have suggested, is through the observation of animal behavior following the ingestion of various plants.

The findings of this thesis have several implications. First, a multicontextual approach, which examines patterns of plant use from both an etic and emic point of view, while it may not account for every factor which contributed to observed patterns of plant use, is nevertheless productive. This approach may be one way of rendering the "useful plant lists," collected over the past hundred years by ethnographers of varying interests and abilities, truly useful. Further ethnographic research on many of the groups from whom these lists were collected is often impossible; some have become extinct due to disease or warfare, others are acculturated and traditional plant knowledge has been lost. However, careful examination of the species in plant lists in the light of what factors lend them perceptual salience and potential utility may enable researchers to formulate hypotheses concerning why certain plants were selected as medicinals. The work of Michael Logan (1989) and Daniel Moerman (1989), discussed in Chapter II, are good illustrations of the potential value of such research.

Another implication of this thesis' research is that it demonstrates that the patterns of medicinal plant use that are observed ethnographically are the product of a long history of human-plant interactions, and especially of the increasingly mutualistic relationship created by an agrarian lifeway. In general, discussions of plant domestication mention the development of staple food plants, but rarely consider the genetic changes which took place in medicinal plant species as new habitats were created through agricultural activity. Chang (1970) has suggested that medicinal plants may have been among the first domesticates, and recent research on plant domestication (c.f. Harris and Hillman 1989) includes discussions of medicinal plants as domesticates. As studies of plant domestication have shown, it may be impossible to determine the "earliest" domesticated food or medicinal plants. What is interesting, however, are the processes which lead to genetic changes in plants associated with increasing disturbance of the landscape over time by human activities. As Johns concludes in a recent paper on Andean root and tuber domestication:

> Certainly, human interaction with phytochemicals is a fundamental part of the domestication process. Anu, maca, potato, and coca are excellent examples of the interconnections of nutritional, pharmacological, physiological, cognitive, and cultural factors in directing the domestication process. A chemical-ecological model of domestication provides a new perspective on human interactions with plants. Further investigations of chemical change in cultivated plants from the Andes and elsewhere can offer new insights into this important aspect of human history, particularly because chemical ecology is capable of generating testable hypotheses concerning the domestication process (Johns 1989: 516).

Interest in this aspect of human-plant interactions has grown with the realization that the rate of plant extinctions is rapidly increasing with the destruction of vast areas of land, especially in the Amazon rain forest (Koopowitz and Kaye 1984), threatening the ecological balance of the entire planet. A recent issue (1989) of the Whole Earth Review, a popular publication, was devoted entirely to "plants as teachers," and in this issue, an article by Rheingold quotes Norman Farnsworth:

> Considering that many of these unique gene sources (of chemical substances) may be lost forever through extinction and that plants have a great potential for producing new drugs of great benefit to mankind, some

action should be taken to reverse the current apathy in the United States with respect to this potential (Farnsworth, 1988; quoted in Rheingold 1989: 20).

In the best of all worlds, the information collected and presented by anthropologists which illustrates the significance and complexity of human-plant interactions would influence the formulation of policies aimed towards the preservation of ecological diversity in areas such as the Amazon, where mass extinctions of plant and animal species are threatened. Until that better world arrives, anthropologists may be faced with "salvaging" what information they can on the plants from these endangered areas. In the future, the only available specimens of such plants may be in botanical gardens, on herbarium sheets, or in the ethnographic record.

Suggestions for Future Research

The information presented in this thesis was intended as a brief, cross-cultural overview of the 15 plants in the random sample. Research goals were oriented towards defining characteristics which contribute to the noticeablility of potential medicinal plants as opposed to other kinds of plants. Further research might be directed in a similar, generalistic direction, where the validity of the conclusions reached in this thesis would be tested using additional data sets. For example, how applicable are the characteristics of perceptual salience to other classes of medicinal plants besides fertility-related plants?

The data concerning several of the plants in the random sample suggest areas where more detailed research is warranted, much like Johns' work on the anu/maca complex (Johns 1982, 1986, 1989). The descriptions of Plumbago zeylanica and Withania somnifera, for example, indicate that a great deal of intraspecific chemical variation exists within these species. The factors contributing to this variation need to be clarified. For example, exactly how does the cultivated species Withania ashwagandha, differ from the "wild" or "weedy" species, W. somnifera, both chemically and morphologically? Does interbreeding and occur between the two species? In the case of Plumbago zeylanica, what conditions contribute to its variable toxicity upon grazing cattle observed by Watt and Breyer-Brandwijk (1962) in Africa? A greater understanding of intraspecific chemical variation may help explain why plants are valued medicinals in one par of their range but not in another.

The economic importance of domesticated animals, especially grazing animals such as horses, sheep and cattle, has led to a great deal of research on the food preferences and avoidances of these herbivores. In contrast, human taste preferences vary widely from individual to individual and culture to culture, and are difficult to characterize (c.f. Moskowitz et al. 1975). Observation of food avoidance, preference, and possible medicinal plant use among non-human primates may provide clues to cross-cultural similarities in the odor and taste qualities of plants used by humans. For example, why are many medicinal plants bitter or spicy-tasting? Although some research on this topic has been done, e.g., Browner and Ortiz de Montellano (1986); Hladik (1977), Leopold and Ardrey (1972), McKey et al. (1981), Siegel (1989), Stahl (1984) and Wrangham and Waterman (1981), more research is clearly needed.

Finally, the difficulties encountered in the collection and interpretation of descriptive material concerning the plants in the random sample underscored the need for systematic data collection by ethnobotanists in the field. Recording the common name and folk uses of a plant (often only a single use is recorded) is not sufficient. The correct taxonomic name should be provided; if this is impossible, a sample of the plant should be taken for later comparison with herbarium specimens. Given that scent and taste are often important characteristics used by traditional peoples for identification of plants, it is hard to understand why these tastes and odors are so seldom reported. In many cases, they provide valuable clues to the underlying chemical composition of the plant. Likewise, adequate descriptions of the habitat and distribution of plant species are often lacking in ethnographic reports. Such shortcomings are easy to understand, given the difficulties of ethnographic fieldwork. Nevertheless, the goals outlined above are not impossible, as the comprehensive work done by researchers such as Janis Alcorn (c.f. Alcorn 1984) and Timothy Johns (c.f. Johns 1982, 1986, 1989) has shown.

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