

HALLUCINOGENIC PLANTS OF THE TARAHUMARA

ROBERT A. BYE, JR.

Department of Environmental, Population and Organismic Biology, University of Colorado,
Boulder, Colorado 80309 (U.S.A.)

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Summary

Plants used by the Mexican Tarahumara Indians to alter their perception are discussed from an ethnobotanical viewpoint. Reports from earlier workers are reviewed. Recent field work has corroborated many of the early observations. In addition, five Tarahumara plants are reported for the first time as hallucinogenic. They include species of *Coryphantha*, *Echinocereus*, *Mammillaria*, and *Scirpus*. Other plants are suspected of producing hallucinations or are associated with hallucinogenic plants.

Introduction

The Tarahumara Indians of southwestern Chihuahua, Mexico, were one of the first native Mexican peoples to gain wide publicity in modern times for their use of "peyote", *Lophophora williamsii*. In addition to "peyote", Lumholtz (1902) reported other types of sacred cacti of "high mental qualities" which they employed to alter the senses. Despite various botanical, ethnological, and geographical field studies since Lumholtz's time, we know relatively little about the hallucinogenic plants of the Tarahumara, or about the phytochemistry and pharmacology of these plants and their role in the Tarahumara culture.

Several approaches have been used in classifying and defining various psychotropic agents (Delay, 1967; Lewin, 1964; Ludwig, 1969; Schultes and Hofmann, 1973). One category, hallucinogens or psychotomimetics, acts on the central nervous system and alters the perception of time, space, and self. Hallucinations may be visual, tactile, and auditory in nature.

The original reports in this paper are based on information I gathered from Tarahumara who live in the central and western sections of their range. The informants had varying experiences with some or all of the plants and represent Mexicanized Indians as well as those who still maintain their traditional customs. Some Tarahumara periodically participate in ceremonies

where the plants are ingested and one contact was a widely respected "peyote" shaman. Many of the Tarahumara, especially those who do not have first-hand experience with the plants, fear the various plants used to alter the senses but do not actively destroy them (as is done with poisonous plants, such as *Amanita muscaria* (Fr.) S. F. Gray). Others express sincere respect for the plants and their powers. In all cases, the Indians are reluctant at first to talk about the plant and never allow it to be collected in their presence.

The original information in this report was obtained through conversations with several Tarahumara in the field when plants were encountered, at gatherings and fiestas, and, on rare occasions, at informal meetings to which samples of the plants were brought. The hallucinogenic plants were described as imparting the effects of "híkuri" or "peyote". The effects included color visions (especially in shades of reds), visions of beings and the dead, apparent movement in space, and shifts in time. In some cases tactile and auditory perceptions were altered, especially with respect to feelings in the joints and to amplification and clarification of singing.

The collectors

As a preface to future interdisciplinary research on Tarahumara psychotropic plants, I shall summarize the data which other investigators and I have gathered. With a solid ethnobotanical foundation, one can proceed with phytochemical analysis of these plants which promise to be of potential value to the biomedical sciences (Schultes 1967, 1969). An awareness on the part of field workers as to which plants the Tarahumara respect and fear may broaden our knowledge of plants with biodynamic principles. In this way field data will not be lost by overlooking information or by inadvertently offending an informant and his sacred plant.

It is helpful to understand the background of the investigators who have gathered ethnobotanical data on the Tarahumara plants. The earliest references to "peyote" in the Tarahumara region are in the *Descripciones Geográficas* which are summarized by Pennington (1963). Missionaries collected information on important medicinal plants which included herbs called "peyote". Although it is not possible to identify these "peyotes" accurately, it appears likely that they refer to a member of the Compositae rather than to a genus of Cactaceae. The padre at San Buenaventura reported in 1777 that the Indians overindulged in the consumption of this plant because of their superstitions (*Descripciones Geográficas...de San Buenaventura*, 1777). In addition, "peyote" was used medicinally to alleviate toothaches at San Buenaventura, Guazapares, and Chínipas (*Descripciones Geográficas...de San Buenaventura*, 1777; *Descr. Geogr....de Guazapares*, 1777; *Descr. Geogr....de Chínipas*, 1777).

The first and probably the best report to date on Tarahumara plants is presented by Lumholtz (1894, 1902). His data originated from the Naráarachic region of the Rio Conchos on the eastern slopes of the Sierra Madre Occi-

dental. Specimens obtained by Lumholtz were identified by B. L. Robinson of the Gray Herbarium, Harvard University. Only two extant specimens of this collection of *Lophophora williamsii* are known today. *Ariocarpus fissuratus* is illustrated in *Unknown Mexico* (Lumholtz, 1902).

James Mooney of the Bureau of American Ethnology made a trip in January, 1898, as part of his field studies in Oklahoma, Texas, New Mexico, and Chihuahua to gather data on "peyote" and its use by the Indians (Mooney, manuscript No. 1887; Powell, 1900). His information was supplied by a few Tarahumara in the region of Guajochic along the Rio Conchos. Some of these Tarahumara were informants for Lumholtz during his visit in the early 1890s. Mooney obtained information on the following types of "híkuri": "wíkworó", "súnami", "muräto", "kókoyómi", "íkuriwa", and "rósopári". The Tarahumara employed all but "kókoyómi", which was considered evil and used only by the Apaches. No specimens of "peyote" collected by Mooney have been found, although letters from two United States Department of Agriculture botanists, V. K. Chestnut and F. V. Coville, indicate that Mooney submitted plant material for identification after his return (Mooney, manuscript No. 2537). The botanical specimens included cacti, *Lophophora* spp. and *Anhalonium engelmannii*, a synonym of *Ariocarpus fissuratus* ("peyote of West Texas"), as well as *Erythrina* sp. ("chilicote"), *Sophora secundiflora* ("frijolillo"), *Cacalia* spp., *Randia* sp. ("bitter spiny plant of Sierra Madra, Mexico"), and *Crescentia alata* ("guaje").

Thord-Gray, who served with the Mexican rebel forces during 1913 and 1914, had a Tarahumara shaman as a military guide and assistant (Thord-Gray, 1960). The data compiled in the *Tarahumara-English...Dictionary* (Thord-Gray, 1955) were obtained presumably from his informant, but I find that almost all the ethnobotanical information and identifications can be traced directly to the works of Bennett and Zingg (1935) and Lumholtz (1902), which are properly recognized in the preface. Before his death in 1926, W. E. Safford (no date) was writing a semipopular book on the contributions of the botanical explorer, Edward Palmer. Part of the manuscript was based on Palmer's observations and notes, many of which are lost, and also on Safford's bibliographic data. Part of the information on *Lophophora williamsii* recorded for Palmer's 1885 expedition to the Tarahumara region may have been obtained directly by Palmer. Mentioned is the reaction of the priest at Norogachic to the use of "peyote" by the natives. Further research in botanical history is needed to determine if Palmer gathered any data on *ophophora* among the Tarahumara. Bennett and Zingg (1935) made an ethnological survey of the Tarahumara during 1930 and 1931. They devote a short chapter to the use of "peyote" by the Tarahumara who resided in the Rio Conchos region. *Lophophora williamsii* was not used in the central and western regions, but some indigenous cacti, including *Mammillaria heyderi* and a ball cactus called "bakánawa", were used. Despite their addition to the number of possible hallucinogenic plants, there is little botanical basis for their discussion because of the lack of documented specimens or photographs. During 1955, Pennington conducted extensive field

work at various Tarahumara localities as part of his cultural geographical study. Specimens of the cacti were sent to a specialist for identification, but the deposition of the specimens after the botanist's death is unknown.

Other people have mentioned the importance of "peyote" among the Tarahumara, but most of their reports paraphrase Lumholtz's original observations (Hartwich, 1911; Rouhier, 1927; Gandola, 1965). Some publications have copies of Lumholtz's illustrations and often erroneously assume that any Tarahumara reference to "peyote" or "jíkuli" implies the plant *Lophophora williamsii* (Garcia Olvera, 1963). The French playwright, Antonin Artaud (1976), published his experiences among the Tarahumara during which "peyote" was frequently used.

The Tarahumara and their plants

All forms of life, including plants, have feelings, according to the Tarahumara. Certain plants, such as the alleged psychotropic cacti and herbs, demand special treatment because they are said to be powerful and could cause harm if offended. Many of these plants are reported to sing to the Tarahumara and this singing can be clarified by ingesting the plant. These plants are considered powerful in effecting cures. Upon ingestion of these plants, the shaman can see and "travel" to locate the evil beings responsible for certain illnesses. Participants in ceremonies consume the plant to insure healthier and safer lives as well as to feel well (and sometimes younger) and have visions. Aside from the apparent altered sensory feelings, the applications of the plants are also considered a powerful remedy for certain injuries or pains. Carrying the "peyote" during one's travel or while running is said to ward off evil forces and strengthen one's body. The use of hallucinogenic plants is strictly guarded by ceremonies and taboos. Some of the plants may also serve evil purposes and cause people to go crazy and die. Toxic doses, mistreatment, misunderstanding, and fear of sorcerers and outsiders have led to a confused and often contradictory modern record of Tarahumara psychotropic plants. Until we can obtain documented plant specimens with subsequent phytochemical and clinical research and reliable ethnological data on the role of the sacred plants in the Tarahumara culture, our knowledge of these active species of cacti and herbs and their potential as therapeutic tools in modern society will be seriously limited. Some of the reported effects may be attributed to various alkaloids which, when known, are included below.

At present we know little about psychotomimetic plants among the Tarahumara. There has been no uniform survey of hallucinogenic plants and their importance to these natives. Each region has yielded fragmented and, in some cases, strikingly different data. The only sacred medicinal plant which is reported to cause visions and appears to be uniformly recognized from the Rio Conchos watershed on the east to the Barranca de Chínipas on the west is the cyperaceous "bakana".

Reputed hallucinogenic plants of the Tarahumara

The following plants comprise those cacti and herbs reported to be agents which, when ingested, cause visual, auditory, tactile, or other hallucinations. In many cases these plants are considered by the Tarahumara as beings which can cause harm if misused.

Cactaceae

Lophophora williamsii (Lem.) Coulter, *Contrib. U.S. Natl. Herb.*, 3 (1894) 131

Tarahumara names: "híkuli"; "jíkuli"; "híkuli wanamé" (Lumholtz); "híkuli walula saelíami" (Lumholtz)

Mexican name: "peyote"

Despite the extensive phytochemical, botanical, medicinal, historical, and ethnological work on this species, we still have great gaps in our knowledge of this most famous of North American hallucinogenic plants. Lumholtz's field research and subsequent publications awakened the interest of several disciplines in studying this plant and its effects. Among the Tarahumara it is valued and used primarily by those living in the eastern regions of Narárichic, Baqueachic, and Guajochic. In the sierras and surrounding westward draining barrancas, "peyote" is not used or its use appears to be dying out. This situation may reflect its more recent introduction among the Tarahumara, possibly by Huichol Indians from the south, and its slow diffusion to the interior rather than a decline in its importance in the high sierras. On the other hand, "peyote" may have had early religious significance to the Tarahumara and adjacent cultures. Archaeological evidence suggests that "peyote" was used north of the Tarahumara region. Huerigos polychrome bowls from the Medio Period (AD 1060 - AD 1340) of Casas Grandes were decorated with a ticked, counter-clockwise spiral which is similar to a Huichol symbol of "peyote" (DiPeso, 1974).

The cacti are said to be collected from the Chihuahuan Desert and are consumed fresh or in water after macerating the dry plant. Ingestion of "peyote" enables the shaman to see better and to aid in the treatment of his patient. Taken by participants in special "peyote" ceremonies, "híkuli" is also credited with purifying, strengthening, and protecting the body. The chewed plant or a water solution of the plant is applied to various bites, wounds, burns, and rheumatic pains. It is reported, in some cases unreliably, to be the most common psychotropic plant employed by the Tarahumara. "Híkuli walula saelíami" is the "peyote" of great authority (Lumholtz, 1902) and may actually represent a plant with numerous shoots resulting from a developmental response to repeated collecting and injury.

Anderson (1969) has summarized the botanical knowledge of the genus *Lophophora*. *Lophophora williamsii* is restricted to the Chihuahuan Desert but, so far, there are no voucher specimens of the plant growing within the state of Chihuahua. The "peyote" localities are reported by Lumholtz (1902), Bennett and Zingg (1935), and Pennington (1963) and include the regions

south of Ojinaga near the mouth of the Rio Conchos and the ridges east of Santa Rosalia, Jimenez, and Camargo. Specimens said to be brought by Tarahumara Indians were recently obtained in Chihuahua City and were reported to have been collected in the region of Camargo and also in the hills west of Chihuahua City. Further botanical field work is needed to identify the localities from which "peyote" is obtained in Chihuahua. *Lophophora* and mescaline, one of more than thirty isolated alkaloids, have been the subjects of much chemical and clinical research which has been summarized by Schultes and Hofmann (1973) and at a symposium on "peyote" (Kapadia and Favez, 1973; McLaughlin, 1973; Paul, 1973; Shulgin, 1973).

My field work in the sierras and barrancas of the western slopes of the Sierra Madre failed to turn up *Lophophora williamsii* in use by the Tarahumara. Verbal descriptions, photographs, and specimens did not elicit any positive or reactionary responses from the Tarahumara. The pressures from Spanish and Mexican settlers have pushed the Tarahumara further westward away from the range of *Lophophora* (see Fig. 1) and have restricted the Indians' movements. These factors coupled with the availability of local

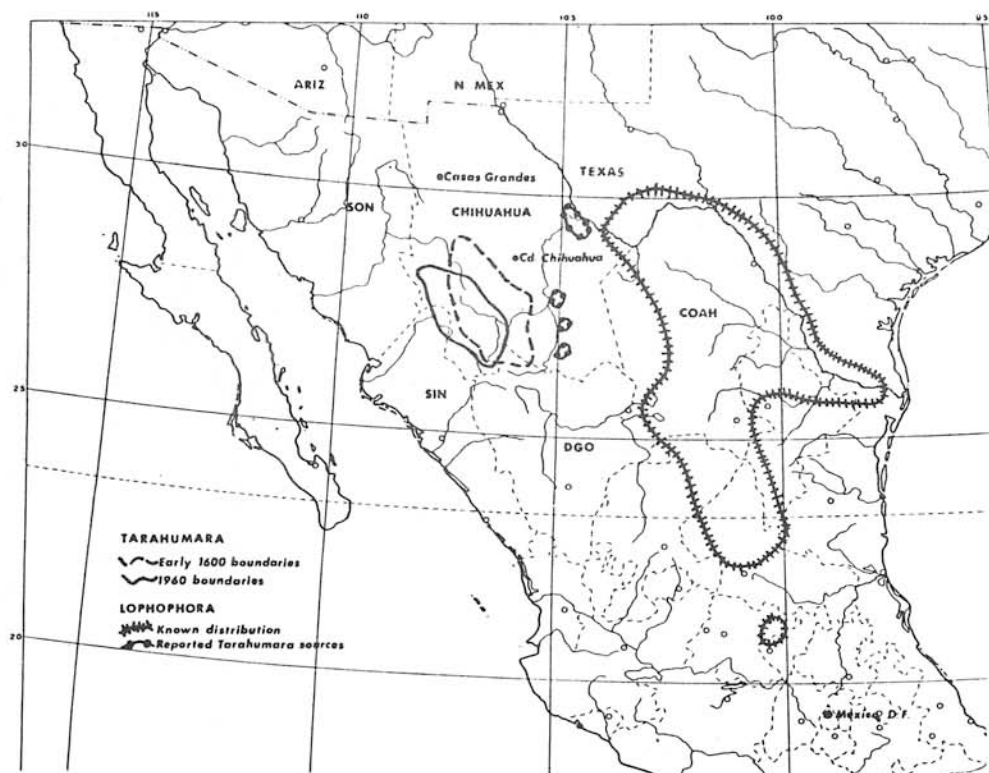


Fig. 1. Ranges of the Tarahumara (early 1600 (ca. contact time) and 1960, based on Pennington, 1963), of the known localities of *Lophophora* (based on Anderson, 1969), and of the Tarahumara source areas as reported in the text. Base map from Goode's Series of Base Maps, No. 112.

plants which produce similar effects may be responsible, in part, for the limited use of *Lophophora*, especially in the central and western sections of the Tarahumara homeland.

Lophophora fricii Habermann, *Kaktusy*, 74 (1975) 123

Tarahumara name: "chiculi hualala saeliامي" (Fric)

In 1923, A. V. Fric of Czechoslovakia collected cacti in Mexico and supposedly traveled in Tarahumara country. During his travels, he was able to make friends with the natives. Possibly through this connection, he may have had an opportunity to record the name "chiculi hualala saeliامي", the Tarahumara name of this cactus, which he assumed to be Lumholtz's "híkuli walula saeliامي" -- the "híkuli" of great authority. This rare, red flowering *Lophophora* is known only from the Sierra Bola, near San Pedro, Coahuila (Habermann, 1975).

Ariocarpus fissuratus (Engelm.) Schum., in Engler and Prantl, *Pflanzenfam.*, 3(6a) (1894) 195

Tarahumara name: "híkuli sunami" (Lumholtz)

Mexican name: "peyote cimarrón" (Pennington)

Lumholtz reported that, although this species was rare among the Tarahumara, it was considered more effective and more powerful than *Lophophora williamsii*. Consumed fresh or ground in water, it was taken in the same manner as *Lophophora*. This "híkuli" was also used as a stimulant by the runners.

Ariocarpus is restricted to the Chihuahuan Desert and, as is the case with *Lophophora*, there are no reliable specimens from living populations in the state of Chihuahua (Anderson, 1963). Pennington (1963) reports that the Tarahumara obtain plants from the Ojinaga and Jimenez regions of Chihuahua. Specimens which I obtained in Chihuahua City are said to have been collected in the region of Camargo by the Tarahumara. The response of the Tarahumara in the sierras and barrancas of the western slopes of the Sierra Madre to specimens of *Ariocarpus* was the same as their reaction to *Lophophora* and indicates, possibly, that *Ariocarpus* has not been employed in this region in the recent past. McLaughlin (1969) confirms the presence of hordenine and reports the isolation of N-methyltyramine in *A. fissuratus*. N-methyl-3,4-dimethoxy- β -phenethylamine has also been isolated from *A. fissuratus* (Norquist and McLaughlin, 1970). A closely related species, *A. retusus*, is not valued by the Huichol, who claim that it may be confused with *Lophophora* and that its ingestion results in a bad and unpleasant experience (Furst, 1971).

Bennett and Zingg (1935) stated that "peyote cimarrón", a small reddish cactus, was considered ineffective by the Tarahumara, although one must not abuse it or else one will die. It reportedly grows in the region of Cusi, San Diego, Tabalopa, and on the "other side" of Chihuahua City.

Epithelantha micromeris (Engelm.) Weber, in Britton and Rose, *Cactaceae*, 3 (1922) 93

Tarahumara names: "híkuli mulato" (Lumholtz; Basauri); "híkuli rosapara" (Lumholtz)

This cactus is the third of five types of "híkuli" recognized by the Tarahumara according to Lumholtz (1902). The ingestion of this cactus by the shaman is said to make his eyes larger and clearer and to enable him to see sorcerers. The whole plant, as well as the fruit (although it is considered less effective), is used to stimulate and protect runners (Lumholtz, 1902; Pennington, 1963). The property of prolonging life is attributed to the plant. As with the preceding two species, its use appears to be restricted to the upper regions of the Rio Conchos. Plants are allegedly obtained from the slopes of the ranges northeast of Valle de Allende beyond the Rio Florida (Pennington, 1963) and near Julimes on the banks of the Rio Florida (Basauri, 1927). They are restricted to the Chihuahuan Desert and are found in Arizona, western Texas, Chihuahua, and Coahuila. Traces of alkaloids and six triterpenes, which may be responsible for toxicities observed in mice, have been identified from *E. micromeris* collected in Texas (West and McLaughlin, 1977).

"Híkuli rosapara" was identified by Robinson of the Gray Herbarium as an advanced stage of "híkuli mulato", although Lumholtz considered it to be quite distinct. This type of "peyote" was reported to make bad people crazy and throw them off cliffs. Rose (1899) suggested that this white, spiny type of peyote might be *Mammillaria senilis*.

Mammillaria craigii Lindsay, *Cact. Succ. J.*, 14 (1942) 107

Tarahumara names: "wichurí"; "wituliki" (Bennett and Zingg); "wichuriki" (Thord-Gray)

Mexican names: "peyote de San Pedro"; "biznaga" (Bennett and Zingg; Thord-Gray)

This round cactus with stout spines and latex-containing tissue (Fig. 2) is found in the western barrancas of Chihuahua. This cactus, reported by Bennett and Zingg (1935) as *M. heyderi* Möhlenpf., was roasted, after removing the spines and splitting it in half. The center was squeezed into the ear to relieve earaches, headaches, and deafness. Various magical properties were attributed to the plant as well. Its ingestion enabled the shaman to locate witches and wizards by clearing his vision, and it stimulated runners. Bruhn and Bruhn's (1973) suggestion that the Tarahumara name is related to the native term for crazy, "wichuwa-ka", is plausible.

In the Barranca de Batopilas, *M. craigii* is respected by all Tarahumara. Mistreating it, such as making botanical specimens of it, is considered very dangerous and terrifies many natives who may see it being collected by a botanist. On one occasion, after a lengthy instruction on proper treatment of these plants, my informant insisted on burying the plant after I had "killed" it by slicing the cactus in half from the top with white hairs, without proper preparation. The center of the plant consists of a pocket rich

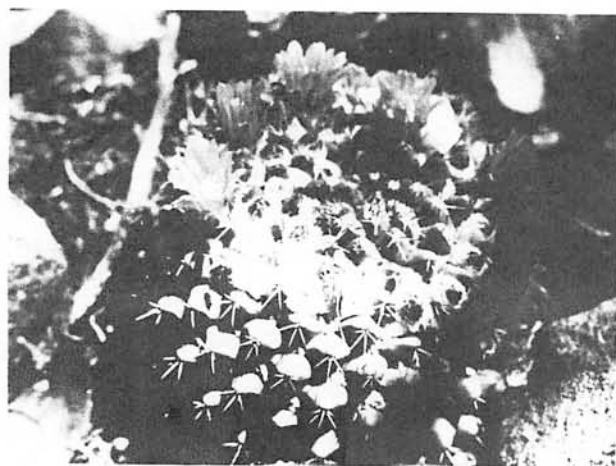


Fig. 2. *Mammillaria craigii*, ca. 3/10 natural size. Bye 3327.

in white latex with radiating vascular tissue with similar white material. This central region is referred to as the "heart". The upper portion of the plant is said to be the most effective. The top, with the spines removed, is ingested and is said to put one to sleep soon. During this sleep, the person "travels" to distant places and sees brilliant colors. If the person is not prepared, it will drive him crazy. Its effects are said to be similar to "híkuli". Bruhn and Bruhn (1973) have identified N-methyl-3,4-dimethoxyphenethylamine in an alkaloid fraction from cultivated plants of *M. heyderi*, a closely related species.

Mammillaria grahamii Engelm. var. *oliviae* (Orcutt) L. Benson, *Cacti of Arizona*, 1969, p.22

Tarahumara name: "híkuri"

Mexican name: "peyote"

Small clusters of this cactus (Fig. 3) are found on the slopes of Barranca de Batopilas and are reported to be the actual "híkuri" of this region. It is said to be distinguished from similar species of *Mammillaria* by the reddish central spines and the reddish vascular tissue in the plant stem. The fruit and top of the plant with the spines removed are eaten and are said to cause drowsiness followed by "travel" with brilliant colors. It is taken by the shaman and participants during special ceremonies. If improperly used, the plant can cause a person to go crazy. Specimens of this Tarahumara "peyote" are awaiting analysis.

Coryphantha compacta (Engelm.) Britton and Rose, *Cactaceae*, 4 (1923) 36

Tarahumara names: "bakana"; "bakánawa"; "wichurí"; "Santa Poli"

This ball cactus (Fig. 4) is found in the sierras on open, exposed slopes of major side canyons of the main barrancas. It is said to be a powerful

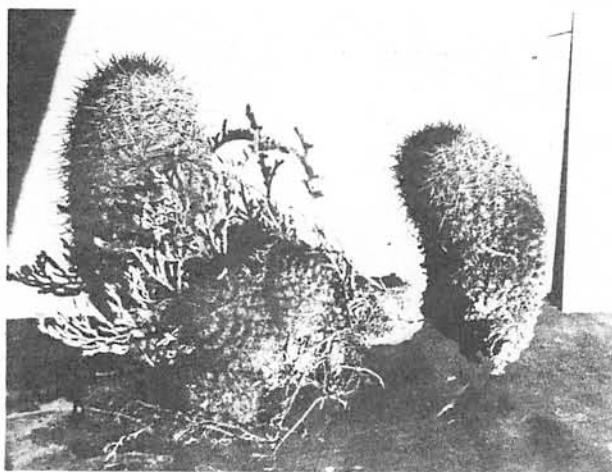


Fig. 3. *Mammillaria grahamii*, ca. 1/5 natural size, with *Selaginella*. Bye 3442.

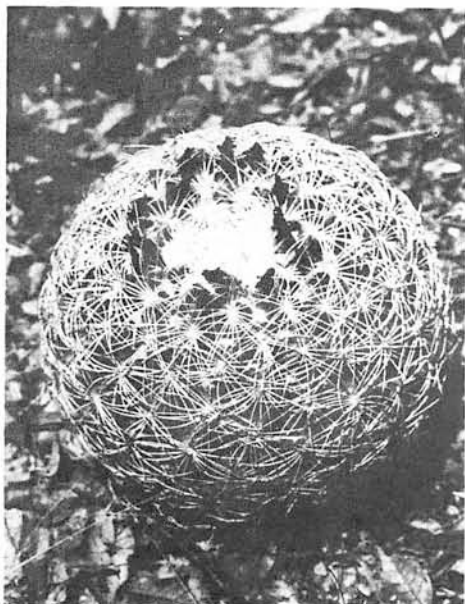


Fig. 4. *Coryphantha compacta*, ca. 1/3 natural size. Bye 7926.

medicinal plant employed by the shaman and feared by some Tarahumara, who say that it is a form of "híkuri". It may be referable to Bennett and Zingg's "bakánawa". Analysis of the Tarahumara "bakana" is underway. Several alkaloids, including β -phenethylamine alkaloids, have been reported from over ten species of *Coryphantha* (Agurell, 1969a,b; Below *et al.*, 1968; Bruhn and Agurell, 1974; Bruhn *et al.*, 1975; Hodgkins *et al.*, 1967; Howe *et al.*, 1977; Keller and McLaughlin, 1972; Keller *et al.*, 1973; Kelley *et al.*, 1972; Ranieri *et al.*, 1976; Sato *et al.*, 1973).

Echinocereus triglochidiatus Engelm., in Wislitz., *Mem. Tour North. Mex.*, 1848, p. 93

E. salm-dyckianus Scheer, in Seemann, *Bot. Voy. Herald*, 1856, p. 291

Tarahumara name: "híkuri"; "wichurí"

Mexican name: "pitallita"

Informants from the sierras and barrancas indicate that these plants (Figs. 5, 6) are "híkuri" of the sierras and can be used in the same manner as the preceding types although they are not as powerful. Once, while I was



Fig. 5. *Echinocereus triglochidiatus*, ca. 3/10 natural size. Bye 3695.



Fig. 6. *Echinocereus salm-dyckianus*, ca. 1/6 natural size. Bye 3722.

pressing specimens of these plants, an old Tarahumara addressed the cut stems and flowers and began singing to them. This singing was done so that the plants would not feel offended by my ruthless actions. Lumholtz (1902) mentioned *Echinocactus* (although his illustration is *Echinocereus*) along with the other species of *Mammillaria* (the original generic determinations of the various "híkuri") as having "high mental qualities". A species of *Echinocereus* is reported to contain an alkaloid (Willaman and Schubert, 1961). McLaughlin (personal communication, 2 March 1977) says that preliminary tests on Tarahumara plants of *E. triglochidiatus* indicate the presence of a tryptamine derivative, possibly *N,N*-dimethyl-5-methoxytryptamine — the first record of its presence in this genus.

Pachycereus pecten-aboriginum (Englem.) Britton and Rose, *Contrib. U.S. Natl. Herb.*, 12 (1909) 422

Tarahumara names: "chawé"; "wichowaka"; "bitaya mawalí"

Mexican names: "cardón"; "hecho"

The juice expressed from the stems of this columnar cactus (Fig. 7) of the western slopes of Mexico is occasionally used by the Tarahumara of the western barrancas to induce visions, along with quick intoxication during "tesgüinadas". The sap may be added to corn "tesgüino" or cooked and fermented alone, although this last preparation is said to act as a strong purgative. Pennington (1963) reports that the young branches are mixed with water. The decoction is then drunk to produce an effect like "híkuri" and results in dizziness and visions during ceremonies. Späth (1929) isolated

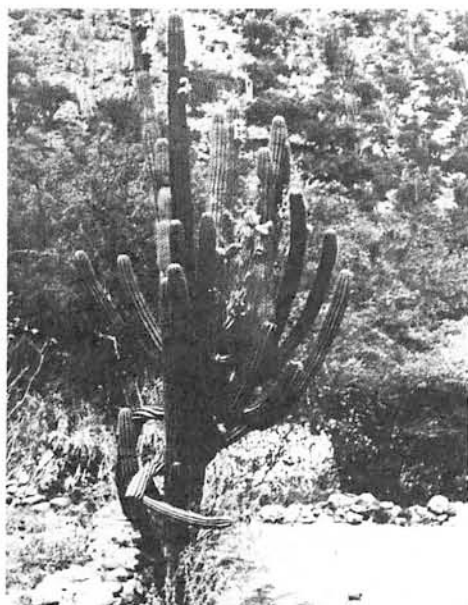


Fig. 7. *Pachycereus pecten-aboriginum*, ca. 1/100 natural size. Barranca de Batopilas, April 1973.

an alkaloid, carnegine, from this species. Later Agurell *et al.* (1971) identified 3-hydroxy-4-methoxyphenethylamine from part of the alkaloid fraction of cultivated plants.

Mammillaria senilis Lodd., in Salm-Dyck, *Cact. Hort. Dyck*, 1849, 1850, p. 82

Rose (1899) suggested that this small hooked-spine cactus of the western slopes of Chihuahua and Durango might be the "híkuli rosapari" of Lumholtz. He related an incident of Nelson who, while collecting in southern Chihuahua, encountered a Tarahumara who was fearfully reluctant to assist in collecting a similar cactus.

Other members of the Cactaceae have been described by travelers in the Tarahumara region as having the effects or properties of "híkuri". Their observations have been summarized and await further ethnobotanical data and specimens.

"Ocoyome". Lumholtz (1902) described this cactus as being globular and woolly-like with long white spines. It was rarely used and only for evil purposes. Basauri (1927) mentioned a kind of "peyote" called "cocoyome" which was found near Julimes along the banks of the Rio Conchos.

"Bakánawa"; "bakánori". Bennett and Zingg (1935) and Thord-Gray (1955, 1960) discussed a small ball cactus which was used primarily in the western canyons and nearby mountains. Although Zingg apparently obtained a specimen, no identification was listed, nor is there any record of a specimen. Any Tarahumara can collect this plant, but only the shaman may use it. It is reported to be a powerful medicine and is used to alleviate pains and is rubbed on legs of runners. The singing of the "bakánawa" is said to become clearer if one chews the plant. Compare notes under *Coryphantha compacta*.

"Peyote". Bennett and Zingg (1935) also reported a small cactus which grows in the Tarahumara region, although it is said to be used only by the Apaches.

"Híkuli dewéame" or "peyote christiano". Bennett and Zingg (1935) reported that a "peyote" which is larger than the green variety was used by the Tarahumara much in the same way as *Lophophora* and is considered more efficacious. It grows near Cusi, San Diego, Tabalopa, and on the "other side" of Chihuahua City.

"Sumarique". Basauri (1927) recorded a kind of "peyote" used by the Tarahumara which grows in the vicinity of Julimes near the Rio Conchos.

Cyperaceae

Scirpus sp.

Tarahumara names: "bakánoa"; "bakánawa"; "bakana"

Throughout various sections of the sierras and western barrancas of the Tarahumara region, this plant is considered to be a very powerful herb. This cyperaceous "bakana" may be one of the most important hallucinogenic plants of the central and western Tarahumara and will be treated in a future

paper (Bye and Burgess, in preparation). It is also recognized by the Tarahumara in the eastern Rio Conchos region. The herb is described by the Tarahumara as grass-like with underground tubers or "bolitas" and is found near certain springs on the slopes of the barrancas. These localities are well known to the natives who may live in many distant areas. The "bolitas" are obtained on a special trip to one of these localities or by barter. Some mestizos grow the plant in areas along arroyos in the canyons and sell them to the Indians. The Tarahumara do not grow them for fear of going crazy from the sounds said to be emitted from the bulrush. Some Tarahumara carry "bakana" on trips because it is one of the best medicines to relieve pains. The tuber is said to be used in curing insane natives. The plant is considered a great protector and curer of physical and mental illnesses. Before using the tubers, one must sing to it. Food and song must be offered to it periodically. Mistreatment of the plant often leads to sickness and death of the offender. Ingestion of the tubers is said to put one in a deep sleep during which one can "travel" great distances, talk with dead relatives, and see brilliant colors. Caution must be exercised after application to the body or ingestion as "bakana" may make one jump into fires. Alkaloids have been isolated from one species of *Scirpus*, three species of *Cyperus*, and a limited number of other genera of Cyperaceae (Raffauf, 1970; Willaman and Schubert, 1961; Willaman and Li, 1970).

Solanaceae

Datura discolor Bern., Trommsdorf N., *J. Pharm.*, 26 (1833) 149

D. inoxia Mill., *Gard. Dict.*, ed. 8 (*Datura* No. 5), 1768

D. stramonium L., *Sp. Pl.*, 1 (1753) 179

Tarahumara names: "uchirí"; "uchurí"; "wichurí"; "dekuba" (Bennett and Zingg); "tikúwari" (Pennington)

Mexican names: "tolovachi"; "tolachi" (Bennett and Zingg); "toloche" (Pennington)

Taxonomic confusion in the genus *Datura* leaves most ethnobotanical data in a state of uncertainty. In the past, general treatments have reported *D. meteloides* A. DC. as the main hallucinogenic and toxic species employed by many native peoples in the New World. Bennett and Zingg (1935) stated that the leaves were used to relieve headaches but that they had to be removed after a short period or else the patient would go crazy. Zingg (n.d.) also describes the fear of insanity that the Tarahumara have about *Datura*.

Pennington (1963) mentioned various medicinal applications of the plant as well as the addition of seeds, leaves, and roots to "tesgüino" as a catalyst and to induce a good feeling and visions. In the Barranca de Batopilas, these plants are considered powerful and can be handled only by someone of authority. My collecting these plants was often accompanied with warnings that I would go crazy and die because I was mistreating them. Some Indians refused to talk to me for several days afterwards. The use of these herbs is apparently confined to the western canyons, where they are more numerous and common.

Barclay (1959) records the following taxa of *Datura* in southwestern Chihuahua: *D. stramonium* ssp. *stramonium*, *D. stramonium* ssp. *quercifolia**, *D. inoxia* ssp. *quinquecupida**, *D. inoxia* ssp. *lanosa**, *D. discolor*, and *D. ceratocaula*. Zingg's specimens of *D. inoxia* ssp. *quinquecupida* (*D. wrightii*) and *D. inoxia* ssp. *lanosa* from southern Chihuahua are deposited in the herbarium at Field Museum. One specimen of *D. ceratocaula* is known from Chihuahua and appears to be disjunct from other known populations to the south. This particular species is known to have been an important psychotomimetic in southern Mexico and its presence in northern Mexico may represent its purposeful introduction in the past. More botanical and ethnobotanical field studies are needed to clarify the situation. As far as can be determined, the Tarahumara, who are willing to talk about this toxic group of plants, do not distinguish among the various species recognized in the recent biosystematic treatment. The phytochemical basis and cultural importance of this common hallucinogen are reviewed by Schultes and Hofmann (1973). The cultural significance of *Datura* has been discussed for the Huichol of Mexico (Furst and Myerhoff, 1966) and for the Chumash of California (Applegate, 1975).

Tarahumara plants with possible hallucinogenic properties

At present there is no published or concrete field information that the following plants were or are used for their hallucinogenic effects by the Tarahumara. Suggestions based on uses of the plants by other cultures and the phytochemical analyses of the plants indicate that they are candidates for use in altering the senses of the Tarahumara. Further field work should clarify the problems.

Leguminosae

Erythrina flabelliformis Kearney, *Trans. N.Y. Acad.*, 14 (1894) 32

Tarahumara names: "kaposí"; "a'posí"; "aposí" (Bennett and Zingg); "aposhí" (Pennington)

Mexican name: "chilicote"

The red seeds of the "chilicote" tree have been employed cautiously by the Tarahumara to treat toothaches and intestinal disorders (Bennett and Zingg, 1935; Pennington, 1963). In addition, the Indians of the Barranca de Batopilas region use a poultice of the ground seeds to treat eye ailments and to improve vision. The toxic principles are recognized by contemporary Indians and their ancestors through the traditional giant poisoning myth which was first recorded by Lumholtz (1902). The seeds are sometimes strung into necklaces. Erythran alkaloids are known to be present but there

*Unpublished names.

is no evidence that they cause hallucinations (Schultes and Hofmann, 1973). The alkaloid composition in *Erythrina flabelliformis* is as follows: erysotrine, 14%; erysodine, 45%; erysovine, 40%; and eryspine, 1% (Hargreaves *et al.*, 1974). These seeds were once (and possibly still are) used by shamans in certain ceremonies, especially when one considers that they are used to heal eye ailments, that they are the major element of an important Tarahumara myth, and that the seeds have been discovered in a Basket Maker burial site in the Tarahumara region (Zingg, 1940). LaBarre's (1969) attempt to associate Lumholtz's "frijolillo" and maguey wine with *Erythrina* and the pre-peyote mescal bean cult, which used red seeds of *Sophora*, may not be plausible because Lumholtz's "frijolillo" may refer to another legume, *Phaseolus*. Species of wild bean are often called "frijolillo", the roots of which are still used by the Tarahumara to aid in the fermentation of "tesgüino" made from *Agave* and stems of *Zea mays* L.

The physiological and cultural relationship between *Erythrina* and *Sophora* still present a perplexing problem to ethnobotanists. The importance of the red beans of *Sophora secundiflora* (Ortega) Lag. ex DC. have been reviewed in the contexts of archaeology (Adovasio and Fry, 1976), ethnography (Campbell, 1958; Howard, 1957; Troike, 1962), biochemical and therapeutic effects (Merrill, 1977). Merrill's work in particular demonstrates the use of red beans of both *Erythrina* and *Sophora* in ceremonial dress.

Seeds of various species of *Erythrina* have been employed to alter the senses in Mexico (Guerra and Olivera, 1954; Schultes, 1972; Standley, 1920 - 1926) and in divination in Guatemala (Hopkins, 1974). The case for the use of *Erythrina flabelliformis* north of the Tarahumara region is circumstantial for the most part.

In their studies among the Chiricahua and Mescalero Apache, Castetter and Opler (1936) refer to the consumption of the fermented maize beverage, "tulbai" or "tiswin", in which seeds of *Sophora* are added. If the use of "tiswin" (or "tesgüino" in Spanish) by the Apache is a relatively recent introduction from northern Mexico as claimed by Castetter and Opler (1936), one could assume that the additives were transmitted with the "tiswin" process as well. The Mescalero Apache border on the northern range of *Sophora* which is specifically mentioned as a "tiswin" additive for its narcotic effects. On the other hand, the Chiricahua Apache of southwestern New Mexico, southeastern Arizona and adjacent Chihuahua live in the northern range of *Erythrina* and could have exploited these local red beans. During the late 1700s and 1800s, the Apache Indians dominated the sierras of western Chihuahua where the Tarahumara still make fermented maize beverage and where *Erythrina flabelliformis* is common. The ingestion of "tesgüino" is a common method of consuming extracts of hallucinogenic plants. The "tesgüino" process along with its additives could have been easily learned here and transmitted northward. The seeds also play a role in the Apache ceremonies and legends similar to that of the Tarahumara. It is possible that the use of *Erythrina* by the Apache reflects, in part, practices acquired from the Tarahumara Indians from the South.

Lycoperdaceae

Lycoperdon sp.

Tarahumara name: "kalamota"

Mexican name: "pata de perro"

On one occasion, a reliable informant indicated that this white puff-ball, which is feared by most Tarahumara and addressed by a derogatory Mexican name, is used by sorcerers to enable them to approach people without being seen and to make people sick. Sparse ethnobotanical and phytochemical data of two species of *Lycoperdon* said to be used in Oaxaca are summarized by Schultes and Hofmann (1973).

Plants related to "peyote"

There are many plants in Mexico confused with the true "peyote", *Lophophora williamsii* (Schultes, 1937). In addition, certain plants are associated culturally with the "peyotes" or "híkuris", such as the brasil-wood (botanical identity uncertain) used in making the rasping sticks, copal (possibly exudates of *Bursera* spp.) employed as offerings and purifiers, magueys (*Agave* spp.) valued in making medicinal water infusions, and Job's Tears fruits (*Coix lachryma-jobi* L.) (Lumholtz, 1902; Bennett and Zingg, 1935).

A few plants may have a more direct relationship with "peyotes". In the Barranca de Batopilas, *Tillandsia mooreana* L. B. Smith (Fig. 8), previously known from only the Rio Mayo valley to the northwest and a few



Fig. 8. *Tillandsia mooreana*, ca. 1/20 natural size. Bye 6093.

localities south and west of Mexico City, is referred to as "waráruwi", a companion plant of "peyote". Harming this bromeliad plant is considered to be very dangerous. Most informants refused to discuss the importance or use of this large, attractive plant found clinging to the steep walls on the shaded north-facing sides of the short tree forest of the barrancas. Even though the local "híkuri" (*Mammillaria grahamii*) and "wichuri" (*M. craigii*) are found in this same zone, the association is not ecological because these cacti are found on the open, dry, sunny south-facing slopes. In the Rio Chínipas barranca, *Oncidium longifolium* Lindley (Fig. 9), a terete-leaved orchid found clinging to the steep stone walls and tree branches, is an important temporary replacement "peyote", if one should misplace "híkuri". *Oncidium cebolleta* (Jacq.) Sw., a synonym of *O. longifolium* (Williams, 1951), is reported to contain an alkaloid (Willaman and Li, 1970). Further information is needed to determine the importance of these plants to the Tarahumara and their possible use as hallucinogenic agents.



Fig. 9. *Oncidium longifolium*, ca. 3/10 natural size. Bye 6438.

Other plants for consideration

As studies continue in the field of hallucinogenic plants, more information is gathered about the role of other plants and their properties. Some of this information can be useful in directing attention toward other Tarahumara plants for further consideration. Janiger and Dobkin de Rios (1976) have suggested that the use of *Nicotiana* with cultural conditioning could produce hallucinations because of the presence of nicotine and certain harmala alkaloids. Wilbert (1972) has investigated the role of tobacco in the shamanistic ecstasy of Venezuelan Indians. Recent studies among the Huichol Indians of Mexico suggest that a mixture of *Nicotiana rustica* and *Tagetes lucida* may produce hallucinogenic effects (Siegel *et al.*, 1977).

Three species of *Nicotiana* are found in the Tarahumara region and all are used to limited extent for smoking and for treatment of headaches and animal bites (Bennett and Zingg, 1935; Pennington, 1963; Thord-Gray, 1960). *Nicotiana trigonophylla* Dunal ex DC. is the native, wild tobacco and is smoked infrequently. It is known as "bawaráka" (Bennett and Zingg, 1935) and "wipaka". The cultivated tobacco, *N. tabacum* L., grows as an escaped plant along the trails of the western barrancas and is cultivated occasionally (Bennett and Zingg, 1935). It is known to the Tarahumara as "wipaka" and "makuchi". The Indian tobacco, *N. rustica* L., was in cultivation in pre-Columbian Mexico and is the tobacco commonly cultivated today by the Tarahumara, who refer to it as "wipaka", "makuchi", "wiparu", and "wipanto". The dried leaves are especially valued for smoking during evening ceremonies. Traditional Tarahumara prefer to smoke cigarettes made with dried leaves of *N. rustica*. On one occasion an elderly Tarahumara was smoking tobacco in a wooden pipe which he claimed was a traditional smoking implement. Tobacco is considered an important element of ceremonies and smoking is restricted to the night (Lumholtz, 1902; Thord-Gray, 1960). The plant is considered to have magical properties and is used to purify people, fields and animals. Thord-Gray (1960) stated that the Tarahumara consider tobacco next in importance to "híkuri" and more powerful than "dekuba" (*Datura*).

The composite, *Tagetes lucida* Cav. (called sweet marigold), is not known to be smoked, alone or in mixture with tobacco, by the Tarahumara. Further observations may reveal its employment in ceremonial smokes similar to that found recently among the Huichol. The sweet marigold is a common medicinal plant of the sierras where it is taken as a tea to alleviate headaches, chest pains, and stomach ailments (Bennett and Zingg, 1935; Bye, 1976; Pennington, 1963). It is a popular market herb in the Chihuahuan cities as well as throughout Mexico (Neher, 1968). The aromatic herb goes by the Tarahumara names of "basigó" and "yeso" or "yesa" and by the Spanish names "Santa Rosa" and "yerbanís" and its variations. At certain Tarahumara fiestas in September, bundles of "yerbanís" are placed on the pots of "tesgüino" and on the cross. Whether this practice of using *Tagetes lucida* is purely for decoration or has ritualistic meaning and purpose needs to be determined.

Conclusions

To alter their states of mind, the Tarahumara employ a number of hallucinogenic plants for which they have great respect. Previous accounts have had little tangible evidence (*i.e.*, specimens) upon which to base their reports (Table 1). Lumholtz made observations on *Lophophora*, *Ariocarpus*, and *Epithelantha*. Bennett and Zingg added two more important narcotic plants, *Mammillaria* and *Datura*, while Pennington later increased the list by one: *Pachycereus*. In my field studies, I have encountered and clarified

TABLE 1

	CL	B&Z	CWP	Bye	Others
Hallucinogenic plants					
<i>Ariocarpus fissuratus</i>	+	(+)	(+)	—; 6000	Mooney
<i>Coryphantha compacta</i>		[+]		+; 5721, 6987, 7926, s.n. (Oct. 1973)	
<i>Echinocereus triglochidiatus</i>	[+]			+; 3658, 3668, 3695, 3873, 3910, 7019, 7925	
<i>Echinocereus salm-dyckianus</i>				+; 3722, 3758, 6988	
<i>Epithelantha micromeris</i>	(+)		(+)		
<i>Lophophora fricii</i>				—; 6267	Fric
<i>Lophophora williamsii</i>	+, GH!	(+)	(+)	+; 3327, 7074	Mooney
<i>Mammillaria craigii</i>		(+)*		+; 3326, 3425, 3442, 4002, 6294, 6317, 7073	
<i>Mammillaria grahamii</i>					
<i>Mammillaria senilis</i>					Rose
<i>Pachycereus pecten-aboriginum</i>			(+)	+; 3346, 3384, 7115	
<i>Scirpus</i> sp.				+; 6470	
(<i>Datura meteloides</i>)		(+)	(+)	+; 3257, 3261, 3475, 3507	
<i>Datura discolor</i>				+; 2977, 3260, 3266, 4568, 5321, 5895	
<i>Datura innoxia</i>		+		+; 2981, 3136	
<i>Datura stramonium</i>					
Suspected hallucinogenic plants					
<i>Erythrina flabelliformis</i>				+; 2924, 3639, 4013, 6226-B, 6271, 6472	
<i>Lycoperdon</i> sp.				+; 2412, 7923	
Associated with hallucinogenic plants					
<i>Tillandsia mooreana</i>				+; 2966, 6093, 7096	
<i>Oncidium longifolium</i>				+; 6438	

(continued on facing page)

TABLE 1 (continued)

	CL	B&Z	CWP	Bye	Others
Possible hallucinogenic plants					
<i>Nicotiana</i> sp.	(+)	(+)			
<i>Nicotiana rustica</i>			(+)	+; 3345, 3989, 5763	Palmer 1885:RR, GH!
<i>Nicotiana tabacum</i>		(+)	(+)	+; 2986, 3589, 4019, 5733	
<i>Nicotiana trigonophylla</i>		(+)	(+)	+; 4016, 5723	Palmer 1885:114, GH!
<i>Tagetes lucida</i>		(—)	—	—; 2319, 2588, 2685, 3096, 4906, 5216, 5292, 7121	Palmer 1885:LL, GH!

*Reported as *M. heyderi*. +, definite reference and specimen. —, not recognized as hallucinogenic. (), direct reference without specimen. [], indirect or weak reference. CL, Carl Lumholtz. B&Z, Bennett and Zingg. CWP, C. W. Pennington. Bye, R. Bye; followed by voucher specimen numbers.

some, but not all, of these records and have added eight more "respected" plants — four hallucinogens and four possible psychotropics or associated plants. Certain alkaloids, important agents in causing hallucinations, have been found in most of these plants. Analyses of the cacti which I have collected are in progress, with most of the preliminary reports being positive for the presence of alkaloids.

The Tarahumara of the central and western Sierra Madre Occidental of Chihuahua recognize local psychotomimetics — plants which are either respected and used or feared and avoided. These sacred cacti and herbs serve medicinal, ceremonial, and social functions within a strict cultural context and are rarely used for individual pleasure. Native plants of the Sierra Madre rather than those of the Chihuahuan Desert are important, except to the Tarahumara on the eastern range in the Rio Conchos drainage with easy access to the eastern *Lophophora*, *Ariocarpus*, and *Epithelantha*. The geographic distribution of these local plants and the historically recent restriction of travel may be key factors for the use of plants growing within the Tarahumara territory. The "bakana", *Scirpus*, is the plant most widely recognized and employed within the whole Tarahumara region. Although they refer to several different plants, "híkuri" and "wichurí" are terms for hallucinogenic plants which are valued throughout Tarahumara-land. "Híkuri" is a name possibly borrowed from the Huichol who still actively use true "peyote"; it applies to the desert cacti such as *Lophophora* in the eastern part of the Sierra Madre foothills, while in the central and western region, it refers to cacti of the sierra, *Echinocereus*, and of the barranca, *Mammillaria*. The Tarahumara term, "wichurí", refers to other plants which produce temporary altered states of consciousness and could cause insanity. "Wichurí" may be derived from the verb, "wichuwama", which means to go crazy.

Elements of the ambient flora of the Tarahumara provide them with plant products which enrich their personal life and culture. The altered states of awareness and the possible therapeutic effects resulting from the use of these sacred plants are probably based on the variety of alkaloids found in these cacti, herbs, seeds, and puffballs.

Specimens

Voucher specimens I have collected are deposited at ECON with duplicates located at COLO, GH, INIF, and MEXU. Specimens collected by Lumholtz and Palmer have been examined at GH.

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Note added in proof

Echinocereus triglochidiatus and *E. salm-dyckianus*

Phenethylamines, including N-methyl-3,4-dimethoxyphenethylamine, N,N-dimethyl-3,4-dimethoxyphenethylamine, and tetrahydroisoquinoline salsoline have been isolated from cultivated plants of the Mexican species *E. merkeri* (Agurell *et al.*, 1969; McFarlane and Slaytor, 1972). *Echinocereus cinerascens* from Hidalgo, Mexico, has yielded N,N-dimethyl-3,4-dimethoxyphenethylamine as the major alkaloid and N-methyl-3,4-dimethoxyphenethylamine in small amounts (Bruhn and Sánchez-Mejorada 1977).

Pachycereus pecten-aboriginum

Recent studies of extracts from plants obtained from Michoacan, Mexico, have yielded 3,4-dimethoxyphenethylamine, 4-hydroxy-3-methoxyphenethylamine, and four tetrahydroisoquinoline alkaloids: salsoline, isosalsoline, arizonine, and heliamine (Bruhn and Lindgren, 1976; Strömbom and Bruhn 1978).

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