

EVOLUTION OF THE IDENTIFICATION OF THE MYRISTICACEOUS HALLUCINOGENS OF SOUTH AMERICA

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1. Introduction

In view of the widespread hallucinogenic use in South America of trees of the myristicaceous genus *Virola*, it is difficult to realize that its discovery is very recent. Inasmuch as sundry hallucinogens still remain poorly understood or even botanically unidentified, it may be significant — especially as many of these psychoactive agents are employed in regions faced with rapid cultural deterioration or even in societies faced with total disintegration — to recapitulate the development of our knowledge of *Virola* use.

Many Indian tribes in the northwestern parts of the Amazon Valley and of the headwater regions of the Orinoco drainage-basin utilize preparations of the bark resin of several species of *Virola* either as a snuff or orally in witchcraft and medicine. Indeed, certain very primitive tribes simply ingest the resin directly, with apparently no preparation, for its psychoactive effects.

2. Earliest ethnobotanical report

There are from 45 to 60 species of tropical trees in the genus *Virola* which belong to the Myristicaceae or Nutmeg Family. All the species are American, occurring in humid forests of Central and South America, being especially abundant in the Amazon flora. Five or possibly six of the species are known to be employed in the preparation of hallucinogenic agents. The psychoactive principles have been determined to be tryptamines, especially 5-methoxy-*N,N*-dimethyltryptamine, present in some of the preparations in rather high concentrations.

The neotropical flora contains members of four related myristicaceous genera: *Compsonera*, *Dialyanthera*, *Iryanthera* and *Osteophloem*. All four genera have interesting folk medical uses in South America and are well worth thorough chemical and pharmacological study (Schultes and Holmstedt, 1971).

3. Narcotic use of the genus *Virola*

The famous English plant explorer Richard Spruce spent five years in the middle of the last century in the Rio Negro area of the Brazilian Amazonia and the adjacent headwater regions of the Venezuelan Orinoquia. This area represents the geographic section of South America of most concentrated use of hallucinogenic snuffs made from *Virola*. In his extraordinarily perspicacious study of the local flora, he devoted very special attention to *Virola*, collecting many species and describing a number as new to science. He often made penetrating ethnobotanical observations on plants valuable in the native economy. Science is indebted to Spruce for valuable information, for example, on several narcotics; the preparation and use of *yopo* snuff from *Anadenanthera peregrina* (L.) Spegaz.; and the botanical identification and description of the plant from which the Tukanoan Indians prepared the intoxicating drink known in the Rio Negro basin as *caapi* — *Banisteriopsis Caapi* (Spr. ex Benth.) Morton. Yet, it seems that Spruce missed the native hallucinogenic use of *Virola*, the genus to which he gave so much taxonomic attention over such an extended period.

This curious utilization of *Virola* escaped other naturalists, ethnographers and travellers who wrote on the upper Rio Negro area. It was not, apparently, until the field work of the German ethnologist Dr. Theodor Koch-Grünberg, early in the present century, that the snuff was reported (Koch-Grünberg, 1923). Writing on the Yekwana Indians of the uppermost Orinoco, in which area he had studied in 1911 - 1913, Koch-Grünberg, without attempting to identify the source plant, stated that *hakudufha* "... is a magical snuff exclusively used by witch doctors and prepared from the bark of a certain tree which, when pounded up, is boiled in a small earthenware pot, until all the water has evaporated and a sediment remains at the bottom of the pot. This sediment is toasted in the pot over a slight fire and is then finely powdered with the blade of a knife. Then the sorcerer blows a little of the powder through a reed ... into the air. Next, he snuffs, whilst, with the same reed, he absorbs the powder into each nostril successively. The *hakudufha* obviously has a strongly stimulating effect, for immediately the witch doctor begins singing and yelling wildly, all the while pitching the upper part of his body backwards and forwards".

This *hakudufha* snuff most certainly must have been elaborated from *Virola* bark, and, if so, Koch-Grünberg's clear description appears to represent the earliest report in the literature of the narcotic use of the genus *Virola*.

4. Identification of the source plants

The first association of the hallucinogenic utilization of *Virola* in a report involving botanical identification, however, appeared in 1938, when the Brazilian botanist Dr. Adolpho Ducke wrote (Ducke, 1938) that the "Indians of the upper Rio Negro use the dried leaves of this species [*Virola*

theiodora (Spr. ex Benth.)] and of *V. cuspidata* [Benth.] in making a snuff powder that they call *paricá*". In discussing the leguminous tree *Anadenanthera peregrina* in 1939, he asserted (Ducke, 1939): "Martius and other writers attribute to this species the source of the narcotic *paricá* employed by certain Amazonian Indians... Notwithstanding, according to information which I obtained from the natives themselves in two localities in the upper Rio Negro, the *paricá*-powder comes from the leaves of species of *Virola*". Although it is now certain that the leaves are not utilized in snuff-making, Ducke's statements represent apparently the earliest identification of this narcotic with *Virola*.

When references were made to the use of a snuff in South America, anthropologists frequently tended to assume automatically that the material was prepared from the seeds of *Anadenanthera*. The *Handbook of South American Indians*, for example, blacks in huge sections of the continent as regions where *Anadenanthera*-snuff is employed — including even extensive areas where the plant is unknown! Historically, this leguminous hallucinogen has unquestionably been the most important snuff preparation, with the single exception of tobacco. Yet, actually, several other plants, in addition to tobacco, are recognized as sources of psychoactive snuffs in South America: the coca plant, *Erythroxylon Coca* Lam., among the Yukuna Indians of the Río Miritiparaná of southeastern Colombia; and *Tanaecium nocturnum* Bur. et K. Schum. in the western Amazonia of Brazil; *Maquira sclerophylla* (Ducke) C. C. Berg in the central Amazon of Brazil; and possibly *Justicia pectoralis* Jacq. var. *stenophylla* Leonard in the uppermost Orinoco.

A most searching discussion on snuffs of the Orinoco was offered by the Rev. James Barker, a missionary, in 1953 (Barker, 1953). Working mainly with Waika Indians near the mission station of El Platanal or Mahekodotedi on the uppermost Orinoco, he described three kinds of snuff. The strongest, he stated, was made in the Río Ocamo; of two weaker kinds, used along the Orinoco itself, one was prepared from a tree bark, the other from a small plant growing in agricultural clearings. Although no botanical vouchers accompanied his description, we believe that we may now, on the basis of later work, presume that the first referred to snuff from *Anadenanthera peregrina* beans, the second to a species of *Virola*, and the third to *Justicia pectoralis* var. *stenophylla*.

From 1941 through 1954, I was engaged in ethnobotanical field work in the northwest Amazon, especially in the Colombian sector, an area where I found an unusual snuff in use by medicine men. It was not tobacco but was made from the bark of a tree. In my botanical collecting, I failed to encounter *Anadenanthera peregrina*, a tree native to open plains areas or grasslands and unknown in the dense forests characteristic of the area. Yet the map in the *Handbook of South American Indians* indicated the whole region as one where *Anadenanthera*-snuff was supposed to be used. Several years of research finally led to the identification of the source of the snuff, variously known there as *yakee*, *yato* or *paricá*, as several species of *Virola*: *V. calophylla* Warb. and *V. calophylloidea* Markgr. This identification, together with an

account of the preparation of the powder by Puinave Indians then residing in the Río Apaporis (Figs. 1 - 4), was published in 1954 (Schultes, 1954a, b). Later, I learned of the use or knowledge of *Virola* snuff in a number of other tribes in the Colombian Vaupés, all of them apparently employing the same species. In this same period, in 1952, Professor Hernando García-Barriga reported on a plant collection (*García-Barriga 14006*) *V. peruviana* (A. DC.) Warb. that Puinave Indians call by the same common name *ya-kee*, suggesting its possible utilization in preparing snuff (Schultes and Holmstedt, 1971). Since a spot test for alkaloids in the field indicated that it was "very positive",



Fig. 1. *Virola calophylla* Warburg: 1, habit with inflorescence; 2, flowers. Drawn by E. W. Smith.



Fig. 2. Puinave Indian tearing strips of bark from felled trees of *Virola calophylla*. (Río Apaporis, Amazonian Colombia.)



Fig. 3. Puinave Indian preparing syrup from boiled raspings of inner bark of *Virola calophylla*. This syrup will be sun-dried and pulverized to prepare snuff. (Río Apaporis, Comisarfa del Vaupés, Colombia.)



Fig. 4. *Virola calophylloidea* Markgraf: 1, habit with inflorescences; 2, flowers. Drawn by E. W. Smith.

it was possibly used. Later investigations in adjacent areas have shown that this species is definitely employed (Lai *et al.*, 1973).

In the Colombian Amazon, only medicine men take the snuff powder, but reports coming from northwestern Brazil and adjacent headwater regions of the Orinoco in Venezuela indicated that, amongst the Waika Indians, *Virola*-snuff was often used by all adult males with or without the intercession of medicine men, even though the drug still remained the most important single element in the shamans' "materia medica".

In 1954, Dr. Otto Zerries began to publish a series of articles on the Waika Indians of Mahekodotedi and their relatives and neighbors (Zerries,

1954, 1955, 1960, 1964), whom he called the Shidishana of the Cantinama region of southern Venezuela. His botanical remarks are unfortunately rather confused and indecisive, insofar as the narcotic snuffs are concerned. Referring to *yopo*-snuff as "a characteristic feature of Waika culture", he stated that *ebena* appeared "to be made of seeds of *Mimosa acacioides* or of a *Piptadenia* species". In discussing ingredients of *ebena*, he mentioned *masho-hara* or *yauardi-hena*, which he described as a piperaceous plant cultivated in garden plots, and a powder made from an unknown plant known as *bolek-hena*. We now know that *masho-hara* is *Justicia pectoralis* var. *stenophylla*; *bolek-hena* is probably the fine ash of the bark of *Elizabethia princeps* Schomb. But he went on to say: "The strongest ingredient is *yacoana*, the inner bark of a wild tree... I presume that it is a species of *Mimosa* (*Mimosa acacioides*) which contains an alkaloid". There can be little doubt that this *yacoana* (the same as *nyakwana*, the name which other groups of Waika apply to *Virola*-snuff) represents a species of *Virola*. It is quite apparent that Zerries' identifications were not based on botanical material, and it is obvious that they were based neither on voucher specimens nor were the result of a botanist's collaboration.

In 1958, the botanist Dr. John Wurdack stated that the source of "ebena" of the Waika was still unknown (Wurdack, 1958). He mentioned *Virola* only generically, reporting that, while most Indians of the upper Orinoco used snuff prepared from *Anadenanthera peregrina*, the Kuripako and Baniwa employ a snuff made from *Virola-exudate*. There is no evidence that Wurdack had collected voucher specimens of the *Virola* species used.

Dr. Hans Becher, the German anthropologist, collected a snuff called *epena* from the Surará Indians (one of the many groups collectively called Waika) in northwestern Brazil in 1956 (Becher, 1960). No botanical identification of the source tree was made, and chemical analyses of the powder lead to doubt as to the true source of his samples.

In 1965, Mr. Georg Seitz, a German journalist resident in Rio de Janeiro, encountered the use of *Virola*-snuff by a civilized Tukanoan medicine man in Tapurucuara on the Rio Negro of the Brazilian Amazonas, where the powder is known as *paricá* (Seitz, 1967). It has since been established that the term *paricá* refers generically to inebriating snuffs, whether prepared from the seed of *Anadenanthera peregrina* or the bark resin of *Virola*. Seitz also collected samples of snuff from Waika and Araraibo Indians on the Rio Marauia, identifying the species employed as *Virola calophylloidea*, but the clear photograph of leaves of the tree would seem to represent *V. theiodora* (Spr. ex Benth.) Warb. I have examined four collections made by Seitz in Tapurucuara on the Rio Negro, where the snuff was used by a Tukano medicine man, and have found that they do represent *V. theiodora*. He made a documentary film on the preparation of the snuff and, in 1967, described the elaboration of the drug (Seitz, 1967) (Figs. 5 - 11).

The Rev. Franz J. Knobloch, a missionary amongst the Waika Indians of the Rio Marauia of Brazil, first mentioned *epena* snuff in 1967 (Knobloch, 1967), when he stated that it was prepared from three plants: *masi-hiri*

henake; *ama-asitaki*, the bark of a tree; and *epena-koke*, the bark of the root. He did not offer botanical identifications; but, in 1970, he reported, without botanical specimens and undoubtedly from literature sources, that the three ingredients of the snuff were *Justicia pectoralis* var. *stenophylla*, *Elizabetha princeps* and *Virola theiodora* (Knobloch, 1970).

An Italian biologist, Professor Ettore Biocca, who spent a long period of time in the upper Rio Negro basin, reported the use of *epena* snuff in



Fig. 5. *Virola theiodora* (Spr. ex Benth.) Warburg: 1, habit with inflorescences; 2, staminate inflorescence; 3, dissection of pistillate flower. Drawn by E. W. Smith.



Fig. 6. Leaves and inflorescences of *Virola theiodora*. (Manáos, Brazil.)



Fig. 7. Waika Indian gently heating strips of bark of *Virola theiodora* in order to liquify the resin. (Rio Tototobí, Territorio de Roraima, Brazil.)



Fig. 8. Gathering the liquified resin of *Virola theiodora* into an earthenware pot for boiling down to a thick syrup in preparing the nyakwana snuff. (Rio Tototobí, Territorio de Roraima, Brazil.)



Fig. 9. Waika Indian collecting resin left on the tree (*Virola theiodora*) after the stripping of bark. This resin is applied to darts and arrows for use as a kind of curare (Rio Tototobí, Territorio de Roraima, Brazil.)



Fig. 10. Waika Indians in the annual memorial ceremony for the dead of the past year about to fill tubes with nyakwana snuff prepared from *Virola theiodora*. (Rio Tototobí, Territorio de Roraima, Brazil.)

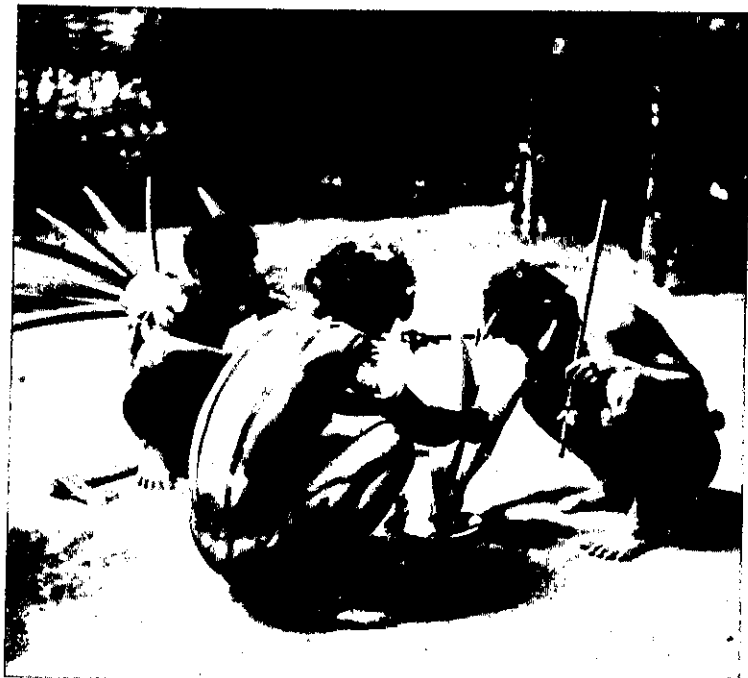


Fig. 11. Waika Indians filling snuffing tubes with the powder prepared basically from *Virola theiodora*. (Rio Tototobí, Territorio de Roraima, Brazil.)

1965 (Biocca 1965, 1968), attributing the source plant to *Virola*. He published coloured photographs of several species, which he stated were employed in preparing the hallucinogenic powder, claiming that his botanical material had been identified by Dr. William Rodrigues of the Instituto Nacional de Pesquisas da Amazônia in Manaus. Rodrigues, however, informs me (personal communication) that he has no recollection of making the determinations; and Biocca's specimens are not included in the herbarium of that institution. Biocca cited no collections in his work, and he has stated (Holmstedt, personal communication) that they were lost. It is not always possible to determine the species of *Virola* from Biocca's illustrations. This botanical incompleteness and inadequacy is unfortunate, since Biocca's field research was obviously far reaching. Reliable botanical authentication would be of the utmost significance, inasmuch as Biocca, a biologist, reported as sources of the snuff several species which have never been found so used by other investigators, some of which chemical study indicates are devoid of the inebriating principles. Biocca has states that *V. cuspidata* (Benth.) Warburg and *V. rufula* (Mart. ex A. DC.) Warburg (as well as a species apparently with a name not validly published!) are the species employed (Biocca, 1966).

The Alpha-Helix Amazon Expedition of 1967 made it possible to further ethnobotanical and phytochemical studies of *Virola* in northwestern Brazil. I visited a group of Waika in the very headwaters of the Rio Cauaburi, near the base of Serra da Neblina on the Brazilian-Venezuelan boundary. Here the preparation and use of *epena* was observed and photographed, and voucher botanical material of all vegetal ingredients was collected. The basic plant component of the snuff proved to be the resin of *Virola theiodora*, but dried and pulverized leaves of a small, very aromatic herb, the acanthaceous *Justicia pectoralis* var. *stenophylla*, and the ashes of the bark of a beautiful leguminous tree, *Elizabetha princeps*, Schomb. ex Benth., are added to the dried and powdered *Virola*-resin (Schultes and Holmstedt, 1971).

Later, on the same Expedition, together with Professor Bo Holmstedt, a toxicologist from the Karolinska Institutet in Stockholm, I was able to visit the remote group of Waika resident on the Rio Tototobí, an affluent of the Rio Demini which flows into the Rio Negro (Schultes and Holmstedt, 1971). We were fortunate that our visit coincided with the annual memorial festival for the dead, at which time the snuff, known among these Indians as *nyakwana*, is used in excessive amounts. We were able to witness the preparation of the snuff. The natives fell *Virola theiodora* in the forest, strip off the bark and gently heat it over a fire to render the resin slightly more liquid and then collect the resin in an earthenware pot. It is boiled, until it is reduced to a thick syrup which is set out to sun-dry, whereupon the resulting solid is pulverized by grinding with a smooth stone. The powder is then sifted carefully through a fine cloth. Occasionally, the dried, powdered leaves of the same *Justicia* are added. The natives assert that the aromatic powder is added to make the snuff smell better. It definitely is not a necessary ingredient and was not part of the hallucinogenic snuff that we observed in use in the ceremony and which we personally took with hallucinatory effects. Neither are ashes ordinarily added to the snuff by these people.

The picture of the hallucinogenic use of *Virola* became even more fascinating with two independent discoveries that the bark resin was taken orally for purposes of inebriation. In 1969, Mr. Peter L. Silverwood-Cope, an English anthropologist, reported, on a voucher specimen identified as *Virola elongata* (Spr. ex Benth.) Warb., that the very primitive nomadic Makú Indians of the Río Piraparaná in the Colombian Vaupés scraped the resin directly from the stripped bark with the finger and ingested it with no preparation whatsoever.

Later, in 1969, I reported learning from Witoto Indians now resident in Leticia, a Colombian town on the Río Amazonas, that their elders, who dwelt in the Karaparaná-Igaraparaná region of the Colombian Amazonas, formerly prepared *Virola* resin in little balls or pellets to ingest when, for purposes of witchcraft, the medicine men wanted to "talk with the little people". The species employed was *Virola theiodora* (Schultes, 1969) (Figs. 12 - 19).

The bark is stripped from the trees, and the cambial layer (from the phloem as well as the xylem) is scraped off in delicate shavings. This work is done in the forest immediately upon felling the tree. Within three or four minutes, a colourless liquid starts to turn brownish and soon takes on a blood-red hue. Returning to his house, the Indian soaks the cambial shavings in water, squeezing and kneading them to extract as much of the resin-like material as possible into the water which is then set to boil slowly, with constant stirring, until a very sticky syrup remains. This syrup is then carefully heated, until only a thick brown paste is left. Meanwhile, bark of the lecythidaceous *Gustavia Peoppigiana* Berg is reduced to ashes and placed in a funnel made of leaves; boiling water is slowly filtered through the ashes, and the filtrate is evaporated to a fine, grey-white powder called a "salt". The sticky pellets are rolled in this powder to cover them and dried, if they are to be kept for later use; the paste may be utilized without this coating, if it is to be taken immediately.

In 1970, Costa published a review of what up to that date had been accomplished from a pharmaco-ethnological viewpoint with *Virola* snuff (Costa, 1970).

In 1971, together with Professor Tony Swain, a phytochemist then on the staff of the Royal Botanic Garden, Kew, I was able to visit the Witotos residing in the village of San Rafael on the Río Karaparaná (Schultes and Swain, 1976). We were fortunate in witnessing this identical method of preparation of the paste from *Virola theiodora* by a medicine man who still practiced the art of divining and hexing through the ingestion of pellets of this paste, known in the Witoto language as *oo-koo'-na*.

Two groups of Witotos — the one at San Rafael, the other at El Encanto, also on the Río Karaparaná — independently indicated the same species of *Virola* (*V. theiodora*) as the "best kind" of *oo-koo'-na*, a species most abundant along river banks subject to floods at the time of highest water. This information corroborates an annotation that I made on an herbarium specimen collected in 1942 (Schultes 3878) in the forests between the Karaparaná and Igaraparaná, without the possibility then of following up the observation: "Red resin bark intoxicating".



Fig. 12. Witoto Indians stripping bark from a felled tree of *Virola theiodora*. (Río Karaparaná, Amazonian Colombia.)



Fig. 13. Witoto Indian by the side of tree of *Virola theiodora* from which strips of bark have been torn for preparation of *Virola* snuff. (Río Karaparaná, Amazonian Colombia.)



Fig. 14. Witoto Indians rasping cambial tissue from *Virola theiodora*. (Río Karaparaná, Amazonian Colombia.)



Fig. 15. Witoto Indians gathering the raspings of cambial tissue from the inner bark of *Virola theiodora*. (Río Karaparaná, Amazonian Colombia.)



Fig. 16. Squeezing out the resin-like exudate from cambial tissue preparatory to boiling the aqueous solution down to a thick syrup. The source of the material is *Virola theiodora*. (Río Karaparaná, Amazonian Colombia.)



Fig. 17. Witoto medicine man carefully stirring boiling liquid into which the resin-like exudate of the bark of *Virola theiodora* has been expressed: a step in the preparation of paste for the pellets which are ingested for hallucinogenic purposes. (Río Karaparaná, Amazonian Colombia.)

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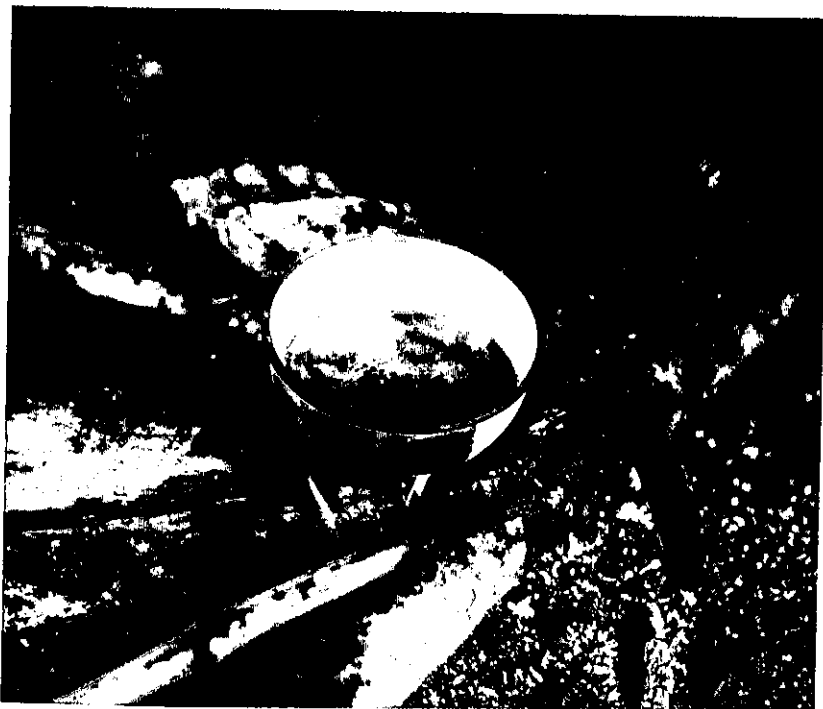


Fig. 18. Boiling an aqueous solution of the expressed "resin" from cambial tissue of *Virola theiodora* in the preparation of pellets of the paste for ingestion. (Río Karaparaná, Amazonian Colombia.)



Fig. 19. Stirring the nearly ready paste from *Virola theiodora* for the preparation of pellets for oral ingestion. (Witoto Indians, Río Karaparaná, Amazonian Colombia.)

The only difference that we encountered in the method of preparation used by these Witotos and those in Leticia was the use of "salt" prepared from several other plants as well as from *Gustavia Peoppigiana*. The medicine men on the Karaparaná contended that the "salt" from the sundry plants imparted different "powers" to the *Virola* paste — a rather unlikely possibility, since the remains of the filtrate are almost wholly, if not wholly, inorganic. The several plants used for preparing the various kinds of "salt" are generically referred to in Witoto as *hě'-rog* (Schultes and Swain, 1976), although each one has a name of its own as a distinct plant. They include the bark of the huge lecythidaceous tree *Eschweilera itayensis* Kunth, said to yield the best "salt"; leaves and inflorescences of the aroid *Spathiphyllum cannaefolium* (Dryand.) Schott; the woody stump of a cyclanthaceous species of *Carludovica* or *Sphaeradenia*; the trunk and leaves of two palms, a species of *Geonoma* and of *Bactris*; and the leaves and twigs of what is probably *Theobroma subincanum* Martius. Whether or not these "salts" from the sundry plants differ enough to have varied effects should they indeed enter into the biological activity of the total preparation, we do not yet know. We have learned, however, that many ethnopharmacological assertions made by Amazon Indians do warrant serious scientific consideration.

In 1977, the Alpha-Helix Amazon Expedition 1976 - 1977, Phase VII, devoted special ethnotoxicological attention to the myristicaceous hallucinogens amongst the Bora Indians of the Río Ampiyacu and its affluents in Peru (Schultes *et al.*, 1977). Although the oral use of *Virola* pellets in a magico-religious context is no longer practiced by these Indians, older members of the tribe remember how the drug is prepared. The method of extraction of the resin-like exudate differs somewhat from that of the neighbouring Witoto Indians. Together with Swain and Dr. Timothy Plowman, I ascertained that the "best" tree for this purpose is considered to be *Virola elongata*, known locally as *cumala blanca* or, in Bora, as *ko-de'-ko* — apparently a generic term for *Virola*. Several other species were indicated: *V. surinamensis* (Rol.) Warb. (*cumala colorado*) and *V. loretensis* A. C. Smith (Schultes *et al.*, 1977).

At the Bora town of Tierra Firme on the Río Ampiyacu, *Virola Pavonis* (DC.) A. C. Smith was likewise indicated as a source of the hallucinogenic pellets; another *Virola* which we collected at this locality and which the natives indicated to be narcotically the "strongest" we cannot identify and may represent an undescribed species. At Tierra Firme, the Indians recognized *V. calophylloidea* and *Osteophloeum platyspermum* (DC.) Warb. as *cumalas* but which could not be employed in the elaboration of the paste (Schultes *et al.*, 1977).

The Boras employed different plants in preparing the "salt" for coating the pellets. They leach out the ashes of the leaves and stump of an epiphytic species of the cyclanthaceous *Carludovica*, known as *pee-ye-ee'-pa-a* or of the leaves of a species of the palm genus *Scheelia* (Schultes *et al.*, 1977).

We were able to make a comparative study in the relatively new Witoto settlement of Puca Urquillo, near the town of Pebas at the mouth of the Río Ampiyacu. These Indians are more acculturated than the Boras, and their knowledge of the hallucinogen is less precise. A medicine man pointed out

Virola elongata and *V. surinamensis*, but we believe that he was confused and that these Indians perhaps formerly used only *V. elongata*. It is very significant that this Witoto group apparently uses also *Iryanthera macrophylla* (Benth.) Warb., the first intimation involving this related genus in the preparation of an hallucinogen (Schultes *et al.*, 1977).

These discoveries were biochemically and pharmacologically significant, inasmuch as the main hallucinogenic principles of *Virola* — tryptamines — are believed not to be active when administered orally, unless potentiated by the presence of monoamineoxidase inhibitors. Recent chemical analyses, however, have indicated that, together with the simple indoles or tryptamines, some species of *Virola* contain β -carboline alkaloids (Agurell *et al.*, 1969) which are monoamineoxidase inhibitors.

5. Expansion of ethnobotanical studies

The 1970s have seen an extension of our knowledge of the use of *Virola* as a snuff. Recent field work has supported earlier ethnobotanical studies and the identifications of plants used. Furthermore, intensification of chemical investigations have helped, in many instances, to clarify problems and have led to a fuller understanding of utilitarian aspects of this and related South American snuff preparations.

Fortunately, much of the most recent field work in ethnobotany has been based, as it should be, on actual voucher specimens. The extensive Amazon studies of the botanist Dr. Ghillian Prance and his co-workers have given special attention to ethnobotany, including in-depth investigation of narcotics (Prance 1970, 1972; Prance *et al.*, 1977; Prance and Prance, 1970). Prance has found that a large number of Waika Indian groups over a wide area north of the Rio Negro in Brazil employ by preference *Virola theiodora* in making their *ebena* or *nyakwana*. In 1972, he reported (on the basis of botanical material) that in six Waika villages from Sururucús to the Rio Uraricoeira in Territorio do Roraima, the snuff was prepared from *V. theiodora* together with *Justicia pectoralis* (Prance, 1972). One of the Waika groups on the Rio Mucujai calls the snuff *tchakiana*, a variant from the usual term in the area. Later field work indicated that the Paumarí Indians of the Rio Purús, south of the Amazon, employ *V. elongata* alone, with no admixture, to prepare a snuff called *kawabo* (Prance *et al.*, 1977).

Reporting on ethnobotanical studies amongst the Yanomamo (Waika) Caburiwe-Teri tribe of the Rio Cauaburí in Brazil, Brewer-Carias and Steyermark (1976) indicate that the hallucinogenic snuff of these natives is elaborated basically from *Virola elongata*. They usually mix the pulverised *Virola* resin with the dried and powdered leaves of *Justicia pectoralis* var. *stenophylla* and the bark ashes of *Elizabetha princeps*. These investigators assert that the *Justicia* is, on occasion, used alone to prepare an hallucinogenic snuff (Figs. 20 - 25).

Chagnon and his co-workers have studied the Waika (Yanomamo) Indians of the uppermost reaches of the Orinoco in Venezuela and in adjacent Brazil in extraordinary depth. Special attention, naturally, was devoted to

hallucinogenic snuffs, so important an element of Waika culture. In 1970 and 1971, they published papers of prime significance (Chagnon *et al.*, 1970, 1971) in which they reported that the hallucinogenic snuff most frequently employed was prepared basically from *Virola*. No specific determination was offered. They indicated that several "kinds" (species?) of *Justicia* (for which voucher specimens were apparently collected) are likewise used — not always as an aromatic additive to *Virola* but sometimes as the sole ingredient of a snuff powder. These *Justicia* snuffs are "complicated from the ethnobotanical and linguistic point of view", since they are said to be referred to by a number of native names (as many as six for one "kind") and are distinguished as "different" by the Indian informants. Use of the ashes of the bark of *Elizabetha princeps* was also reported. The significant implications of Chagnon's reports, especially statements concerning the use of *Justicia* alone as a snuff, should stimulate further and more intensive chemical and ethnopharmacological studies of the whole problem of narcotic snuffs.

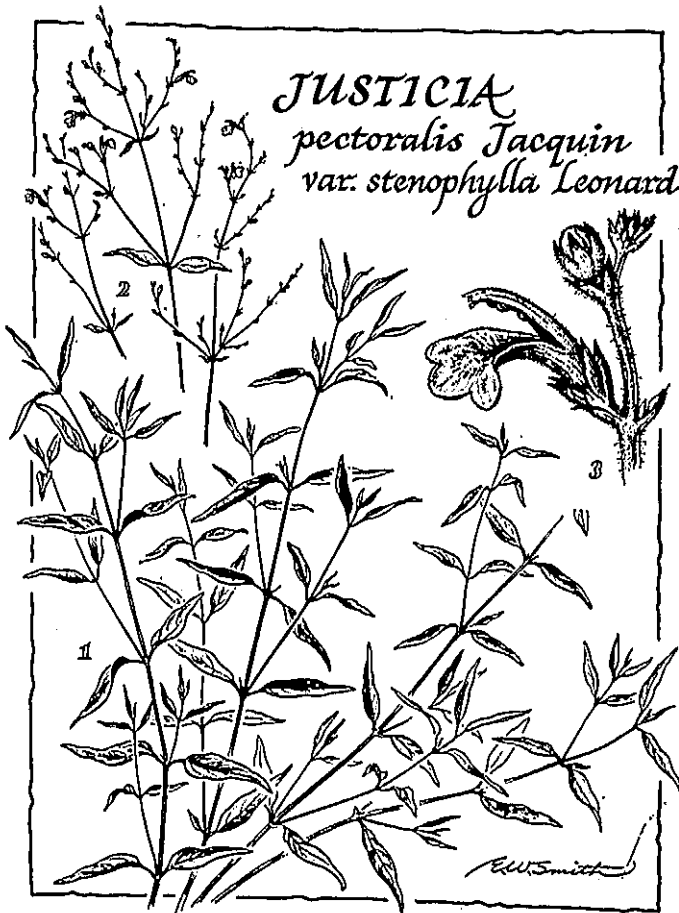


Fig. 20. *Justicia pectoralis* Jacquin var. *stenophylla* Leonard: 1, habit; 2, inflorescences; 3, flowers.

Drawn by E. W. Smith.



Fig. 21. Waika Indian with a collection of leaves of *Justicia pectoralis* var. *stenophylla* preparatory to drying and pulverizing the leaves as an additive to the snuff powder made from *Virola theiodora*. (Rio Tototobí, Territorio de Roraima, Brazil.)



Fig. 22. Waika Indians selecting leaves of *Justicia pectoralis* var. *stenophylla* and removing the midrib, preparatory to toasting and pulverizing. (Rio Tototobí, Territorio de Roraima, Brazil.)



Fig. 23. Waika Indian pulverizing dried leaves of *Justicia pectoralis* var. *stenophylla* preparatory to adding the powder to the *Virola* snuff. (Rio Maturacá, Amazonas, Brazil.)



Fig. 24. Waika Indian sifting the nyakwana snuff, a mixture of the powdered resin-like exudate of the cambial tissue of *Virola theiodora* and the dried leaves of *Justicia pectoralis* var. *stenophylla*. (Rio Maturacá, Amazonian Brazil.)

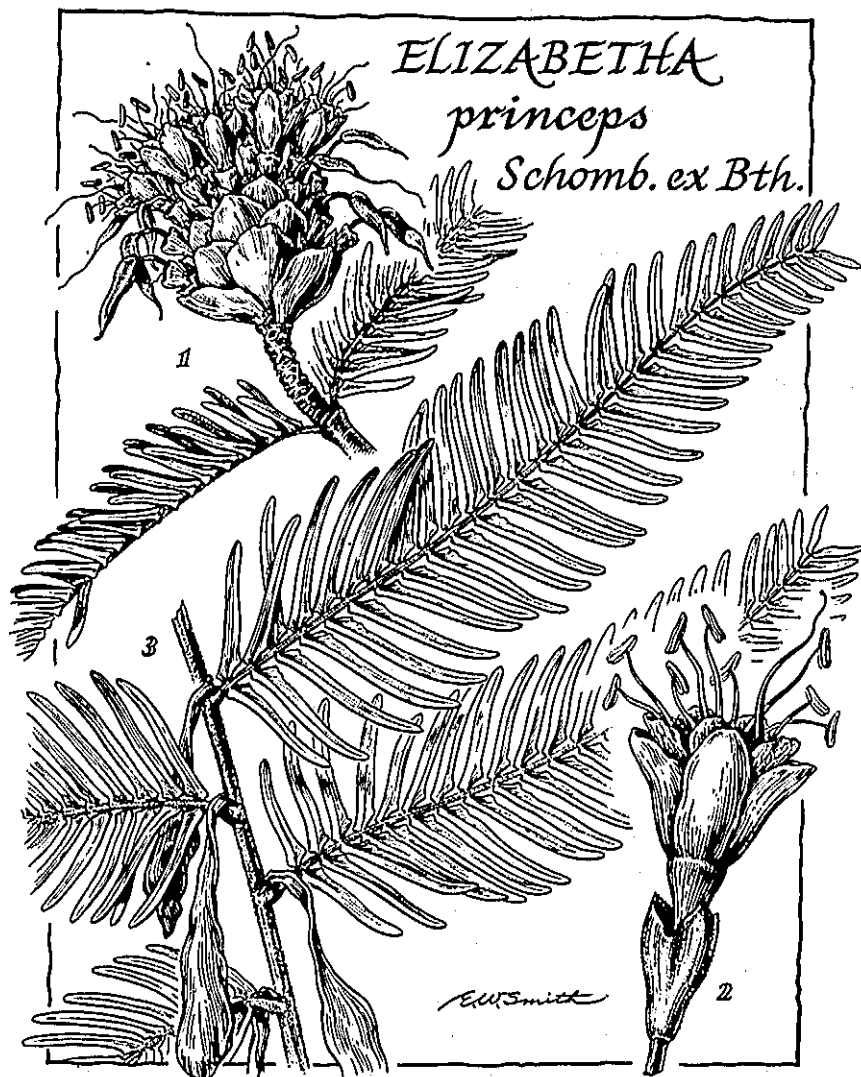


Fig. 25. *Elizabetha princeps* Schomb. ex Benth.: 1, inflorescence; 2, detail of flower; 3, portion of leaf.
Drawn by E. W. Smith.

6. Botanical description of principal species

It appears that by far the most important species of *Virola*, insofar as elaboration of hallucinogenic snuffs and other preparations is concerned, is *V. theiodora*. Therefore, it would seem to be pertinent here to append the botanical description of this tree, which is distributed mainly in the western Amazonia of Brazil and Colombia and in adjacent parts of Peru and possibly also in Venezuela, being especially abundant in the Rio Negro drainage area. It is a tree normally of well drained, albeit frequently floodable, forests.

Virola theiodora (Spr. ex Benth.) Warburg, *Nova Acta Acad. Leop. - Carol.*, 68 (1897) 187

The specific epithet means "smelling like tea", in reference to the characteristic odour of the dried leaves of this species, indicative perhaps of the presence of certain essential oils not present in other species of the genus.

Slender tree, 25 - 75 feet in height; trunk cylindrical, up to 1½ feet in diameter; bark smooth, brown, mottled with grey patches. Branchlets slightly red-brown tomentellous, becoming glabrous. Leaves (with pronounced fragrance of tea when dried) firmly papyraceous, sometimes even thick-chartaceous, often sparsely glandular-punctate, oblong to broadly ovate, basally obtuse to cordate, apically long-acuminate, marginally entire but usually sinuate, 9 - 35 cm long, 4 - 12 cm wide, upper surface glabrous, dark green, nitid, nether surface sparsely stellate-puberulent, secondary veins 9 - 20, usually prominent, ascending and arcuate, petiole subterete, mostly 4 - 15 cm long, often brown-tomentellous, usually becoming glabrous, bracts 2.5 cm long, deciduous. Staminate inflorescences many-flowered, paniculate, usually shorter than leaves, up to about 15 cm long (usually shorter), often brown- or golden-brown-tomentellous, usually becoming glabrous, bracts 2.5 cm long, deciduous. Pistillate inflorescences shorter. Staminate flowers strongly pungent, single or in clusters of 2 - 10, pedicel about 2 mm long, perianth thin, puberulent within and without, infundibuliform, 1.5 - 2.5 mm long, subacutely lobed about one fourth its length; androecium 2 mm long, filament column thick, 0.5 - 0.8 mm long; anthers 3 - 5 (usually 3), 1 - 1.7 mm long, usually connate, apiculate. Fruit about 5 - 8 per inflorescence (but often fewer), subglobose, 10 - 20 mm long, 8 - 15 mm in diameter, usually slightly apiculate, glabrescent when mature, pedicels 3 - 4.5 mm long; aril membranaceous, lacinate about one half its length.

7. Disintegration of indigenous knowledge

In studies on the use of *Virola*, there has been an opportunity very recently to observe the rapidity with which knowledge of the uses of plants disintegrates with acculturation. During the Alpha-Helix Amazon Expedition 1976 - 1977, Phase VII, ethnotoxicological investigations were carried out amongst Boras and Witotos in the vicinity of Pebas, a village on the Peruvian course of the Amazon, below Iquitos, during April and May, 1977. These Indians, all of them transported from the Colombian region of the Karaparaná-Igaraparaná, are now highly acculturated. Some of the older inhabitants remember appreciable amounts of plant lore, but many of the younger and middle-aged Indians have little or no acquaintance with any except the very commonest economic plants.

The elaboration of pellets of *Virola* for oral ingestion is a case in point. These Indians have not used *Virola* in their witchcraft or medicine for two generations. The tradition of making the pellets is well conserved, and they do not hesitate to demonstrate the process. Their knowledge of which species

of *Virola* to use, however, we found to be unclear and confused, although they knew that the drug was employed by "our fathers and grandfathers". They willingly went through the whole process of making the "paste" for the pellets, even from species which, in some instances, chemical examination in the laboratory aboard the experimental ship showed to be wholly lacking in the effective tryptamines.

Of the species indicated as sources of the narcotic paste by these Boras and Witotos, *Virola calophylla*, *V. elongata*, *V. peruviana*, *V. venosa* (Benth.) Warb. (or a closely related species) could, on the basis of their chemical constitution, be so used. Material from the same trees from which the natives took bark, and frequently also the paste which they prepared from the bark, were analyzed on the laboratory ship Alpha-Helix shortly after collection. *V. calophylla* contained *N,N*-dimethyltryptamine and *N*-monomethyltryptamine; *V. elongata* yielded tryptamine, *N*-monomethyltryptamine, *N,N*-dimethyltryptamine, 5-methoxy-*N,N*-dimethyltryptamine and 5-methoxy-*N*-monomethyltryptamine; and *V. peruviana* showed *N,N*-dimethyltryptamine and 5-methoxy-*N,N*-dimethyltryptamine. What has been identified tentatively as *V. venosa* vel aff. — but which may represent a new species allied to *V. venosa* — was collected only in a sterile condition: tests indicated that it contains *N,N*-dimethyltryptamine, *N*-monomethyltryptamine, 5-methoxy-*N,N*-dimethyltryptamine and 5-methoxy-*N*-monomethyltryptamine (Holmstedt, Lindgren, Rivier and Schultes, unpublished data).

The possibility of the use of *Virola peruviana* — previously reported as a source of the hallucinogenic snuff *ya-kee* in the Colombian Vaupés (Lai, Tin-Wa, Mika, Persinos and Farnsworth, 1973) — has, as indicated above, been substantiated on the basis of chemical examination of material referable to this species.

These studies indicate how rapidly and effectively aboriginal traits can disappear from a culture. It is a lesson in our race to learn as much as possible of the ethnopharmacology of the northwest Amazon before complete acculturation and/or extinction of tribal groups occurs.

One of the unexpected results of our field studies on this Alpha-Helix Expedition was the report that the related genus *Iryanthera* may have a part in the elaboration of hallucinogenic pellets. These Indians pointed out *I. Ulei* Warb. as a source of an hallucinogenically active paste, and chemical analysis did indeed indicate that it contains the active 5-methoxy-*N,N*-dimethyltryptamine. This is the first report of psychoactivity in the genus *Iryanthera*. The Boras and Witotos did indicate that another species, *I. Tessmannii* Mgf., was not used to make the paste, and chemical studies show that it is negative for the active tryptamines.

8. Summary

In summary, then, we may report that the identification of the major ingredients of the myristicaceous hallucinogens of South America has pro-



Fig. 26. Apprenticed Makuna medicine man about to inhale *Virola* snuff through bird-bone snuffing tube. (Río Popeyacá, Comisaría del Amazonas, Colombia.)

ceeded gradually from 1938 to 1977 — a span of nearly 40 years — and that, at the present time, the following plants are now believed to enter into their elaboration.

Major constituents

Myristicaceae

Iryanthera macrophylla (Benth.) Warburg, *Nova Acta Acad. Leop.-Carol.* 68 (1897) 155

Virola calophylla Warburg, *Nova Acta Acad. Leop.-Carol.*, 68 (1897) 231

Virola calophylla Markgraf, *Repert. Sp. Nov.*, 19 (1923) 24

Virola cuspidata (Benth.) Warburg, *Nova Acta Acad. Leop.-Carol.*, 68 (1897) 176

Virola elongata (Benth.) Warburg, *Ber. Deutsch Bot. Gesel.*, 13 (1895) 89

Virola lorentensis A. C. Smith, *Bull. Torr. Bot. Club.*, 58 (1931) 95

Virola Pavonis (A. DC.) A. C. Smith, *Brittonia*, 2 (1937) 504

- Viola peruviana* (A. DC.) Warburg, *Nova Acta Acad. Leop.-Carol.*, 68 (1897) 188
- Viola surinamensis* (Rol.) Warburg, *Nova Acta Acad. Leop.-Carol.*, 68 (1897) 208
- Viola theiodora* (Spr. ex Benth.) Warburg, *Nova Acta Acad. Leop.-Carol.*, 68 (1897) 187
- Viola venosa* (Benth.) Warburg, *Nova Acta Acad. Leop.-Carol.*, 68 (1897) 224
- [Questionably employed.] *Viola rufula* (Mart. ex A. DC.) Warburg, *Nova Acta Acad. Leop.-Carol.*, 68 (1897) 224

Additives

Acanthaceae

- Justicia pectoralis* Jacquin var. *stenophylla* Leonard, *Contrib. U.S. Nat. Herb.*, 31 (1958) 615

Sources of alkaline ash admixtures

Araceae

- Spathiphyllum cannaefolium* (Dryand.) Schott, *Gen. Aroid.*, 1 (1858) 1, t. 1

Cyclanthaceae

- Carludovica* spp.
Sphaeradenia sp.

Palmae

- Bactris* sp.
Geonoma sp.
Scheelia sp.

Lecythidaceae

- Eschweilera itayensis* Kunth in Engler, *Pflanzenr. Lecyth.*, (1939) 111
- Gustavia Peoppigiana* Berg in Martius, *Fl. Bras.*, 14 (1) (0000) 471

Leguminosae

- Elizabetha princeps* Schomb. ex Benth., *Hooker Journ. Bot.*, 2 (1840) 92

Sterculiaceae

- Theobroma subincanum* Martius in Buchner, *Repert. Pharm.*, 35 (1830) 23

References

- Agurell, S., Holmstedt, B., Lindgren, J.-E. and Schultes, R. E., Alkaloids in certain species of *Viola* and other South American plants of ethnopharmacologic interest, *Acta Chem. Scand.*, 23 (1969) 903 - 916.

- Barker, J., Memoria sobre la cultura de los guaiques, *Bol. Indig. Venez.*, 1 (1953) 433 - 489.
- Becher, H., *Die Surará und Pakidai. Zwei Yanomami-Stämme in Nord-West Brasilien*, Hamburg Museum für Volkerkunde und Vorgeschichte, Hamburg, 1960.
- Biocca, E., *Yanoama*, Leonardo da Vinci Ed., Bari, 1965; *Yanoama* (transl. G. Cabrini), Plon, Paris, 1968.
- Biocca, E., *Viaggi tra gli Indi Alto Rio Negro-Alto Orinoco*, Vol. 2, Consiglio Nazionale delle Ricerche, Rome, 1966, pp. 235 - 252.
- Brewer-Carias, C. and Steyermark, J., Hallucinogenic snuff drugs of the Yanomamo Caburiwe-Teri in the Cauaburi River, Brazil, *Econ. Bot.*, 30 (1976) 57 - 66.
- Chagnon, N. A., LeQuesne, P. and Cook, J. M., Algunas aspectos de uso drogas, comercio y domesticación de plantas entre los indios yanomamo de Venezuela y Brazil, *Acta Cienc. Venez.*, 21 (1970) 186 - 193.
- Chagnon, N. A., LeQuesne, P. and Cook, J. M., "Yanomamo" hallucinogens: anthropological, botanical and chemifindings, *Curr. Anthropol.*, 12 (1971) 72 - 74.
- Costa, O. de A., Farmaceo-etnología do paricá e do yakee, *Rev. Bras. Farm.*, 51 (1970) 273 - 299.
- Ducke, A., Plantas nouvelles..., *Arch. Inst. Biol. Veg.*, 4 (1) (1938) 3.
- Ducke, A., *As Leguminosas da Amazônia Brasileira*, Serviço de Publicidade Agrícola, Rio de Janeiro, 1939, p. 41.
- Knobloch, F. J., Die Aharaibu-Indianer in Nordwest Brasilien, *Anthropos*, 1 (1967) 118.
- Knobloch, F. J., The Araraibú Indians; a "White" tribe in the Amazon, *Mankind Q.*, 10 (1970) 185 - 198.
- Koch-Grünberg, T., *Vom Roraima zum Orinoco...*, Vol. 3, Verlag Strecher und Schröder, Stuttgart, 1923, p. 386.
- Lai, A., Tin-Wa, M., Mika, E. S., Persinos, G. T. and Farnsworth, N. R., Phytochemical investigation of *Virola peruviana*, a new hallucinogenic plant, *J. Pharm. Sci.*, 62 (1973) 1561 - 1563.
- Prance, G. T., Notes on the use of plant hallucinogens in Amazonian Brazil, *Econ. Bot.*, 24 (1970) 62 - 68.
- Prance, G. T., An ethnobotanical comparison of four tribes of Amazonian Indians, *Acta Amazônica*, 2 (2) (1972) 7027.
- Prance, G. T. and Prance, A. E., Hallucinogens in Amazonia, *Gard. J.*, 20 (1970) 102 - 107.
- Prance, G. T., Campbell, D. G. and Nelson, B. W., The ethnobotany of the Paumarí Indians, *Econ. Bot.*, 31 (1977) 129 - 139.
- Schultes, R. E., A new narcotic snuff from the northwest Amazon, *Bot. Mus. Leaflet*, *Harvard Univ.*, 16 (1954a) 241 - 260.
- Schultes, R. E., Un nouveau tabac à priser de l'Amazone du nord-ouest, *J. Agric. Trop. Bot. Appl.*, 1 (1954b) 298 - 311.
- Schultes, R. E., De plantis toxicariis e Mundo Novo tropicale commentationes. IV. *Virola* as an orally administered hallucinogen, *Bot. Mus. Leaflet*, *Harvard Univ.*, 22 (1969) 229 - 240.
- Schultes, R. E. and Holmstedt, B., De plantis toxicariis e Mundo Novo tropicale commentationes. II. The vegetal ingredients of the myristicaceous snuffs of the northwest Amazon, *Rhodora*, 70 (1968) 113 - 160.
- Schultes, R. E. and Holmstedt, B., De plantis toxicariis e Mundo Novo tropicale commentationes. VIII. Miscellaneous notes on myristicaceous plants of South America, *Lloydia*, 34 (1971) 61 - 78.
- Schultes, R. E. and Swain, T., De plantis toxicariis e Mundo Novo tropicale commentationes. XIII. Further notes on *Virola* as an orally administered hallucinogen, *J. Psyched. Drugs*, 8 (1976) 317 - 324.
- Schultes, R. E., Swain, T. and Plowman, T. C., De plantis toxicariis e Mundo Novo tropicale commentationes. XVII. *Virola* as an oral hallucinogen among the Boras of Peru, *Bot. Mus. Leaflet*, *Harvard Univ.*, 25 (1977) 259 - 272.
- Seitz, G., Epena, the intoxicating snuff powder of the Waika Indians and the Tucano medicine man, Agostino, in D. Efron (ed.), *Ethnopharmacological Search for*

- Psychoactive Drugs*, Public Health Serv. Publ. No. 1645, US Govt. Printing Office, Washington, DC, 1967, pp. 315 - 338.
- Wurdack, J. J., Indian narcotics, *Gard. J.*, 8 (1958) 116 - 118.
- Zerries, O., Los indios waika y su situación cultural, *Bol. Indig. Venez.*, 2 (1954) 61 - 76.
- Zerries, O., Some aspects of Waika culture, *An. XXXI Congr. Int. Americanistes, São Paulo*, Vol. 1, 1955, pp. 73 - 88.
- Zerries, O., Medizinmannwesen und Geisterglaube der Waika-Indianer des Oberen Orinoko, *Etnol.*, N. F., 2 (1960) 485 - 507.
- Zerries, O., *Waika. Die kulturgeschichtliche Stellung der Waika-Indianer des Oberen Orinoko im Rahmen der Volkerkunde Sudamerikas*, Klaus Renner, Munich, 1964.

Pertinent literature not mentioned in the text

- Aguirell, S., Holmstedt, B., Lindgren, J.-E. and Schultes, R. E., Identification of two new β -carboline alkaloids in South American hallucinogenic plants, *Biochem. Pharmacol.*, 17 (1968) 2487 - 2488.
- Furst, P. T., *Hallucinogens and Culture*, Chandler and Sharp, San Francisco, 1976.
- Holmstedt, B. and Lindgren, J.-E., Chemical constituents and pharmacology of South American snuffs, in D. Efron (ed.), *Ethnopharmacologic Search for Psychoactive Drugs*, Public Health Serv. Publ. No. 1645, US Govt. Printing Office, Washington, DC, 1967, pp. 339 - 373.
- Marini-Bettolo, G. B., Delle Monache, F. and Biocca, E., Sulle sostanze allucinogene dell'Amazzonia. Nota II. Osservazioni sull'epena degli Yanoama del Bacino del Rio Negro e dell'Alto Orinoco, *Ann. Chim.*, 54 (1964) 1179 - 1186.
- Marini-Bettolo, G. B., Allucinogeni impiegati dagli Indi del Bacino Amazzonico e dell'Alto Orinoco, *Ann. Inst. Super. Sanita*, 1 (1965) 784 - 892.
- Schultes, R. E., Botanical sources of the New World hallucinogens, *Psyched. Rev.*, 1 (1963) 145 - 166.
- Schultes, R. E., Hallucinogenic plants of the New World, *Harvard Rev.*, (1963) 18 - 32.
- Schultes, R. E., Ein Halbes Jahrhundert Etnobotanik amerikanischer Halluzinogene, *Planta Med.*, 13 (1965) 126 - 157.
- Schultes, R. E., The botanical origin of South American snuffs, in D. Efron (ed.), *Ethnopharmacological Search for Psychoactive Drugs*, Public Health Serv. Publ. No. 1645, US Govt. Printing Office, Washington, DC, 1967, pp. 33 - 57.
- Schultes, R. E., Hallucinogens of plant origin, *Science*, 163 (1969) 245 - 254.
- Schultes, R. E., The New World Indians and their hallucinogenic plants, *Bull. Morris Arb.*, 21 (1970) 3 - 14.
- Schultes, R. E., The botanical and chemical distribution of hallucinogens, *Annu. Rev. Plant Physiol.*, 21 (1970) 571 - 594. Reprinted in B. du Toit (ed.), *Drugs, Rituals and Altered States of Consciousness*, Balkema, Rotterdam, 1977, pp. 25 - 55.
- Schultes, R. E., Avenues for future ethnobotanical research into New World hallucinogens and their uses, in B. du Toit (ed.), *Drugs, Rituals and Altered States of Consciousness*, Balkema, Rotterdam, 1977, pp. 261 - 267.
- Schultes, R. E. and Hofmann, A., *The Botany and Chemistry of Hallucinogens*, Charles C. Thomas, Springfield, Ill., 1973.
- Wassén, S. H., The use of some specific kinds of South American Indian snuff and related paraphernalia, *Etnol. Stud.*, (28) (1965).