A NARCOTIC MORNING-GLORY

(UNA CONVOLVULACEA NARCOTICA)

Part I

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Rivea corymbosa, a large woody vine of the morning-glory family, was known as *ololiuqui*, one of the divinatory narcotics, by the Aztecs for many centuries before the Spanish conquets. Its use in divination still persists amongst certain tribes in the mountainous regions of southern Mexico. Long believed to be one of the narcotic members of the *Solanaceae*, *ololiuqui* has now, through an evaluation of ancient chronielers and field investigations of the last forty years, been definitely identified. The *Convolvulaceae* was once thought to be a family completely devoid of narcotic properties, but recent preliminary analyses have indicated the presence in *Rivea corymbosa* of physiologically by active narcotic principles. Ingestion of the seeds is said to induce visions and hallucinations and produces a delirium, during which state prophetic and adivinatory statements are culled from the incoherent utterances of the native users. It is believed that, in pre-Hispanic times, the narcotic may have been used as an analgesic to ease the physical and mental sufferings of Aztec sacrificial victims.

Rivea corymbosa (L.) *Hallier filius* in Engler Bot. Jahrb. 8 (1893) 157.
Convolvulus corymbosus Linnaeus Syst. Nat. ed. 10, 2 (1759) 923.
Convolvulus domingensis Desrousseau in Lamarck Encycl. 3 (1791) 554.
Convolvulus sidaefolius Humboldt, Bonpland & Kunth Nov. Gen. & Sp. 3 (1818) 99.
Ipomoea corymbosa (L.) Roth Nov. Pl. Sp. Ind. Orient. (1821) 109.
Ipomoea sidaefolia (HBK) Choisy in Mém. Soc. Phys. Hist. Nat. Genève 6 (1833) 459.
Turbina corymbosa (L.) Rafinesque Fl. Tellur. 4 (1838) 81.
Ipomoea Burmanni Choisy in De Candolle Prodr. 9 (1845) 350.
Ipomoea antillana Millspaugh in Field Mus. Nat. Hist. Bot. Ser. 2, pt. 1 (Plantae Utowanae), Publ. No. 43 (1900) 84.
Ipomoea domingensis (Desr.) House in Muhlenbergia 3 (1907) 38.

ORIGINAL DESCRIPTION:

"C. fol. cordatis, pedunc. umbellatis, caule repente. *Plum. ic.* 89, f. 2."

Plant a large, scandent, twining, woody vine. Leaves 5–9 cm. long, 2.5–4 cm. wide, broadly cordate or ovate-cordate, entire, glabrous or

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very sparingly pubescent, long-petiolate. Peduncles axillary, usually many-flowered. Flowers borne in congested cymes. Corolla gamopetalous, infundibuliform or hypocraterimorphous, 2–4 cm. long, white or whitish, the lobes entire, glabrous. Stigmas two. Stamens included. Ovary glabrous, 2–celled. Sepals ovate to ovate-lanceolate, enlarged in fruit, scarious, somewhat ligneous, about 1 cm. long. Fruit ellipsoidal, baccate, indehiscent, 1–celled, 1–seeded. Seed roundish, minutely puberulent, rather woody.

Rivea, a genus which Choisy established in 1833, has been separated from the large genus *Ipomoea* on several minor characters. These characters are technical and apparently often intergrade. *Rivea corymbosa* may be distinguished from the Middle American species of *Ipomoea* by its fruit, by the texture of its sepals and by the shape of its flowers. *Rivea corymbosa*, first described by Linnaeus in 1759 as a species of *Convolvulus*, has sepals which are somewhat ligneous, whereas the species of *Ipomoea* usually have membranous, often herbaceous, sepals. In *Rivea corymbosa* the flower is usually hypocraterimorphous, a shape which is not common amongst species of *Ipomoea*. Its fruit is distinctive, being baccate, dry and indehiscent, with only one seed, usually with two or more seeds.

In his monographic treatment of the genus *Ipomoea* in North America, House (in Ann. N. Y. Acad. Sci. 18 (1908) 182) stated that he considered *Rivea* worthy of generic rank.

Recently, the combination *Turbina corymbosa* (L.) Raf. has been frequently used to designate the *ololiuqui* plant. The tendency at the present time, however, is to abandon this combination in favour of *Rivea corymbosa*.

Of the synonyms of *Rivea corymbosa* which have most frequently been used in refrence to the narcotic *ololiuqui*, the following are the most important: *Ipomoea sidaefolia* (HBK) Choisy and *Turbina corymbosa* (L.) Raf.

The genus *Rivea* is represented in the East Indies and adjacent regions, in Africa, in South and Middle America, and in the West Indies. *Rivea corymbosa* is the only species of the genus known to be native to the New World. It is very widely distributed in Middle America, occurring in Mexico, Guatemala, Honduras, Costa Rica, and Nicaragua. In South America, it is known from Venezuela, Perú and Bolivia. It has taken hold and has spread abundantly in some parts of Cuba. It occurs also in Florida. Hallier filius (in Engler Bot. Jahrb. 8 (1893) 157) reports it as possibly occurring in Ceylon. In Mexico, the plant is frequent from Sinaloa and Tamaulipas but appears to be more abundant in Vera Cruz, Oaxaca, Tabasco and Yucatan.

In Mexico, *Rivea corymbosa* is known and has been known by a number of different vernacular names, the more important of which are enumerated below:

Aztec: *ololiukqui; ololiuhqui; ololiuqui; ololiuhque; ololiuque; coatl-xoxouhqui; coaxihuitl; cuexpalli; yololique.*
Chinantec: *a-mu-kia; huan-mei; huan-men-ha-sei.*
Maya: *xtabentun.*
Mazatec: *no-so-le-na.*
Mixtec: *yucu-yaha.*
Spanish: flor de la Virgen; la señorita; manto; pascua; piule; semilla de la Virgen; yerba de la serpiente; yerba de las serpientes; yerba de la Virgen.
Zapotec: *badoo; bador; bidoo; bitoo; kwan-la-si; kwan-do-a.*
Erroneous spellings: *olilinhque; ololinhque, olininque; ololuchqui; ololinque.*

Ololiuqui has received relatively little critical attention in anthropological and botanical studies, notwithstanding the fact that it presents a number of fascinating ethnobotanical problems. One reason for this neglect may be that the identity of the ololiuqui plant has been imperfectly understood. The information necessary for a clear understanding of it, even though available, has been misinterpreted.

In 1615, Francisco Ximénez issued a Spanish translation (22, 64) of a portion of the unpublished ethnobiological notes of Francisco Hernández, a Spanish physician who, between 1570 and 1575, carried out for Philip II extensive research on the flora and fauna of Mexico. He described ololiuqui under the heading: *De la yerva que llaman ololiuqui que quiere decir planta de ojas redondas.* Ximénez did not attempt to identify this plant nor did he figure it. He merely stated that:

> ...it will not be wrong to refrain from telling where it grows, for it matters little that this plant be here described or that Spaniards be made acquainted with it.

A contemporary of Hernández, Bernadino de Sahagún, whose *Historia de las cosas de Nueva España* was written after careful investigation of Mexican life and customs, gathered comprehensive information regarding the use of plants and plant products. He enumerated three plants which were called *ololiuqui* (46, 47, 48), but only one of these was a narcotic. Under the heading: *De ciertas hierbas que emborrachan,* he mentioned ololiuqui and stated that:

> There is an herb called *coatl-xoxouhqui,* and it bears a seed called *ololiuqui.*

The Aztec name *coatl-xoxouhqui* means "green snake" and probably refers to the twining habit of the plant. In the Paso y Troncoso edition of Sahagún's writings (1905) a number of early illustrations made under the direction of Sahagún were reproduced. Figure 449 on Lam. Cl. is crude, but it agrees in all essentials with the figure of ololiuqui published by Hernández. It has congested fruits, cordate leaves, a swollen root,

and a twining habit —characteristics of *Rivea* and related genera of the *Convolvulaceae*.

Writing in 1629, Hernando Ruiz de Alarcón (4) described in great detail the Aztec method of using ololiuqui. In his description, he recorded several peculiarities of the plant and stated that:

> ...Ololiuqui is a kind of seed like the lentil [*Lens culianaris* Medik.] which is produced by a species of ivy of this land; when it is drunk, this seed deprives of his senses him who has taken it, for it is very powerful.

Although this account of such an important narcotic plant leaves much to be desired, there can be little doubt but that the plant which Alarcón had in mind was the same as the one which Hernández subsequently described and figured.

In 1651, Hernández (15) described and figured ololiuqui under the heading: *De Oliliuhqui, seu planta orbicularium foliorum.* This is the earliest detailed account and the first illustration of the plant. A free translation of the 1651 Latin version follows:

> "*Oliliuhqui*, which some call coaxi huitl, or snake-plant is a twining herb with thin, green cordate leaves; slender, green, terete stems; and long, white flowers. The seed is round and very much like coriander, whence the name [in Nahuatl, the term *ololiuqui* means "round thing"] of the plant. The roots are fibrous and slender. The plant is hot in the fourth degree. It cures syphilis and mitigates pain which is caused by chills. It relieves flatulency and removes tumours. If mixed with a little resin, it banishes chills and stimulates and aids in a remarkable degree in cases of dislocations, fractures, and pelvic troubles of women. The seed has some medicinal use. If pulverized or taken in a decoction or used as a pouifice on the head or forehead with milk and chili, it is said to to cure eye troubles. Whem drunk, it acts as an aphrodisiac. It has a sharp taste and is very hot. Formerly, when the priests wanted to commune with their gods and to receive a mesage from them, they ate this plant to induce a delirium. A thousand visions and satanic hallucinations appeared to them. In its manner of action, this plant can be compared with *Solanum manïacum* of Dioscorides. It grows in warm places in the fields."

Jacinto de la Serna (56), one of the early chroniclers of Mexico, wrote at great length on the superstitions of the Aztecs. He observed and recorded carefully every detail concerning the method of using ololiuqui, but he failed, as did Alarcón, to describe the plant fully. However, his statement that the seeds resemble the lentil is in agreement with the corresponding observation of Hernández and Alarcón.

An early attempt to identify ololiuqui botanically was made in 1854 when Oliva (28) declared that it was "*Convolvulus microcalyx*". Although this identification was later shown to be incorrect, it was important since, for the first time, it referred ololiuqui to the proper family—the *Convolvulaceae*. Oliva's identification was adopted in León's edition of *Cuatro libros de la naturaleza y virtudes de las plantas y animales de la Nueva España* (22). Among one hundred and twenty-three plant

determinations, León included ololiuqui as *"Convolvulus microcalyx??"*. Notwithstanding the fact that the author of this important contribution to Mexican ethnobotany had accepted Oliva's identification, it was not adopted in other contemporaneous publications. Martínez Gracida, for example, in his comprehensive *Catálogo de la flora y la fauna del Estado de Oaxaca* (12), reported the occurence of *ololuc* or *ololiuqui* (also called *yerba de las serpientes*) in Oaxaca, but he failed to include the botanical identification made by Oliva and accepted, with reservation, by León.

In 1897, Doctor Manuel Urbina (61) identified ololiuqui as *Rivea corymbosa* (*Ipomoea sidaefolia* (HBK.) Choisy). This identification was published in a more detailed form in 1903 in an article entitled: *El peyote y el ololiuqui* (62), which was reprinted in 1912 (63).

In 1911, Hartwich (14), probably unacquainted with Urbina's work, stated that he could not identify ololiuqui from Hernández' illustration of the plant, but that it might well be a member of the *Solanaceae*.

Doctor William E. Safford in his well-known paper *An Aztec narcotic* (39) expressed his belief that Urbina's conclusions were wrong. He suggested that ololiuqui might not be *Rivea corymbosa*, but he did not definitely identify it until a later date. He wrote:

> "Dr. Manuel Urbina, ...declared it to be *Ipomoea sidaefolia* of Choissy; but this identification, while agreeing with Hernández's illustration, lacks confirmation through investigation of the chemical properties and physiological action of the seeds of this species; and it is not known that any of the Convolvulaceae are narcotic, although many of the Solanaceae, which have somewhat similar flowers, are highly so. It is very strange that Mexican botanists living in the country of the Ololiuhqui have not solved the mystery of its identity."

Furthermore, Safford expressed doubt as to the value of certain early Mexican accounts of plants and plant uses when he stated:

> "A knowledge of botany has been attributed to the Aztecs which they were far from possessing... The botanical knowledge of the early Spanish writers, Sahagún, Hernández, Ortega, and Jacinto de la Serna, was perhaps not much more extensive: their descriptions were so inadequate that even to the present day the chief narcotic of the Aztecs, *Ololiuhqui*, which they all mention remains unidentified."

Safford's lack of faith in the reliability of the botanical knowledge of the Aztecs and the early Spanish writers seems unjustified. It was undoubtedly this lack of faith, together with a belief in the absence of narcotic principles from the *Convolvulaceae* which led Safford to disagree with Urbina's identification of ololiuqui and to look upon his conclusions with suspicion.

In 1915, Safford (40) definitely stated that ololiuqui should be referred to *Datura meteloides* Dunal ex DC., a species of the *Solanaceae*. This identification, repeated in his later papers (41, 42, 43, 44, 45), has

received such serious consideration that anthropologists and botanists have very generally accepted it. Indeed, this identification has been accepted in several very recent anthropological and botanical papers (10, 11, 21).

Ololiuqui has been indirectly linked with the *Solanaceae* prior to the time of Hartwich and Safford. For example, Hernández, who worked in pre-Linnean times and who had none of the modern concepts of malies and genera, linked ololiuqui to *Solanum maniacum* of Dioscorides, a solanaceous plant (15) probably referable to *Datura stramonium* L. However, it must be emphasized that Hernández did not identify ololiqui as *Solanum maniacum* but merely compared the two plants from the point of view of their physiological effects. He also pointed out similarities between the action of ololiuqui and that of *Cannabis*, *Papaver*, and other Old World narcotic plants.

Safford's reasons for identifying ololiuqui as a species of *Datura* were several. In the first place, *Datura* was used in northern Mexico and in North America for purposes of divination (45). To Safford, it seemed very probable that ololiuqui, a narcotic of central and southern Mexico, merely extended the use of *Datura* southwards. This appeared all the more likely since the symptoms of *Datura* and ololiuqui intoxication are very similar.

In the second place, Safford suspected that Hernández might have erroneously figured a convolvulaceous plant instead of a *Datura*. He argued:

> "...It is not surprising that it should have been so confused [i. e., *Datura meteloides* with *Rivea corymbosa*], for its trumpet-shaped flower, like that of the closely allied *Datura discolor*, strongly suggests a morning-glory" (41).

Although it is true that the *Convolvulaceae* and the *Solanaceae* are related (belonging to the *Tubiflorae* of the *Metachlamydeae*) and have certain similarities in their floral structure, this argument is hardly a convincing one. It must be remembered that the vegetative differences between *Rivea corymbosa* (a large, woody vine) and *Datura meteloides* (an erect herb) are so great that mere floral similarity should not cause confusion. It should be emphasized also that the natives were interested chiefly in the seeds, which are quite different in the two genera.

Concerning the possibility of error on the part of Hernández, Safford further states:

> "The identity of the latter plant [ololiuqui], held sacred by all the Indian tribes who use it, was carefully kept secret from strangers... The late Doctor Manuel Urbina... believed it to be a morning-glory, *Ipomoea sidaefolia*; but none of the Convolvulaceae have narcotic properties. He was misled by Hernández, who never learned the identity of this sacred plant, but who described and figured

in its stead the Ipomoea referred to. As a matter of fact, the name *ololiuhqui*, originally applied to certain species of Convolvulaceae, was given to a certain Solanaceous plant with flowers shaped very much like those of a Convolvulus or Ipomoea."

From a study of the older writers on ololiuqui, I have been unable to find supporting evidence of Safford's statement that the name was formerly applied to species of the *Convolvulaceae* and was later used to designate certain species of the *Solanaceae*. Neither of the two earliest figures of the narcotic ololiuqui is solanaceous in aspect, and I have been unable to find a description which would suggest that this supposed transfer of name had taken place. There apparently was no definite transfer of the name to the *Solanaceae* until 1915, when Safford himself applied it erroneously to *Datura meteloides*.

The eminent toxicologist Lewin (23, 24) agreed with Safford in identifying ololiuqui as *Datura meteloides*. He did not refer to Safford's studies, however, and it may be that he arrived at his conclusions independently.

In Mexico, where Urbina published his identification of ololiuqui, the attribution of the narcotic to *Rivea corymbosa* is rather generally accepted (16, 27, 30, 32, 33, 48, 61, 62, 63). Some hesitation and doubt, however, have been caused by the *Datura* identification made by Safford. Herrera (16) for example, while identifying the "ololiuqui" of Jalisco, Oaxaca, and Veracruz as *Rivea corymbosa*, complicated the problem in his catalogue by accepting Safford's assertion that the "ololiuqui" of Sinaloa, Guanajuato, and Jalisco is *Datura meteloides*. In 1933, Martínez (26) rejected Safford's determination, but he did not accept *Rivea corymbosa* as the plant from which ololiuqui seeds were obtained. He believed ololiuqui to be a species of *Ipomoea*, possibly *I. hirsuta* Jacq. f. (*I. mexicana* A. Gray) and stated that it could not, because of discrepancies in seed characters, be referable to *Rivea corymbosa*. In 1937, however, Martínez (27) accepted *Rivea corymbosa* as the correct identification.

In a popular account of New World narcotics, written in 1936, V. A. Reko (36) rejected Urbina's identification and seemed to favour the conclusions of Safford. Finally Hesse has recently considered ololiuqui to represent *Datura meteloides*.

A number of writers (1, 8, 13, 18, 19, 20, 38, 58, 59) who have mentioned ololiuqui incidentally have refrained from discussing the botanical identity of the plant. In some cases, this was problably due to the uncertainty and confusion which existed in the minds of the botanists who had studied the problem.

The first actual field evidence to corroborate the work of Hernández and Urbina's identification was found by Doctor B. P. Reko who had

studied the works of some of the older writers and interpreted their reports in the light of his own discoveries. He concluded that Urbina's determination was correct and that Safford's was incorrect. In 1919, he (31) defined *ololuc* (as ololiuqui is known in parts of Oaxaca) as the round, lentil-like seeds of *Rivea corymbosa* and stated that the medicine-men used them to produce an intoxication resembling somnambulism. In a letter written in 1923,(2) he wrote that the natives of the Sierra Juárez of Oaxaca (Zapotec Indians) "use ololiuqui which is doubtless *Ipomoea sidaefolia* Choisy". Again in 1919, he (32) accepted Urbina's identification and rejected the determination suggested by Safford.

Subsequently, in 1934, Reko published a review of the identity and use of ololiuqui (33). Going back to the reports of Hernández and Sahagún and reproducing Hernández' figure of ololiuqui, he outlined some of his own field observations which agreed with the ancient records and which argued against the possibility that ololiuqui was a species of *Datura*. Furthermore, the narcotic seeds which he collected in Oaxaca were sent to Safford who identified them as the seeds of *Rivea corymbosa*.

Admitting that narcotic constituents were unknown in the *Convolvulaceae*, Reko insisted that this fact could not be used to discredit the reports of earlier writers, inasmuch as *Rivea corymbosa* had not, as yet, received chemical investigation, and he suggested that a narcotic principle—possibly a glucoside—actually was present in the plant.

In several articles on narcotic plants, I have referred to ololiuqui (52, 53, 54, 55). I accepted as correct the Urbina identification, basing my conclusions on a study of the reports of early writers and on an evaluation of the arguments for and against the Urbina and Safford identifications.

In summarizing the problem of the identification of ololiuqui, therefore, we may state that all of the available early reports as well as modern field studies indicate that Urbina was correct in referring ololiuqui to *Rivea corymbosa* and that Safford was wrong in suggesting that it was derived from a species of *Datura*. Furthermore, recent pharmacological work, in demonstrating the presence of an intoxicating principle in the seeds of *Rivea corymbosa*, removes the most important argument which Safford advanced in favour of his identification

(2) B. P. Reko to J. N. Rose, July 18, 1923; preserved on sheet No. 1745713, United States National Herbarium, Washington, D. C.