A CONTRIBUTION TO OUR KNOWLEDGE OF RIVEA CORYMBOSA

THE NARCOTIC OLOLIUQUI OF THE AZTECS

BY

RICHARD EVANS SCHULTES

BOTANICAL MUSEUM OF HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS
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I. Introduction

IN the life of primitive peoples, narcotic plants have usually played an extremely important part. Because of their intoxicating or poisonous properties, a large number of such plants have been valued by the aborigines of North, Middle and South America. But perhaps nowhere in the New World did a greater variety of narcotic plants enter into the religious ceremonies, medical practices and daily life of a people than in Mexico.

The Aztecs, in pre-hispanic Mexico, from their own experiences and from association with conquered or friendly tribes, had acquired a knowledge of many narcotic and poisonous plants. The most important of these were the cactus, peyotl (*Lophophora Williamsii* (Lem.) Coulter); the mushroom, teonanacatl (*Paneolus campanulatus* L. var. *sphinctrinus* (Fr.) Bresadola); and the convolvulaceous vine, ololiuqui (*Rivea corymbosa* (L.) Hallier filius), the plant with which this article deals.

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.

The purpose of the present paper is to review the history of the use of ololiuqui and to present the pertinent details for an understanding of its identity. With this

purpose in mind, I have endeavored to refer to all of the writings concerning the use of ololiuqui among the Indians of Mexico, but since the published records are widely scattered and are often incidental, it is probable that some may have been overlooked. As many of the anthropological records of ololiuqui are preserved in obscure or rare publications, it has been thought advisable to include in this paper translations of the relevant passages from these records. The historical material has been correlated with several discoveries which have recently been published as well as with field notes made during my ethnobotanical investigations in Oaxaca in 1938 and 1939.

II. The history and identification of ololiuqui

In 1615, Francisco Ximénez issued a Spanish translation (21,61) 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.[1]

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

[1]The translations in this paper are, unless otherwise credited, free translations made by the author from the original sources.

three plants which were called *ololiuqui* (44,45,46), 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. CI 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*.

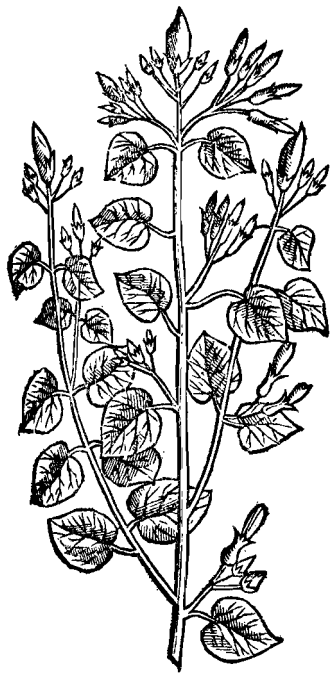
Writing in 1629, Hernando Ruíz de Alarcón (5) described in great detail the Aztec method of using ololiuqui. In his description, he recorded several peculiarities of the plant and stated that:

> . . . ololiuqui is a kind of seed like the lentil [*Lens culinaris* 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 (see Plate I). A free translation of the 1651 Latin version follows:

De OLILIVHQVI, seu planta orbicularium foliorum. Cap. XIV.



OLILIVHQVI, quam *Coaxihuitl*, seu herbam Serpentis alij vocant, volubilis herba est, folia viridia ferens, tenuia, cordis figura. caules teretes, virides, tenuesq;. flores albos, & longiusculos. semen rotundum simile Coriandro, vnde nomen. radices fibris similes. calida quarto ordine planta est. luem Gallicam curat. dolores è frigore ortos sedat. flatum, ac præter naturam tumores discutit. puluis resina mixtus pellit frigus. luxatis aut fractis ossibus, & lumbis fœminarum laxis, aucto robore mirum auxiliatur in modum. S eminis etiam est vsus in medicina, quod tritum, ac deuoratum, illitumq; capiti, & fronti, cum lacte & *Chilli*, fertur morbis oculorum mederi. deuoratum verò, venerem excitat. Acri est sapore, & temperie, veluti & planta eius, impensè calida. Indorum sacrifici cum videri volebant versari cum Superis, ac respõsa accipere ab eis, ea vescebãtur planta, vt desiperent, milleq; phantasmata, & dæmonũ obuersãtium effigies circumspectarent. qua in re Solano maniaco Dioscoridis similis fortasse alicui videri possit.

Reproduction of the earliest illustration and detailed discussion of the uses of *Rivea corymbosa*. Hernández, Francisco: "Rerum medicarum Novae Hispaniae thesaurus, seu plantarum, animalium, mineralium mexicanorum historia" (Rome, 1651) p. 145.

Oliliuhqui, which some call *coaxihuitl*, 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 tumors. 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 poultice on the head or forehead with milk and chili, it is said to cure eye troubles. When 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 message 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 maniacum* of Dioscorides. It grows in warm places in the fields.

Jacinto de la Serna (54), 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 (27) 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* (21). 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 occurrence 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 (58) 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* (59), which was reprinted in 1912 (60).

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* (37) 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 Hernandez'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, though 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, Sahagun, Hernandez, 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 (38) 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 (39,40,41,42,43), 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 (10,11,20).

Ololiuqui had 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 families and genera, likened ololiuqui to *Solanum maniacum* of Dioscorides, a solanaceous plant (15). However, it must be emphasized that Hernández did not identify ololiuqui 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. In this connection, it is interesting to note in passing the effects which were once attributed to "*Solanum maniacum*". Translations of two ancient writers are accordingly quoted:

DODOENS: *A new herbal, or historie of plants* (Translated by Henry Lyte) (1619) 320. "The roote of *Solanum Manicum*, taken in wine to the quantitie of a dram, causeth idle and vaine imaginations: and, taken to the quantitie of two drams, it bringeth frensie and madnesse, which lasteth by the space of three or foure dayes: and if foure drams thereof be taken, it killeth."

THEOPHRASTUS: *Enquiry into plants* (Translated by Sir Arthur Hort) 2 (1916) 273. "Of the plants called *strykhnos* one induces sleep, the other (thorn-apple) causes madness. . . . The kind which produces madness . . . has a white, hollow root about a cubit long. Of this three twentieths of an ounce in weight is given, if the patient is to become merely sportive and to think himself a fine fellow; twice this dose if he is to go mad outright and have delusions; thrice the dose, if he is to be permanently insane; . . . four times the dose is given, if the man is to be killed. The leaf is like that of rocket, but larger, the stem about a fathom long; the 'head' is like that of a long onion, but larger and rougher. And it also resembles the fruit of the plane-tree."

In the index of plants accompanying Sir Arthur Hort's translation (THEOPHRASTUS l.c., p. 478), *Solanum maniacum* is referred to *Datura Stramonium* L. There can be no doubt but that *Solanum maniacum* was a species of *Datura*, but it is by no means certain that the species was *D. Stramonium*. Safford (42), who monographed the genus *Datura*, held to the opinion that *D. Stramonium* was an American species unknown in the Old World before the 16th Century. He held that *Datura ferox* L. and *D. Metel* L. were the only representatives of the genus in the Old World in pre-Colombian times. There has been much debate concerning the native home of *Datura Stramonium*, and opinion is still divided between an Old and a New World origin. The evidence would seem to support Safford's viewpoint, but it is not yet possible to state positively that *Datura Stramonium* was exclusively a New World species before 1492. All authorities, however, are in agreement that this species was unknown in Europe until the 16th Cen-

tury. It is doubtful, therefore, whether *Solanum maniacum* can be referred to *Datura Stramonium*. When all the many details are examined, it seems more probable that the narcotic *Datura* of which Dioscorides wrote was *D. Metel*, the widely known metel-nut of southern Europe and Asia.

The European and Asiatic narcotic metel-nut (*Datura Metel*) has often been confused with the New World *D. meteloides*, the species to which Safford referred ololiuqui.

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 (43). 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" (38).

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 Dr. Manuel Urbina . . . believed it to be a morning-glory, *Ipomoea sidaefolia*; but none of the Convolvulaceae have narcotic properties. He was misled by Hernandez, 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 for 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 are 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 (22, 23) 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, 26, 29, 31, 32, 46, 58, 59, 60). 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 Vera Cruz 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, Martinez (25) 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. hirsutula* 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, Martinez (26) accepted *Rivea corymbosa* as the correct identification.

Finally, in a popular account of New World narcotics, written in 1936, V. A. Reko (34) rejected Urbina's identification and seemed to favor the conclusions of Safford.

A number of writers (1,8,13,17,18,19,36,56,57) who have mentioned ololiuqui incidentally have refrained from discussing the botanical identity of the plant. In some cases, this was probably 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 (30) 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 the ololiuqui which is doubtless *Ipomoea sidaefolia* Choisy." Again, in 1929, he (31) accepted Urbina's identification

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

and rejected the determination suggested by Safford.

Subsequently, in 1934, Reko published a review of the identity and use of ololiuqui (32). 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 (50,51,52,53). 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, the field observations of Reko, and my own ethnobotanical 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 favor of his identification.

III. The nomenclature and taxonomy of Rivea corymbosa

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 DeCandolle 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.

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 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 ellip-

Flowering and fruiting branches of *Rivea corymbosa* (L.) Hall.f. Flowering branch drawn from a specimen in the Gray Herbarium (Harvard University) —*Seler 1382*, Cuicatlan, District of Cuicatlan, Oaxaca, Mexico, November 15, 1895. Fruiting branch drawn from specimen number 6595 in the Economic Herbarium of Oakes Ames (Botanical Museum, Harvard University)—*Schultes & Reko 872*, Santo Domingo Latani, District of Choapam, Oaxaca, Mexico.

Drawn by GORDON W. DILLON

PLATE II

RIVEA

corymbosa (L.) Hall. f.

soidal, 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 the type of 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 among species of *Ipomoea*. The fruit of *Rivea corymbosa* is distinctive, being baccate, dry and indehiscent, with only one seed, while the fruit of most species of *Ipomoea* is a dehiscent capsule, usually with two or more seeds.

The fruit and seed of *Rivea corymbosa* magnified ten times.

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 favor of *Rivea corymbosa*.

Among recent writers who have accepted *Rivea corymbosa*, the following may be cited: Urban (Symb. Antill. 8 (1920) 572; Grey & Hubbard (List Pl. Grow. Bot. Gard. Atkins Inst. Arnold Arb. (1933)); Standley (in Field Mus. Nat. Hist. Bot. Ser. 18, 3 (Fl. Costa Rica) 973 (Publ. 420)).

Of the synonyms of *Rivea corymbosa* which have most frequently been used in reference 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, Peru and Bolivia. 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.

IV. The chemical composition of Rivea corymbosa

Until recently, nothing was known of the chemical composition of the seeds of *Rivea corymbosa*. Preliminary studies which have been made on the pharmacology and chemistry of ololiuqui indicate that its chemical constituents are very complex.

When Urbina identified ololiuqui as *Rivea corymbosa*, he recognized that no narcotic substance was known to occur in the *Convolvulaceae*, but he pointed out that the family was rich in glucosides. All doubt as to the narcotic properties of *Rivea corymbosa* was dispelled in

1937, when the late Professor C. G. Santesson of Stockholm discovered active narcotic principles in ololiuqui seeds (47,48).

According to Santesson, a heavy, white precipitate is produced if water is added to an alcoholic extract of the seeds of *Rivea corymbosa*. This is an indication of the presence of a resin. Whether or not this resin contains active principles is a question which must await further research. If an alcoholic extract is freed from its resin content and evaporated and the residue taken up with water, the resulting aqueous solution is cloudy and, after heating, contains a slimy mass. Freed from this slime, the filtrate, a yellow solution, gives strong acid reactions. Santesson believed that the *Schleim* might play a chemical part in the physiological rôle of the narcotic constituent.

The aqueous solution of the residue from the original alcoholic extract does not give a positive sugar reaction, but if it is heated with hydrochloric acid, a positive Fehling's test is obtained. This indicates that a glucoside is set free during treatment with hydrochloric acid, but that prior to this treatment, the glucoside is in some way masked.

Experiments which Santesson conducted suggest that the condition which ololiuqui induces is, in his own words, "eine partielle Lähmung des Gehirns, eine Art Narkose oder Halbnarkose." The extracts containing the unsplit glucoside and those containing the split glucoside produced comparable effects. The only difference between the two extracts is that the one containing the split glucoside seems to be slightly more narcotic in lower animals than the one with the unsplit glucoside. Inasmuch as the splitting of the glucoside did not seem to be of importance in rendering the narcotic active, Santesson suspected that the active principle might not

be the glucoside but something else which is masked under ordinary circumstances. The results of a number of tests indicated that, when the glucoside was split, an alkaloid was set free.

The alkaloid is not perceptible (or only very slightly so) to alkaloid-reagents before the splitting of the glucoside. After the splitting, however, all alkaloid tests are strongly positive. All the evidence from experiments and tests indicates that the alkaloid, normally in combination with a sugar, is set free only by destruction of the bond with heat and hydrochloric acid. Remarking that "ein solcher Körper ist meines Wissens eine Seltenheit", Santesson compared this with the gluco-alkaloid *solanine* which is found in *Solanum Dulcamara* L. of Europe.

Although the alkaloid is chemically masked before it is freed from the sugar, its physiological activity is apparently not affected by this union. This is evident from the fact that the extract containing the unsplit, as well as that containing the split glucoside, produces narcotic effects.

Doctor Marsh of the United States Department of Agriculture obtained negative results when he experimented with the seeds of *Rivea corymbosa* (32), and Reko, although he had been warned that five or six seeds would produce an intoxication, ate a handful without noticeable effects (32). Santesson cannot explain the failure of ololiuqui to produce effects in the experiments of Marsh and Reko, but he offers the interesting suggestion that racial differences in susceptibility to intoxication may account for the phenomenon. He points out the long recognized fact that appreciable quantitative and qualitative differences in the effects of opium (*Papaver somniferum* L.), coca (*Erythroxylon Coca* Lam.), and other drugs are evident among members of the white, red and yellow races.

Neither the glucoside nor the alkaloid of *Rivea corymbosa* is known chemically. Their peculiar properties seem to suggest that they are new. The chemical and pharmacological studies of this interesting hypnotic narcotic are still in preliminary stages and it is not unreasonable to anticipate even more significant discoveries when thorough investigations of *Rivea corymbosa* are undertaken.

V. The chemical composition of related Convolvulaceae

The chemical composition of a number of species of the related genus *Ipomoea* and its segregates is known and presents certain similarities to that of *Rivea corymbosa.*

A number of official drugs of this family are useful because of their purgative properties. Among these may be mentioned the following: Radix Jalapae or Jalapa root (*Ipomoea Purga* (Wend.) Hayne); Kaladona or Pharbitis seeds (*Ipomoea Nil* (L.) Roth); Turpeth root (*Operculina Turpethum* (L.) Silva Manso); and Mexican Scammony (*Ipomoea orizabensis* (Pell.) Ledénois). Other species find rather extensive uses in the native materia medica of a number of countries.

In possessing a peculiar group of resins of a glucosidal character, the *Convolvulaceae* are unique in the plant kingdom. There are several resins of this nature, all very closely related, which are known as the *glucoretines.* When hydrolyzed, they yield a sugar. This is a parallel condition to that in *Rivea corymbosa,* but in this plant it is an alkaloid that is combined with the sugar.

According to Tschirsch & Stock in the most recent and comprehensive treatment of the chemistry of the resins (*Die Harze* 2 (1936) 1618-1634), eight species of convolvulaceous plants are known to contain glucoretines: *Ipomoea Purga* (Wend.) Hayne; *I. orizabensis*

(Pell.) Lédenois; *I. simulans* Hanb.; *I. triflora* Maria & Velasco; *I. Nil* (L.) Roth; *Convolvulus Scammonia* L.; *Operculina macrocarpa* (L.) Urb.; and *O. Turpethum* (L.) Silva Manso. Some of these plants contain as much as twenty percent of resin. Undoubtedly further chemical research will reveal the presence of glucoretines in many more, if not in most, of the convolvulaceous plants.

Although there is as yet considerable disagreement among chemists concerning the constitution of the glucoretines, Tschirsch & Stock suggest that there are two basic resins in the group: *jalapin (orizabin, turpethin, scammonin)* and *convolvulin (rhodeoretin, jalapurgin, tempicin)*. These authorities also suggest that the substances which have been called *alpha-* and *beta-turpethin, pharbitisin,* and *ipomoein* are impure mixtures of simpler glucoretines. The purgative properties of the *Ipomoea* drugs are attributed to the gluco-resins which they contain.

Standley (in Field Mus. Nat. Hist. Bot. Ser. 10 (1931) 329) (Publ. 283) reports that *Stictocardia campanulata* (L.) Standl. (*Rivea campanulata* (L.) House) is used in Panama to coagulate rubber—the sap of the *Stictocardia* being added to the latex from species of *Castilla.* This use is of interest since the rubber-coagulating properties of *Stictocardia companulata* may possibly be a result of the glucosidal resin content which it may, like its near relatives, contain.

In Morelos, Mexico, *Ipomoea arborescens* (Humb. & Bonpl.) S. Don is believed to cause insanity and cerebral disorders if taken internally and to be poisonous to domestic animals (Standley in Contrib. U.S. Nat. Herb. 23 (1924) 1205). An investigation of the chemical constitution of this species might reveal the presence of a principle similar to the narcotic gluco-alkaloid of *Rivea corymbosa.* It is very suggestive that *Ipomoea arbores-*

cens, like *Rivea corymbosa*, can act physiologically on the human brain.

Henry (*The plant alkaloids*, ed. 3 (1937) 95) reports that recently Orekhov & Konovalova (Arch. Pharm. 271 (1933) 814; Brit. Chem. Abstr. a2 (1937) 311) have found four alkaloids in the seeds of *Convolvulus pseudocantabricus* Schrenk: *convolvine; convolamine; convolvidine*; and *convolvicine*. Convolvine is said to possess local anaesthetic properties (Nolle: Khim. Farm. Prom. 5 (1934) 35). This discovery of anesthetic properties in a convolvulaceous plant coincides in a striking manner with several 17th Century Spanish reports that ololiuqui seeds were used by Aztec priests to deaden pain and to benumb the flesh. These reports will be considered in greater detail in a later section of this paper.

VI. The uses of Rivea corymbosa

Without any doubt, the most important use of *Rivea corymbosa* was and is as a narcotic for divination. The seeds were widely used for this purpose among the ancient Aztecs and are still used for divination among many Indians of southern Mexico. In three hundred years, the methods and purposes of using ololiuqui have undergone but slight changes.

It is indeed significant that all of the reports of the use of ololiuqui in modern times come from the State of Oaxaca. In this State, large tribes of Indians still live in comparative isolation and carry out a number of their ancient rites, influenced little or not at all by Christianity. There are reports of ololiuqui from several groups of Zapotec Indians as well as from the Chinantecs, Mazatecs and Mixtecs. All of these tribes were in contact with the Aztecs in pre-hispanic times. Whether narcotization with ololiuqui is a practice which the Aztecs learned from the Oaxacan tribes or whether the Oaxacans borrowed it

from the Aztecs is uncertain. The writer believes, however, that further investigation along botanical, ethnological and ethnographical lines will prove that the more southern of these peoples (the Oaxacans) became acquainted with the properties of this plant long before their Aztec neighbors to the north.

The use of *Rivea corymbosa* as a narcotic has not been reported from the Maya area, although the plant is well known there and is called *xtabentun*. (Standley in Field Mus. Nat. Hist. Bot. Ser. 3, 2 (1930) 394; Berendt: *Noticias de varias plantas y sus virtudes* (mss.) (1864) 24).

In 1917, Reko (32) found the Zapotecs in Amatlán, District of Miahuatlán, Oaxaca, employing a narcotic seed in divination. Among the natives, this seed was called *piule* or *la señorita*. When specimens were sent to Safford, they were identified as the seeds of *Rivea corymbosa*. Reko also stated that piule seeds were used among the Zapotecs of the Sierra Juárez where they were known as *bitoo* ("the god"). Among the Mixtecs, this narcotic was called *yucu-yaha*, a name which means "chili-plant", probably in allusion to the hotness to the taste of ololiuqui seeds. Reko further stated that this narcotic was used in Tehuantepec and in the Chinantla in Oaxaca.

During her study of the Zapotecs of Mitla, Elsie Clews Parsons (28) discovered that a small, narcotic seed was used commonly in divination. Descriptions of the plant and of the type of intoxication which it induces indicate that these seeds, which the Zapotecs of Tlacolula call *bador*, are doubtless those of *Rivea corymbosa*. This conclusion is strengthened by the fact that Zapotecs in four nearby parts of Oaxaca are known to use *Rivea corymbosa*. According to Parsons:

"... divination about recovery in sickness is also practiced by means of a plant which is described as a narcotic. This plant, *bador*, little children, the only plant of its kind in town, grows in the yard

of a family who sells its leaves and seeds to two or three *curanderos* to administer to patients. After drinking the infusion, the patient, who must be alone with the curer if not in a solitary place where he cannot hear even a cock's crow, falls into a sleep during which the little ones, male and female, the plant children *(bador)*, come and talk. These plant spirits will also give information about lost objects''.[1]

Parsons also states:

" . . . vine of the clematis-like *bador* climbs over the cactus hedge. It is a small capital for the family because the leaves and seeds are bought by . . . the *curanderos* for a few centavos. They put a leaf on the forehead of one who has lost something and give him thirteen seeds to take in water. He has to be alone with the *curandero*. His eyes will close . . . and the little ones of the plant will come to him in a vision and show him the whereabouts of his lost property.''

Commenting on the antiquity of the use of these seeds in divination, Parsons writes:

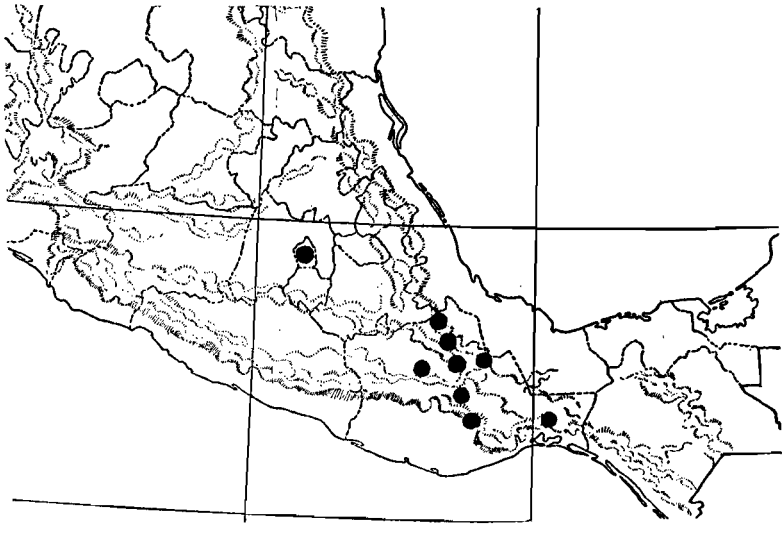
"The divinatory function of the *curandero*, whether by corn or by the giving of the narcotic *bador*, was undoubtedly a function of the early Zapotecan doctor.''

It seems very probable that the Zapotecs, among whom the use of ololiuqui is widespread at the present time, used *Rivea corymbosa* in pre-hispanic times as did their Aztec neighbors to the north.

In 1938 and 1939, I heard numerous reports among the Mazatecs of the use of the seeds of a convolvulaceous plant for purposes of divination. Descriptions of this plant and its use indicate that it is probably *Rivea corymbosa*, even though specimens were not found in cultivation or growing wild in the Mazatec country. There can be no doubt, however, that the plant occurs there. Johnson (18,19), working on the ethnology and linguistics of the Mazatecs, has found these Indians using the *semilla de la Virgen* for divination in addition to teonanacatl (*Paneolus campanulatus* L. var. *sphinctrinus* (Fr.) Bres-

[1]The passages from Parsons (28) are quoted with the permission of the University of Chicago Press.

Plate III



The distribution of the use of *Rivea corymbosa* as a narcotic in pre-hispanic and modern Mexico.

adola) and the *hierba María*, an unidentified plant. In a recent letter to the writer, Johnson reports that among the Mazatecs, there are *curanderos* who grind the flowers *(flor de la Virgen)* on a metate and eat them before divination and before attempting to find lost articles. He reports the Mazatec name as *na-so-le-na*, the literal translation of which he gives as "flower-her-mother".

The name *semilla de la Virgen* or *yerba de la Virgen*, as well as the synonymous *semilla de la señorita*, is applied to *Rivea corymbosa* in many other parts of Oaxaca.

In 1939, in the Chinantec-Zapotec town of Santo Domingo Latani, District of Choapam, I encountered under cultivation an extremely large vine of *Rivea corymbosa*, the seeds of which were utilized as a narcotic among the Indians. A specimen from this plant is preserved in the Economic Herbarium of Oakes Ames (No. 6595) in the Botanical Museum of Harvard University.

In Latani, this appeared to be the only plant of *Rivea corymbosa*. It was heavily laden with fruit and must have supplied sufficient seeds for the needs of the local *curanderos*. This situation—the monopoly of the supply of ololiuqui in a village—closely parallels that which Parsons (28) described for the Zapotec town of Mitla, where there was one *bador* plant, ". . . the only plant of its kind in town, [which] grows in the yard of a family who sells its leaves and seeds. . . ."

In Latani, knowledge of the plant and its properties is common to all the townspeople. Indeed, several natives who were not *curanderos* had had personal experience with its narcotic properties. There was no hesitation in answering questions about the use of the seeds and the nature of the intoxication induced. Among the Zapotecs of this town, the plant is called *kwan-la-si*; among the Chinantecs, *a-mu-kia* ("medicine for divination"). In Santiago Yaveo, a Zapotec settlement south of Latani,

the plant is known as *kwan-do-a* (''children's medicine''). The Zapotec names in these two towns as well as the Chinantec name indicate that *Rivea corymbosa* is considered to be a medicine. In Latani, the seeds are used in small quantities to conteract flatulency just as the Aztecs, according to Hernández (15), were accustomed to use them.

The Chinantecs of the village of San Juan Teotalcingo, District of Choapam, employ a narcotic seed for divination. I was unable to procure specimens when I visited this village, but descriptions of the seeds and the plant which produces them suggest that it is *Rivea corymbosa.* In Teotalcingo, according to my native assistants, this plant is called *hwan-men-ha-sei* which is said to mean ''vine bearing brown (red?) seeds''.

While questioning native assistants in the western Chinantec town of San Juan Tepetotutla concerning medicines and narcotics, I learned that both teonanacatl and ololiuqui are used in divination by the *curanderos.* Twenty-three seeds of *Rivea corymbosa* were procured in Tepetotutla although there is apparently no plant of this species under cultivation in the village. The supply of seeds is said to come from the neighboring Chinantec village of San Pedro Yolox. The inhabitants of Tepetotutla call the ololiuqui plant *hwan-mei* and use the seeds medicinally for rheumatism.

In recapitulation, we may say that at the present time ololiuqui is known to the Zapotecs of Mitla, Amatlán, Tehuantepec, the Sierra Juárez, and the District of Choapam; to the Mixtecs of the Mixteca Alta; to the Lazatecs of the District of Teotitlán; and to the Chinantecs of the Districts of Choapam, Ixtlán and Cuicatlán.

In the foregoing paragraphs, we have considered the use of ololiuqui in Mexico at the present time. As has

been stated above in the historical introduction, it has had a long history among Mexican Indians. In the 16th Century, ololiuqui was utilized by the Mexican Indians not only as a divinatory narcotic, but also as a panacea and as an important ingredient in magic potions. Its use in the past is equally as interesting and significant as its use to-day.

An excellent summary of the uses of ololiuqui among the ancient Aztecs is provided by Simón's definition of the name in his *Dictionnaire de la lengue Nahuatl ou Mexicaine* (55): "*Ololiuhqui* s. Plante médicinale dont le graine est ronde et qui est appelée aussi *coaxiutl*, herbe du serpent (Hern.). Elle servait à guérir du mal véné rien et entrait dans une composition dont les astrologues frottaient le corps au moment de se livrer à certaines practiques généthliaques (Bét)."

If we are to judge from the early writers, ololiuqui must have been very extensively used in the Valley of Mexico in pre-hispanic times. It seems to have been more important in divination than peyote (*Lophophora Williamsii* (Lem.) Coulter), teonanacatl (*Paneolus campanulatus* L. var. *sphinctrinus* (Fr.) Bresadola, or piciete (*Nicotiana Tabacum* L.). Ololiuqui was accorded as many ritual honors as piciete.

Sahagún (44,45,46), describing the use of ololiuqui, reported that the *coatl-xoxouhqui* plant:

. . . . bears a seed which is called ololiuqui. This seed intoxicates and causes one to become talkative. The natives give it in a drink to injure those persons whom they wish to harm. Those who take it see visions and frightful things. Witch doctors, or those who wish to harm other people, administer it in foods and in drink. This plant is medicinal, and its seeds are good for rheumatism when they are pulverised and applied to the afflicted parts.

According to Hernández (15), the medicinal use was much more extensive than reported by Sahagún. Ololiu-

qui was believed to cure flatulency, to remedy venereal troubles, to deaden pain, and to remove tumors. When mixed with a resin (probably from *Bursera* spp.), it was used as a boneset. The seeds were pulverised and mixed with chili (*Capsicum annum* L. or *C. frutescens* L.) and milk to make a poultice which was described as a cure for "eye-troubles." The narcotic use of ololiuqui was also described by Hernández.

For extended accounts of the use of *Rivea corymbosa* as a narcotic in divination among the Aztecs, recourse must be made to the writings of Serna (54), Acosta (3, 4), Alarcón (5) and other contemporaries who had to contend with ololiuqui as a threat to the extension of Christianity in Mexico. Since these accounts are rare or are to be found only in obscure publications, and since they are written in Old Spanish, a few of the most pertinent will be translated in detail. Alarcón (5), stated, in part, that:

> Those things which I have mentioned [i.e., springs, rivers, mountains, ololiuqui, etc.] have their deities. Ololiuqui. . . . deprives those who use it of their reason. . . . The natives communicate in this way with the devil, for they usually talk when they become intoxicated with ololiuqui, and they are deceived by various hallucinations which they attribute to the deity which they say resides in the seeds. . . .
>
> It is remarkable how much faith these natives have in the seed, for, when they drink it, they consult it as an oracle in order to learn many things. . . . especially those things which are beyond the power of the human mind to penetrate, as for example, to learn the cause of an illness. . . . which they attribute to witchcraft. . . . They consult this seed through the medium of one of their deceiving doctors, some of whom practice the drinking of ololiuqui as a profession. . . . If a doctor who does not practice ololiuqui-drinking wishes to free a patient of some trouble, he advises the patient himself to partake of the seeds. For this patient must pay as though his doctor had taken the drink and were a *payni* [an ololiuqui-doctor]. The doctor appoints the day and hour when the drink must be taken and establishes the reason for the patient's drinking it. Finally, the one drinking the

ololiuqui must seclude himself in his room alone. . . .No one must enter during the divination. He who is consulting the seeds believes that ololiuqui. . . .is revealing what he wants to know. The delirium passed, the *payni* comes out of seclusion reciting a thousand fabrications, among which there may be a few truths. Thus, in every way, the doctor keeps his patient deceived. . . .

It happens that he who drinks ololiuqui to excess loses his mind because of the great potency of the seeds. As a consequence of indulgence, the senses are distorted, and he who uses the narcotic speaks whatever words come into his warped mind. . . .Perhaps he condemns the innocent, perhaps he exposes the guilty, or perhaps his words are uttered in such confusion that their meaning cannot be understood . . . .and these unfortunate people believe the utterances, attributing everything to ololiuqui. . . .For this reason, they venerate these plants [ololiuqui and peyote] so much that they do all in their power so that the use of the plants does not come to the attention of the ecclesiastical authorities. . . .

It remains to describe the manner of using ololiuqui, the purposes for which it is taken, and the great inconveniences which follow its use. . . .Chronic illness, kinds which the *curanderos* have pronounced incurable with ordinary medicines, are attributed to witchcraft and . . . , according to their belief, cannot be cured if the one who has cast the spell does not break it. This is the usual way in which the doctors make profits and wreak much injury with the satanic superstitions surrounding ololiuqui. . . .The doctor immediately attributes the illness to witchery. . . .In order to aid the doctor, the patient relates his suspicions. The deceiving doctor immediately orders the use of ololiuqui, and the patient follows the doctor's words as though they were the words of a prophet or of an oracle. . . .

In 1634, Alua (2) recorded the answers of an Indian penitent to questions which were asked during a confession. One of these follows:

"I have believed in dreams, in magic herbs, in peyote, and in ololiuqui, in the owl. . . .etc."

This statement emphasizes the fact that ololiuqui, was considered a powerful force in native religious philosophy.

In his manuscript on the idolatries of the Mexican Indians, Serna (54) treated of narcotics in detail under the caption: *De las idolatrias y abusiones y obseruaciones*

de cosas a que atribuyen diuinidad, especialmente el ololiuqui, piciete, y el peyote. Of ololiuqui, he stated in part:

They also practice much superstition with a lentil-like seed which they call *ololiuqui* and a root which they call *peyote*. They venerate these plants as though they were divine. When they drink these herbs, they consult them like oracles about sicknesses and cures, about lost or stolen articles and their location. They consult these herbs about all things which cannot be fathomed by the human mind.... Consulting these plants, . . . all their doubts and uncertainties are dispelled. Those whose profession is the use of these plants are called *payni*, which means "he who drinks a purge" or "he who drinks a syrup." These *payni* receive an excellent remuneration; if the *payni* be not skilled in his office or if he desires to avoid the uncomfortable after effects of these draughts, he advises the patient himself to drink the seeds.

These seeds... are held in great veneration.... They place offerings to the seeds. . . in secret places so that the offerings cannot be found if a search be made. They also place these seeds among the idols of their ancestors....The natives do these things with so much respect that when some transgressor of the law who has the seeds in his possession is arrested and is asked for the paraphernalia which are used in taking ololiuqui . . . or for the seeds themselves, he denies vehemently that he knows anything about the practices.The natives do this not so much because of fear of the law as because of the veneration in which they hold the seed ololiuqui. They do not wish to offend ololiuqui with demonstrations before the judges of the use of the seeds and with public destruction of the seed by burning.

In considering the use of ololiuqui as a direct medicine, Serna (54) cited a case in which the administration of the narcotic had disastrous results. He stated that:

. . . it was a serious fever and the medicine-man advised the patient to drink ololiuqui. The patient refused. Finally, however, the medicine-man persuaded all the members of the family of the sick man to drink ololiuqui to help the patient. After drinking, they lighted candles and gave ololiuqui to the sick man. All became drunk . . . And when they regained their senses, the sick man began to rage in agony against the doctor; calling him a knave, a witch. With this, the patient died.... after having drunk such a superstitious potion as ololiuqui . . . It is not without concern that Christian priests see the

facility with which the devil works among these people, even after they have been baptized and accepted into the church.

Ololiuqui was used extensively by the ancient Aztecs as an ingredient of magical ointments and potions. Ololiuqui was believed to possess a deity of its own which worked miracles if properly propitiated. One account of the use of the narcotic seeds in magical potions is that of Clavigero, translated by Cullen (9). It stated:

"Besides the usual unction with ink, another extraordinary and more abominable one was practiced every time they [the Aztec priests] went to make sacrifices on the tops of the mountains, or in the dark caverns of the earth. They took a large quantity of poisonous insects . . . , burned them over some stove of the temple, and beat their ashes in a mortar together with the foot of the *ocotl*, tabacco, the herb *Ololiuqui*, and some live insects. They presented this diabolical mixture in small vessels to their gods, and afterwards rubbed their bodies with it. When thus annointed, they became fearless to every danger. . . . They called it *Teopatli*, or divine medicament, and imagined it to be a powerful remedy for several disorders; on which account those who were sick, and young children, went frequently to the priests to be annointed with it."

Acosta (3,4), likewise wrote a detailed report on the magical use of ololiuqui, stating in part:

"This unction was made with divers little venomous beasts. . . . To make an ointment of these beasts, they put them all together and burned them upon the hearth . . . until they were consumed to ashes. Then they did put them in mortars with much tobacco or *petum* (being an herb that nation useth much to benumb the flesh that they may not feel their travail) . . . . They did likewise mingle with these ashes scorpions, spiders, and palmers alive . . . then they did put to it a certain seed being ground which they call *ololuchqui*, whereof the Indians make a drink to see visions, for that the virtue of this plant is to deprive man of sense . . . . By means of this ointment, they become witches and did see and speak with the devil. The priests being slobbered with this ointment lost all fear."

In speaking of the use of ololiuqui as an anaesthetic, Acosta stated that:

"... they said that they felt thereby a notable ease, which might be, for that the tobacco and *ololuchqui* have this property of themselves, to benumb the flesh, being applied in manner of an emplaster which must be by a stronger reason, being mingled with poisons, and for that it did appease and benumb the pain, they held it for an effect of health and a divine virtue."

Alvarado (6) also described at some length the use of *Rivea corymbosa* in magical ointments, stating, in conclusion, that:

... they place the mixture before their gods, saying that it is the food of the gods, for which reason they call it *divine food*; and with this unction, they become witch-doctors and commune with the devil.

He also mentioned the benumbing properties of ololiuqui.

Hernández (15) stated that ololiuqui was used to kill pain.

The numerous statements to the effect that ololiuqui was used to benumb the flesh and to mitigate pain command attention because of the fact that an analgesic alkaloid has been isolated from a related convolvulaceous plant—*Convolvulus pseudocantabricus* Schrenk. From this same plant were also isolated other alkaloids which may or may not have pain-killing properties. Inasmuch as Hernández, Sahagún, Serna, Acosta, Alarcón, Alvarado and other writers make reference to the benumbing or analgesic properties of ololiuqui seeds, it seems very probable that the seeds were used by the Aztecs to kill pain and that further chemical and pharmacological investigation of *Rivea corymbosa* may reveal that this plant, like *Convolvulus pseudocantabricus*, possesses analgesic constituents.

It is very doubtful that the use of ololiuqui in magical potions has survived to the present time. However, its use as an oracular narcotic and as a medicine still persists. The utilization of the plant as a remedy, while prevalent,

seems to be much less extensive at the present time than at the time of Hernández' ethnobotanical investigations.

Ololiuqui intoxication is best described by the word which Santesson (47,48) has used to characterize the narcotic condition which *Rivea corymbosa* induces in frogs and mice: *Halbnarkose* or "semi-narcosis." Reko (32) has aptly termed it *hypnotisch-somnambilistisch* or "hypnotic-somnambulistic."

In Latani and in Teotalcingo the natives administer approximately thirteen of the intoxicating seeds for narcotic purposes, and according to Parsons (28), the inhabitants of Mitla use the same quantity. The doses, however, seem to be variable in many cases. The seeds are taken in water or in alcoholic beverages such as *pulque*, *mescal*, *aguardiente*, or *tepache*. The fact that the narcotic is often administered in water would seem to indicate that the possible action of alcohol in rendering the gluco-alkaloid active is not an essential factor in the intoxication.

The intoxication begins shortly after the ingestion of ololiuqui. It rapidly proceeds to a stage where visual hallucinations appear. However, there is often an intervening stage of dizziness or giddiness followed by a feeling of general ease and well-being, lassitude and increasing drowsiness. Usually, the drowsiness develops into a stupor or a kind of somnambulistic narcosis. During this stupor, the patient is dimly aware of what is going on about him and is susceptible to suggestions. The visions which occur during the somnambulistic stage of the intoxication are described by the natives as very similar to those which are said to be induced by *Lophophora Williamsii* and by *Paneolus campanulatus* var. *sphinctrinus*. They are often grotesque visions which portray people or thoughts or happenings that have occupied the patient's mind during the preceding hours. It is partly by

means of these hallucinations and partly by means of the indistinct and dilirious talking which accompanies the narcosis that the medicine-man practices divination.

According to the natives, ololiuqui intoxication lasts normally about three hours and is followed by few unpleasant after-effects. Ololiuqui is usually taken at night and, in contrast to peyote which is eaten in company, is administered to single individuals who seek a quiet place in which to undergo the intoxication.

The intoxication which is induced by *Rivea corymbosa* resembles in some respects those which are induced by several other narcotics. *Rivea corymbosa* has retained a place of prominence among the materia medica and divinatory plants of the New World, chiefly because of its ready adaptability to the simple needs of the medicine-man or *curandero* and of those who receive his ministrations. Indeed, this adaptability of the drug to the needs of the Chinantec, Mazatec, Mixtec and Zapotec Indians may well be the main reason for the survival of the use of ololiuqui in Oaxaca.

VII. The vernacular names of Rivea corymbosa in Mexico

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: *oliliukqui; ololiuhqui; ololiuqui; ololiuhque; ololiuque; coatlxoxouhqui; 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 del la serpiente; yerba de las serpentes; yerba de la Virgen.*

Zapotec: *bador; bitoo; kwan-la-si; kwan-do-a.*

Erroneous spellings: *olilinhque; ololinhque; olininque; ololuchqui; ololinque.*

VIII. Plants confused with the narcotic ololiuqui

The name *ololiuqui* seems to have been applied to several different plants among the Aztecs, but only one of these plants was a narcotic. A parallel may be cited in the case of the term *peyotl* or *peyote* which, among the Aztecs of old and even in modern Mexico, is applied to a large number of dissimilar plants (38,51).

According to Sahagún (44,45,46), the Aztecs knew three plants by the name *ololiuqui*. Only one of these—*Rivea corymbosa*—was used as a narcotic. The other two have never been identified, but the illustrations of them in the Paso y Troncoso edition of Sahagún's *Historia*. . . indicate definitely that they are not convolvulaceous. Under the heading *De las hierbas medicinales*, Sahagún stated:

> There is an herb called *ololiuqui* or *xixicamatic* which has leaves like miltomate [*Physalis* sp.] and thin, yellow flowers. The root is round and as large as a cabbage.

Doubtless, the plant is not referable to *Rivea corymbosa*, even though for many years it has been so identified (46). Figure 566 in the Paso y Troncoso edition depicts a plant with leaves which could easily be taken for those of a species of *Physalis*. The flowers are figured as gamopetalous, with long-exerted stamens; and the habit appears to be herbaceous.

The third *ololiuqui* of which Sahagún speaks was also known as *hueyytzontecon*. It was medicinal. Its leaves were figured as ternate; its flowers lavender or whitish; and its root tuberous. The flowers apparently were gamopetalous and the habit herbaceous. Although this *ololiuqui* was reported to be used as a purge and although other characters might suggest the Convolvulaceae, the plant is not referable to this family.

Sahagún himself emphasized the fact that *ololiuqui* was a term which designated different plants when he wrote: "En otra parte, se puso este nombre ololiuqui, pero son diferentes hierbas."

In Oaxaca, *ololiuqui (Rivea corymbosa)* is often called *piule*. *Piule*, like the word *peyote*, apparently refers to numerous plants other than *Rivea corymbosa*. In 1919, Reko (30) reported *piule* as one of the names designating *Rivea corymbosa*. Since this time, however, the same name has been found to refer to several species of *Rhynchosia* in Oaxaca. In 1923, Herrera (16) included *Rhynchosia longeracemosa* Mart. & Gal. (*Dolichos longeracemosa* (Mart. & Gal.) Rose) under the name *piule*. In 1938, Santesson (49) carried out pharmacological and chemical studies with piule seeds which were referred to *Rhynchosia phaseoloides* DC. Positive tests for alkaloides and for glucosides were obtained, and extracts of the seeds produced narcosis when injected into animals. The writer found that the Chinantec and Mazatec Indians of Oaxaca both regard these two species of *Rhynchosia* as poisonous, and Reko, in a personal communication to the author, states that the seeds of *Rhynchosia phaseoloides* have been used as a narcotic among the Zapotecs of Oaxaca.

IX. Summary

I. Ololiuqui, one of the most important narcotics of ancient and modern Mexico, has been imperfectly understood and interpreted by many botanists and anthropologists in spite of the fact that all of the information essential to a clear understanding has long been available.

II. All of the ancient writers described ololiuqui as a vine with coriander-like seeds. Hernández and Sahagún figured ololiuqui as a convolvulaceous plant. In 1897, Urbina correctly identified ololiuqui as *Rivea corymbosa*

(L.) Hall. f., but, in 1915, Safford referred ololiuqui to *Datura meteloides* Dunal ex DC. The Safford identification, although erroneous, gained wide acceptance, and, in spite of a reaffirmation of the Urbina identification by Reko in 1934, has persisted.

III. *Rivea* is a segregate of the genus *Ipomoea* and the genus has its greatest development in Asia. *Rivea corymbosa* is the only species of the New World. The correct combination for this plant of Central America, the West Indies, and the northern part of South America, is *Rivea corymbosa* but several other names are more frequently used for it.

IV. Recent investigation has demonstrated the presence in *Rivea corymbosa* of a resinous constituent and a gluco-alkaloid. The gluco-alkaloid is physiologically active, producing narcotic effects.

V. The Convolvulaceae are characterized by having resins of a glucosidal nature. The purgative action of some of the species of this family is due to the glucoresin content of the plants.

VI. *Rivea corymbosa* was used by the Aztecs in prehispanic times as a narcotic in divination, as a medicine, and as an ingredient in magical and analgesic ointments. The plant is used at the present time in Oaxaca, being known among the Chinantec, Mazatec, Mixtec and Zapotec Indians.

VII. *Rivea corymbosa* has been known under a number of different vernacular names.

VIII. The name *ololiuqui* was applied to at least three different plants by the Aztecs, but only one of these plants was a narcotic. The name *piule* is used at the present time in Oaxaca to refer to *Rivea corymbosa* as well as to the poisonous species of *Rhynchosia.*

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