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LATUA PUBIFLORA
MAGIC PLANT FROM SOUTHERN CHILE

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INTRODUCTION

The Solanaceae or Nightshade Family has long been known for its narcotic, poisonous and medicinal plants, as well as for several important food plants. Various genera, such as *Datura*, *Mandragora*, *Atropa*, and *Hyoscyamus*, contain potent alkaloids which have physiological effects on man. Native peoples throughout the world have discovered these plants and their properties quite independently of one another. For example, in both the Old and New Worlds, different species of the genus *Datura* have been widely used as narcotics and poisons by peoples as different as the Hindus, ancient Greeks and American Indians.

This cultural convergence has occurred not only in the kinds of plants used but also in the circumstances and purposes involved in their use. Many solanaceous species contain the so-called belladonna alkaloids, including hyoscyamine and scopolamine. These substances have a marked effect on the central nervous system, producing delirium, hallucinations and trance-like states often re-

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sembling psychosis. Consequently, solanaceous drugs have been widely employed in native cultures for witchcraft and shamanism. Medicine men consider these plants valuable agents for communicating with the spirit world in order to diagnose the cause of illness. As in the case of other hallucinogenic plants, these species have definite therapeutic value and have long been administered for strictly medicinal purposes in diverse parts of the world.

One of the rarest and most interesting genera of the Solanaceae with these striking narcotic and toxic properties is *Latua*, an endemic from southern Chile with a single species: *L. pubiflora*. Owing to its great beauty and toxicity, *Latua* evoked some interest among botanists and pharmacologists shortly after its discovery in the middle of the 19th Century—an interest which led to a number of articles on the characteristics and effects of the plant. Yet, *Latua* still remains relatively unknown for two reasons. First: the plant grows only in the narrow coastal cordillera between Valdivia and Chiloé, a difficult mountainous terrain with an extremely wet climate and few roads; during the rainy season, the existing roads are nearly impassable. Second: the occurrence of *Latua* and its use is a closely guarded secret surrounded by much superstition, since the plant is employed primarily by local shamans and sorcerers in their magical healing rites. Those familiar with *Latua* and its properties are very protective of this knowledge and are unwilling to discuss it with outsiders. For this reason, little has appeared in the literature concerning the ethnotoxicity of *Latua*. We hope to summarize present knowledge of this plant and to add the results of our own chemical, botanical and anthropological research.

Latua pubiflora (*Griseb.*) *Baillon*, Hist. Plant. 9 (1888) 334.

Lycioplesium pubiflorum Grisebach, Syst. Bemerk. (1854) 40.

Latua venenosa R.A. Philippi in Bot. Zeit. 33 (1858) 24.

Shrub to small tree 2–10 m. tall, with one to several main trunks 3–25 cm. in diameter, spreading upward and outward from base. Bark thin, streaked with corky, longitudinal fissures, becoming somewhat rough, reddish to greyish brown. Branches smooth, grey, armed with spines. Branchlets cylindrical, those of current year's growth covered with yellowish brown pubescence, glabrescent. Spines erect, arising as modified branches in leaf axils, rigid, up to 2 cm. long, usually with a small leaf at the base and one or two minute cataphylls towards the apex. Leaves alternate, fascicled on short shoots or scattered on long shoots, simple, narrow-elliptic to oblong-lanceolate, apically acuminate, marginally entire to erose-serrate, basally attenuate, 3.5–12 cm. long, 1.5–4 cm. wide, pilose, glabrescent, dark to light green above, paler green beneath; petiole usually short, 2 mm. long, pilose, glabrescent. Stipules absent. Peduncle solitary, arising in the axil of a spine and its basal leaf, erect, 1-flowered, 5–9(20) mm. long, tomentose, with a series of overlapping bud scales at the base; scales ciliate, ovate, about 2 mm. long. Calyx inferior, gamosepalous, 5-parted, campanulate, persistent, somewhat accrescent, 8–10 mm. long, rugulose with tomentose pubescence, pale green to purplish, lobes valvate, acute, triangular, erect, about 3 mm. long; calyx in fruit 11–16 mm. long, splitting irregularly. Corolla much larger than calyx, gamopetalous, 5-parted, regular, elongate-urceolate, inflated, 3.5–4 cm. long, 1.5 cm. in diameter at the middle, densely pilose without, variably colored magenta to red-violet, lobes short, trilobate, recurved, about 5 mm. long with induplicate-valvate aestivation. Stamens 5,

inserted at base of corolla; filaments of different lengths, slightly exceeding corolla, filiform, 3–4 cm. long, adnate for 8 mm., basally pilose, glabrous above, bright pink; anthers bilocular, elliptic, longitudinally dehiscent, 2 mm. long, brownish; pollen ash grey, tricolporate. Ovary ovoid, basally gibbous, bilocular, with numerous anatropous ovules attached on axile placenta; style filiform, equalling corolla, 3 cm. long, pink; stigma short, semicircular, slightly bilobulate, bright green. Fruit a fleshy berry, globose, 2 cm. in diameter, apiculate, pale green to yellow. Seeds numerous, somewhat reniform or irregular, often flattened ventrally, 2 mm. in diameter, albuminous; testa thick, reticulate-pitted, dark brown to black. Embryo cylindrical, slightly curved.

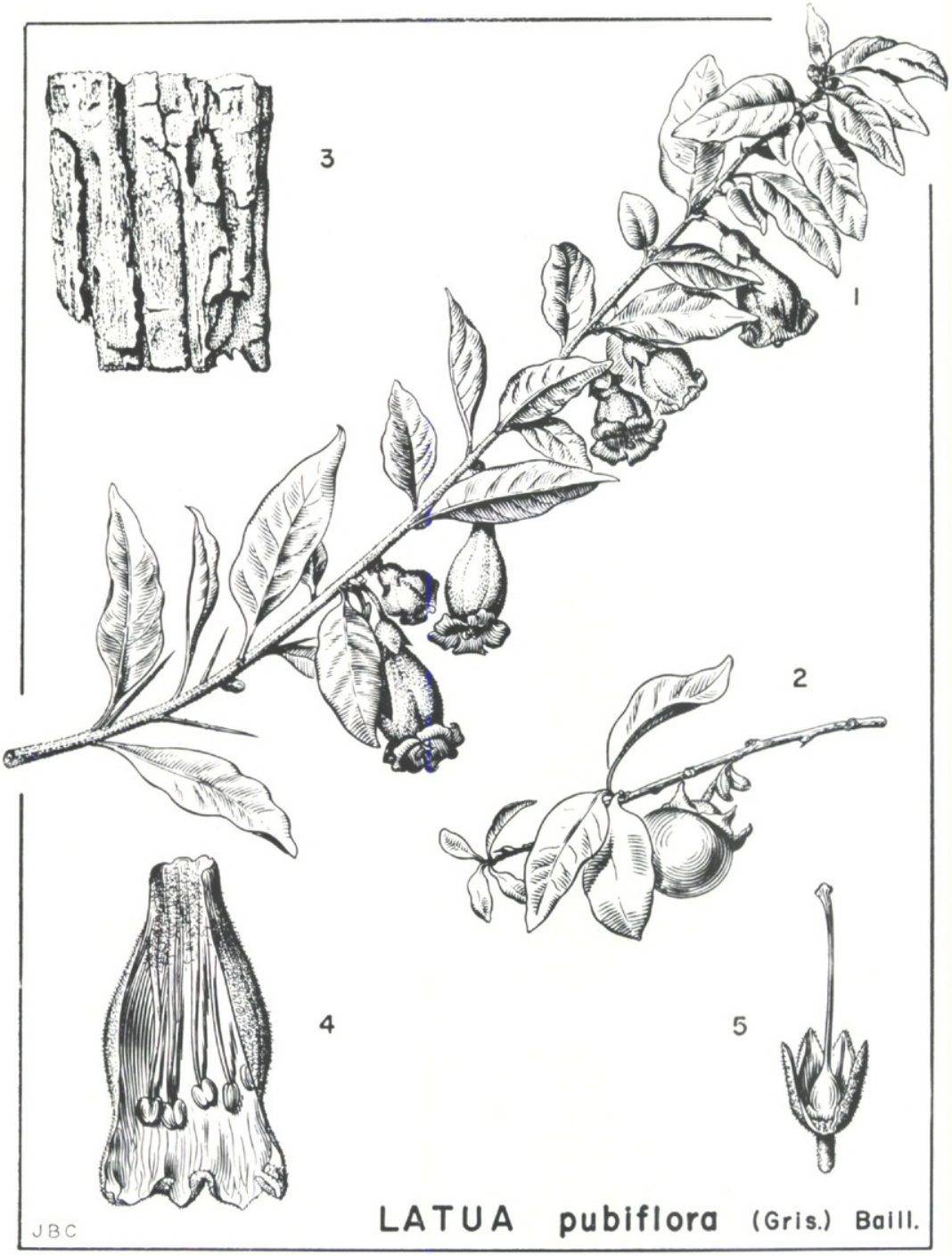
CHILE. CHILOÉ: In sylvis montanis, pr. Ancud, flores coccinei, incolis Taio, Jul.m. *W. Lechler 880* (type, GOET, not seen; photograph of type, GH; isotype, K).—Chiloé; 1848, *Lobb s.n.*(K).—Ancud, frutex venenosissimus; 1861, *Philippi s.n.*(K).

LLANQUIHUE: Along roadsides and in pastures between El Ñadi and Estero Mañío, Cordillera de Zarao; 22-III-1969, *T. Plowman 2609* (ECON, GH, K).—Tree 10 m. tall in woods behind church in El Ñadi, Cordillera de Zarao, 300 m. elev.; 23-III-1969, *Plowman 2613* (ECON, GH, K).

OSORNO: San Juan de la Costa; 1-X-1938, *C. Rudolph 5507* (Herbarium, Universidad Austral, Valdivia=VALD).—San Juan de la Costa; 23-III-1939, *J.L. Morrison 17613* (GH, K).—Aleucapi; 14-II-1944, *Rudolph 5566* (VALD).—Huitrapulli; 30-I-1949, *Rudolph 5595* (VALD). About 10 mi. east of ocean on road to Osorno; 29-I-1958 *W.J. Eyerdam 10528* (US).

VALDIVIA: Valdivia, *Philippi s.n.* (G, not seen; photograph, GH)—Valdivia; 1863, *Pearce s.n.* (K).—San José, *E.C. Reeed s.n.* (K).—Along the shore of a stream, La Ensenada, Corral; 20-IX-1931. *H. Gunckel 3750* (Herbarium, Facultad de Química y Farmacia, Univ. de Chile, Santiago=FARM). La Ensenada; 16-X-1935, *Gunckel 79* (K).—Chaihuín; XII-1936, *Gunckel 11824* (FARM).—Bima District, west of La Unión, Cordillera de la Alerce, 500–900 m.; 11-II-1958, *Eyerdam 10640* (US).—Cordillera de la Costa near Valdivia; X-1962, *K. Kubitski 371* (VALD).—Along road from La Unión to El Mirador, 500–700 m., growing at edge of forest and in pastures; 30-III-1969, *Plowman 2643* (ECON, GH, K).

PLATE III



Latua pubiflora (Gris.) Baill. 1, flowering branch, one-half natural size. 2, fruiting branch, one-half natural size. 3, portion of bark, natural size. 4, excised corolla, approximately natural size. 5, calyx with ovary, approximately natural size.

Drawn from *T. Plowman 2643* by JOSHUA CLARK

Latua was first described in 1854 by Grisebach as a new species of *Lycioplesium*—*L. pubiflorum*—from a specimen collected by Lechler near Ancud in Chiloé. In 1858 the Chilean naturalist R.A. Philippi described the same plant as a new genus *Latua*, using the specific epithet *venenosa* (1858, 1864). The correct combination *Latua pubiflora* was first made by Baillon in 1888, not by Philippi as stated by Wettstein (1891) and Reiche (1910) (see Hunziker, 1960). The name *Latua venenata* Phil. appeared as an error in Hooker's Botanical Magazine (1863) and has been perpetuated in synonymy by several authors.

Latua pubiflora is found sporadically in the coastal mountains of southern Chile between 40° and 43° latitude from the province of Valdivia to Chiloé (see Plate IV). This region has a very wet climate with over 2540 mm. (100 in.) of rainfall annually. *Latua* occurs primarily in the middle elevations of the cordillera between 300 and 900 m. (900–2700 ft.).

The plant grows usually as a tall shrub along clearings and in secondary forests. Due to extensive deforestation for timber and grazing, much of its present range is now occupied by fields and pastures. *Latua* has adapted especially well to these open conditions and is now becoming a weed along roadsides and in open places. It spreads easily by adventitious branches from the underground parts, thereby thwarting efforts to eradicate it by cutting. In shaded woodland, *Latua* may reach a height of ten meters, growing in association with *Eucryphia*, *Laurelia* and *Chusquea*. Although locally common, it is known from relatively few localities.

In the northern provinces of Osorno and Valdivia, *Latua* begins to flower at the beginning of the rainy season in October, producing fruit in February and March. Further south, where there is less seasonal

PLATE IV

THE KNOWN DISTRIBUTION OF LATUA PUBIFLORA

Insert map taken from Goode Series of Base Maps, No. 203, Univ. of Chicago.

change in precipitation, the plant flowers in March (Llanquihue) and July (Chiloé). There may be more than one flowering a year, but we have not observed this.

Latua is pollinated by hummingbirds, as might be suspected from the reddish, tubular and pendulous flowers. The statement by Mariani (1965) that birds and animals avoid the branches of *Latua* is probably a folk tale based on the plant's evil reputation.

There has been some discussion about the color of the flowers of *Latua* (Scala, 1920; Gunckel, 1933). The label on the type bears the words *flores coccinei*, i.e. deep red. Other authors have referred to them as violet (Murillo, 1889), red (Wettstein, 1897) and dark violet or *atro-violaceus* on the chromotaxy scale of Saccardo (Gunckel, 1933). Plowman observed flowers from several localities and noted that there is some variation but that they are usually magenta (Horticultural Color Chart 27/1).

Young anthers were collected and preserved in Carnoy's solution (Voucher specimen = *Plowman 2643*). Meiosis in the pollen mother cells showed metaphase figures with nine bivalents (N = 9), (see Plate V). This is an uncommon number for the Solanaceae, where the base number 12 is very prevalent. However, nine pairs of chromosomes have been reported for several genera in the family, including *Fabiana*, *Nierembergia*, *Petunia* and *Nicotiana* (Darlington and Wylie, 1955).

Latua has been placed in various parts of the Solanaceae, since different investigators have used different criteria for delineating the tribes. Bentham and Hooker (1876) included *Latua* in the Solaneae on the basis of the valvate aestivation of the corolla, removed from such genera as *Lycium* and *Atropa* with imbricate aestivation. Wettstein (1898), considering the number of cells in the ovary a more important character, placed *Latua* in the

PLATE V

METAPHASE CHROMOSOMES OF THE FIRST MEIOTIC DIVISION IN LATUA PUBIFLORA. N=9

Solaneae, subtribe Lyciinae, along with *Lycium* and *Atropa*. Until more work is done on the phylogenetic relationships in this family, these considerations will remain problematical.

The generic epithet *Latua* was taken from the native Mapuche name for the plant. Two variants of the name have appeared in the literature: *latúe* (Philippi, 1858; Lenz, 1904; Reiche, 1910) and *latué* (Murillo, 1889; Valenzuela, 1917; Gunckel, 1959). Plowman recorded a third variant *latuy*, in use at Puerto Montt in the Province of Llanquihue. Most probably several variations in pronunciation exist from one locality to another. *Latúe* and the longer form *latue-hue* are translated: "that which causes (something) to die". These forms are derived from the Mapuche words *lan*, "to die"; *tu*, a causative particle; and *hue*, "the instrument with which something is done" (Febrés, 1765; Lenz, 1904; Valenzuela, 1917). This native name for the plant indicates an explicit recognition of its poisonous nature.

The Spanish names of *Latua* also reveal a knowledge of its toxic properties: *palo mato*, literally "the tree that kills", meaning the same as latúe (Philippi, 1858); *palo de los brujos* (Philippi, 1858), *árbol de los brujos* (Lenz, 1904) and *palo de bruja* (Philippi, 1869; Miranda, 1918), all meaning "witches' tree".

Latua should be regarded first as a poisonous plant. Its toxicity has been frequently mentioned in the literature (Murillo, 1889; Dragendorff, 1898; Reiche, 1901; Lewin, 1929), although there are very few records of actual poisonings. Accidental poisonings are apparently frequent, due to the superficial resemblance of *Latua* to a commonly used medicinal plant of the same region, the *tayu* (*Dasyphyllum diacanthoides* (Less.) Cabr. = *Flotowia diacanthoides* Less., Compositae). This confusion was first mentioned by Philippi (1861) in his

PLATE VI

Habit of *Latua pubiflora* growing in open pasture, Cordillera Pelada, Province of Valdivia, Chile. Photograph by HANS KLEMPAU.

original account of *Latua*, in which he reported several cases of inadvertant poisonings:*

> It has been six years now since I first learned that the Indians of the Province of Valdivia possess a secret way of producing insanity with a poisonous plant, for a long or short time depending on the dose. It is considered with great secretiveness. Padre Romualdo, a missionary in Daglipulli, succeeded in learning that the plant is a tall shrub called *latúe* which grows in the forests of the coastal mountains. He was finally able to obtain a branch of it. This had no leaves, however, since the Indian who brought the plant thought that the Padre wanted it in order to examine its poisonous qualities which lie mainly in the bark. Later, I learned the details of *latúe* from Señor Juan Renous. The shrub is very similar in its growth, thorns and leaves to *tayu* or *palo santo*, but the flowers are like *Sarmienta repens* R. & P. in their size and shape. . . . Of the fruit, Señor Renous had nothing to report, but he did tell me of several cases of intentional and unintentional poisonings. The latter occur quite readily since, as mentioned, the shrub is so very similar to *tayu* whose bark is used externally and internally in the form of a decoction for bruises, blows caused by falls or kicks, etc. He related to me among others the following case which had just recently occurred. One of his woodcutters had suffered a strong blow with the blunt end of his axe and went into the forest to get some bark of *tayu* for it. He took instead *latúe* and drank a concoction of this poison. He became insane almost immediately and wandered into the mountains. He was found three days later in an unconscious state. Several days were required for his recovery, although he suffered severe headaches for several months. The fruits are just as poisonous as the bark and in their color and size somewhat resemble young apples. Some people who were traveling from Osorno to Maullín, where *latúe* also grows, mistakenly ate a few fruits. They arrived at Maullín completely bewildered and nearly unconscious. Unfortunately, I have none of the details of the symptoms which the ingestion of *latúe* produces, nor of the antidote which the Indians employ to combat the dire effects of poisoning.

Here and elsewhere (Mariani, 1965), there are references to malevolent and criminal uses of *Latua*. Several natives from Llanquihue (Río Frío) told us of such deliberate poisonings to produce insanity or death. It is

* Translated by T. Plowman.

Flowering branch of *Latua pubiflora*. Photograph by HANS KLEMPAU.

occasionally suspected that insane persons have been given *Latua* by an enemy or sorcerer. This belief arises in great part from superstitions associated with the use of the plant in magical practices.

It has been frequently stated that the ingestion of the juice of the leaves and fruits of *Latua* causes death (Guajardo, 1890; Urban, 1934; Mariani, 1965). We have not, however, encountered any actual cases of fatal intoxication. *Latua* has also been credited with aphrodisiac properties (Eyerdam, 1958, herbarium label; Mariani, 1965) and has been employed as an ingredient in love potions (Bodendorff and Kummer, 1962). Although this use has not been confirmed, it is interesting to recall that the seeds of *Datura Metel* L., containing the same alkaloids as *Latua*, were commonly utilized in India for the identical purpose (Safford, 1920).

Latua was employed formerly as a fish poison by the native Chileans. Pomar (1901) wrote that the juice of *Latua*, as well as that of *Drimys Winteri* Forst., was placed in the still water of rivers and caused fish to become torpid and easily caught.

Local inhabitants in Llanquihue Province informed Plowman of the common methods of preparing *Latua*. This knowledge seems to be rather widespread among native farmers. Padre Leandro Serna (1969) of Río Frío mentioned the following method of taking the plant, stating that the bark of a young branch with plenty of sap is placed in hot water. The resulting liquid is served in a cup of wine, coffee or soup, or in a cigarette. Another informant asserted that the leaves or stem are boiled for two hours before drinking. One-half cup of this decoction supposedly will produce intoxication.

The effects of taking *Latua* are still rather poorly known. Those symptoms which have been recognized closely resemble a characteristic belladonna intoxication.

A native informant described the physical effects to be dry mouth and hot feverish feeling in the body; other effects are marked dilation of the pupils (Miranda, 1918) and frothing at the mouth (Serna, 1969). Effects on the central nervous system reportedly include acute mental disturbances and "insanity" (Philippi, 1869; Reed, 1892; Gotschlich, 1913), as well as convulsions, delirium and hallucinations (Murillo, 1889). Mariani (1965) has described these cerebral effects as intense psychomotor agitation accompanied by delirium which corresponds to acute, exogenous, toxic psychosis. Symptoms of intoxication may occur immediately after ingestion (Philippi, 1868) or as long as 24 hours later (Serna, 1969). Some symptoms, especially headaches, may last for weeks or even months.

There are several antidotes known and used in local medicine to combat the effects of *Latua* poisoning. Most frequently mentioned is the ubiquitous *hierba mora* (*Solanum nigrum* L., Solanaceae). (Murillo, 1889; Mariani, 1965; Sparre, 1970). A decoction of *mora* is drunk for eight days while fasting. Compresses soaked in the infusion are wrapped about the head and neck or rubbed on the back. Other plants similarly used are *culle* (*Oxalis* sp., Oxalidaceae) and the fruit of *espino negro* (*Rhaphithamnus spinosus* (A. Juss.) Moldenke, Verbenaceae).

A rare account of the action of *Latua* is given by Dr. Benkt Sparre, Curator at the Museum of Natural History of Stockholm. At the time of his self-experiment, he was Professor at the Universidad de Concepción (Chile). In a letter to the authors, he describes his experiment in the following way:

> *Dec. 12, 1953—Latua pubiflora* was collected at La Posada, about 3–4 kilometers north-northwest of Maullín (Llanquihue, Chile) *Sparre and Smith 331* (material in herbarium at Concepción and Smithsonian Institution, Washington, D.C.), sample: Smith 119-H-E (Beltsville, Maryland, U.S.A.).

According to explanations by elderly villagers of La Posada, who had not tried latue themselves, an infusion was prepared in the evening with green leaves and bark. It was said that only "los hechiceros" (witches) used latue. Intoxicated and with an appropriate refill from a "sub-hechicero" (witch's apprentice), they could dance and preach for a week. None of my informants had seen this, but they had heard it from old people. According to the same informants, "los hechiceros" could quickly recover with a drug from a *Solanum* species of the section *Morella* (to which *Solanum nigrum*) belongs. Some of these species were collected nearby, but my friends could not tell me which they were. They only knew the vernacular name, "hierba mora", which is *Solanum*, but as we know, the vernacular names mean very little. It might have been something which looked like *Solanum* "hierba mora".

Jan. 1, 1954.—In the evening, just prior to a fête-champêtre at Centinela where we lived in an agricultural college, about 5 centiliters of the infusion were taken. After approximately three hours, I noticed extreme dryness in my mouth, a strong urge to spit, which was made difficult due to the fact that the saliva dried to a whitish and later more solid froth. A strong urge to urinate was also felt. This was unfortunately impossible as the urine emerged just one drop at a time though repeated attempts were made.

Somewhat later, possibly three or more hours after the consuming of the infusion, I felt a "heavy" intoxication. This was not like alcoholic inebriation, where you have rather happy and agreeable thoughts and events before a hazy state occurs. This was an immediate and almost complete loss of memory.

Without my knowledge, my friend, Dr. Earl E. Smith, Beltsville, brought me home and put me to bed. In my journal I noted that I "missed my chance with the girl", but later Smith consoled me and told me that the girl in question had a face like a horse although she had a beautiful body. Even this mistake might have been due to the infusion.

Jan. 3, 1954.—I awoke in the middle of the night with, as I remember, a kind of claustrophobic feeling, or it might have been a normal feeling that woke me up followed by the claustrophobia. I could not find the toilet and started to run down the passage. According to what I remember, it was dark and I hit walls and doors. My nose started to bleed. In one way or another, I went into Smith's room and when I felt something that seemed to be a bed, I crept down—to Smith's surprise and alarm. He later told me that with force he managed to lead me back to my own room and locked me in.

I had quite a hangover the next morning, although I was fairly clear in the head, and wanted to take part in a previously planned excursion. At breakfast, with Prof. Lars Brundin, Stockholm, Docent Kuno Thomasson, Uppsala (born in Estonia), Dr. Heinz Löffler, Vienna, and a few Chileans among others in attendance, I suddenly spoke to those present in a completely unknown language without looking at anyone present. Unfortunately, I remember nothing from this conversation, nor with whom I thought I spoke. Possibly it was one of the last of the Araucarian hechiceros who finally had found a chap to talk with. What I remember is that I suddenly jumped out of my chair, thinking that someone wanted to beat me. It was my own hand which hung on the back of the chair which frightened me. I was unable to read a message on a piece of paper I had received before breakfast.

During the day-long excursion, I was periodically fairly clear, periodically drowsy. During these latter periods, I saw the forest around the road as some kind of Russian boyar-ballet in heavy costumes. Oddly enough, green was the dominant colour.

In the afternoon I felt fairly well restored, though my working capacity was less than usual. I still could not read.

Jan. 4, 1954.—Smith and I proceded on our trip at a normal pace, though in the morning I still could not read. In the evening, I wrote notes in my journal, but I had difficulties in keeping to the lines.

Jan. 5, 1954.—Completely normal sight. Normal condition.

This account as well as the Spanish names for *Latua* —"palo de bruja" and "árbol de los brujos"—suggest that the plant plays a role in magic and shamanism. Although we now know that this is true, the role has never been described in any detail. In 1892, Reed first wrote that *Latua* was "much used by curanderos to produce convulsions and insanity". Gusinde (1936) mentioned that the plant was employed by the *machi* or shaman for its poisonous qualities. Since *Latua* is intimately associated with certain magical and religious practices of the indigenous Chileans, it is important to understand the relationship between these people and their magical plants, and especially the role of the *machi*.

The inhabitants of southern Chile belong to several groups, all of which are now referred to as Mapuche or

Araucarian. The southernmost tribe, known as Huilliche and extending to Chiloé, are the people who know and use *Latua.* As in many other South American tribes, the Mapuche nearly always have one or more medicine men or shamans, known as *machis,* who are responsible for curing the sick through their magical powers and with medicinal herbs. In the Mapuche psyche, it is believed that all diseases and death are caused by certain evil spirits called *wecuvu. Wecuvu* may exist anywhere and in many different forms or beings. Man has very little control over these ever present demons, except through the machi who is able to interpret and assuage their evil influences. The primary function of the *machi* then is to heal sickness by discovering and exorcising the appropriate *wecuvu* which has bewitched the patient (Cooper, 1946).

The *machi* is usually a woman, although in former times this occupation was served by men or male transvestites (Latham, 1922; Faron, 1964). In early youth, the future *machi* receives a divine revelation, after which she dedicates her life to this role in the community. She receives instruction and training from older *machis* who impart their knowledge of magic and healing to the young novitiate. Persons who enter this profession are usually extremely nervous and psychic. Not uncommonly they are epileptic and readily disposed to trances, auto-hypnosis and clairvoyant states. During these altered states of consciousness, they are able to communicate with the spirit world and to serve as intermediaries between the people and the supernatural powers.

The *machi's* training period is devoted to developing her psychic abilities through various methods: intense mental concentration and meditation, chanting, fasting, violent exercise in the form of whirling dances, auto-hypnosis and the constant use of narcotics. She also re-

ceives extensive instruction in the utilization of native medicinal plants which form the physical basis of her healing powers. She is at once doctor and magician, playing a decidedly benevolent role in the community, in contrast to the sorcerer or *kalku* whose role is decidedly evil (Faron, 1968). Using her magical powers, the *machi* may determine the cause of someone's death, foretell the future, bring good or bad luck and discover stolen objects. Such acts of divination are common shamanistic practices among New World peoples.

The curing ceremony of the *machi*, known as the *machitun*, is a complex ritual deeply rooted in cultural traditions. This ceremony varies considerably from place to place, for each *machi* conducts the rites as learned in her own region. There are, however, several practices in common throughout the area. The trance state of the *machi* is nearly always basic to the ceremony. Other aspects are the use of the sacred canelo tree (*Drimys Winteri*), the playing of a small drum (the *kultrun*) by the *machi* and the fumigation of the patient with tobacco smoke. The *machi* usually has a sacred pole or *rewe* constructed near her hut. This consists of a trunk of canelo with rough-hewn steps cut in the form of a ladder. It is planted in the ground with smaller branches tied around it.

During the *machitun*, the *machi* smokes constantly and plays her drum with a monotonous rhythm. She is usually accompanied by one or more assistants who dance and sing a hypnotizing chant, designed to intensify the *machi's* trance. When the *machi* reaches a highly transformed state of mind, she climbs up the *rewe* while her helpers dance around. She then falls into a swoon, often epileptic in nature, and is caught in a blanket held by her assistants beneath. At this time, the source of the sickness or perpetrator of evil is revealed to her. The

machi then mutters incoherently, and her assistants interpret the divinatory mumblings.

In addition to this revelatory state, she also employs other means of determining the cause of illness. Often she will kill a lamb and extract the heart; or she may pretend to remove the patient's intestines, which are then magically replaced without a scar; or she will pretend to remove from the patient's body some foreign object, such as a worm or a thorn, which is the presumed source of trouble (Latcham, 1922; Cooper, 1946).

Hallucinogenic and narcotic plants play an important role in the life of the Mapuche shaman. These drugs are normally employed during the *machitun* ceremony and are administered to the young *machi* as part of her education. Certainly these psychoactive plants have a powerful effect on her psyche and enable the *machi* to experience what Castaneda (1968) has called "non-ordinary reality", consisting of trances and hallucinatory states. In this realm of consciousness, she is capable of free exchange with the spirit world from which she derives her magical healing powers. It is not surprising that the plants used to produce these states are considered sacred and secret.

Tobacco has been regarded as the most important narcotic plant of the *machi* (Latcham, 1922). Several strongly intoxicating varieties are known and smoked in ceremonial pipes or cigars, snuffed in powder or chewed. Tobacco is not only smoked by the *machi*, but the smoke is blown upon the patient to purify him. This plant serves a dual purpose of exorcising the demonic spirits and of propitiating the Supreme Being.

A species of *Datura* is also employed narcotically by the Mapuche. *Datura Stramonium* L., known as *miayu* or *chamico*, has been used to discipline unruly children who are fed the seeds in order to narcotize them mildly, while they are lectured by their elders (Gusinde, 1936;

Cooper, 1946). *Datura Stramonium* subsp. *ferox* (L.) Barclay has been used medicinally as an anesthetic (Pérez de Barradas, 1957). We may assume that the *machi*, like her counterparts in other cultures, has a wide knowledge of this plant and all its properties, including its hallocinogenic and trance-inducing effects.

It has only recently been confirmed that *Latua* is employed by the *machi* as a psychoactive agent. This was revealed to Sr. Rolando Toro, a psychologist from Santiago, who attended a *machitun* in Chiloé, in which *Latua* played an integral part of the ceremony. His account follows:

> *Latua* is used in an infusion by the shamans or curanderos, who ingest it during nocturnal ceremonies of a magical nature. After drinking the infusion at 20 to 30 minute intervals, they slowly begin to sing and dance in a circle. The chants are variations on the word latué:
>
> Latué – latué – la – tué
> La – la – la – tué
> Tué
> La – tué
> La – a a – a (slowly)
> La – tué – la – tué – la – tué (fast).
>
> Their movements are monotonous and consist in marking the rhythm by stomping their feet on the ground, along with movements of the head with the arms hanging like wings. The movements are not graceful but rather rigid, like those of catatonia. The dances last for four to six hours with intermittent prayers:
>
> "Con un tizón ardiendo
> Cristo quema el mal
> de vientro de N."
> With a firebrand
> Christ burns the evil
> from the belly of N. (here the name of the patient).
>
> The cure consists in driving the demons from the body of the patient. To do this, he is slapped with branches of *palqui* (*Cestrum Parqui* L'Her., Solanaceae) and is made to drink a potion which makes him vomit. Then his face is covered with the genital skin of a goat. The cure embraces every type of physical and mental infirmity and is always given at night. These meetings are equivalent to a witches' sabbath with curative ends.

We do not know how widespread is this use of *Latua*, although it must be known to most of the *machis* in the region in view of their familiarity with the medicinal flora. It is of interest to note the Christian influence which has been incorporated into a primarily indigenous ceremony. This mixture of religious elements is reminiscent of shamanistic practices in other areas, such as the ceremonial use of *ayahuasca* and *San Pedro* in Peru, magic mushrooms and *peyote* in Mexico. *Latua* must now be appended to the growing list of plants used in magico-religious rites for hallucinogenic purposes.

Experimental

Material

The numbers of the voucher specimens given in the table and legends to figures refer to the collection number of T. Plowman. Voucher specimens have been deposited in the Economic Herbarium of Oakes Ames, Botanical Museum of Harvard University.

Isolation of Alkaloids

20 g. of the powdered plant material and 10 g. of diatomaceous earth were stirred with 30 ml. of chloroform and 10 ml. of a 1 M solution of sodium carbonate to form a homogeneous mixture. The mixture was packed in a glass column (1.7 x 60 cm.) and eluted with 300 ml. of chloroform (flow rate 1 ml./min.). The eluate was passed through another column of the same size packed with a mixture of 15 g. of diatomaceous earth and 2 ml. of 1 M phosphoric acid. The alkaloids were eluted with 250 ml. of chloroform saturated with ammonia and passed through a column (1.7 x 8 cm.) containing 10 g. of aluminium oxide (flow rate 1 ml./min.). The chloroform extract was dried with anhydrous sodium sulphate, filtered and evaporated to dryness (Pharmacopoea Nordica, 1964).

Gas Chromatography (GC)

Gas chromatographic analysis was performed with an F & M Model 400 apparatus equipped with hydrogen flame ionization detection system. The column support, 100–120 mesh Gas Chrom P, was size-graded, acid-washed and silanized according to the method described by Horning *et al.* (1963). The coating was applied by the filtration technique (Horning *et al.*, 1959). The stationary phase used was 5% SE-30 (2.25 m. x 3.2 mm. glass tube). The column was operated at 200° and the injector block and the detector chamber were kept at 250°. The amount of alkaloids in mg./100 g. dry plant material and the percentage of each alkaloid in the alkaloid mixture was determined by planimetry using atropine and scopolamine as standards.

Gas Chromatography – Mass Spectometry (GC–MS)

The principles of the technique have been described earlier (Holmstedt and Lindgren, 1967). The mass spectrometry work was carried out with an LKB 9000 gas chromatograph-mass spectrometer. The ion source was 270°, the electron energy was 70 eV and the electron ionization current 60 A, respectively. The separations were made on a column (2 m. x 3.2 mm.), packed with 5% SE-30 on Gas Chrom P at 210°.

Results

The results are presented in Table I and Plates 6, 7.

Discussion

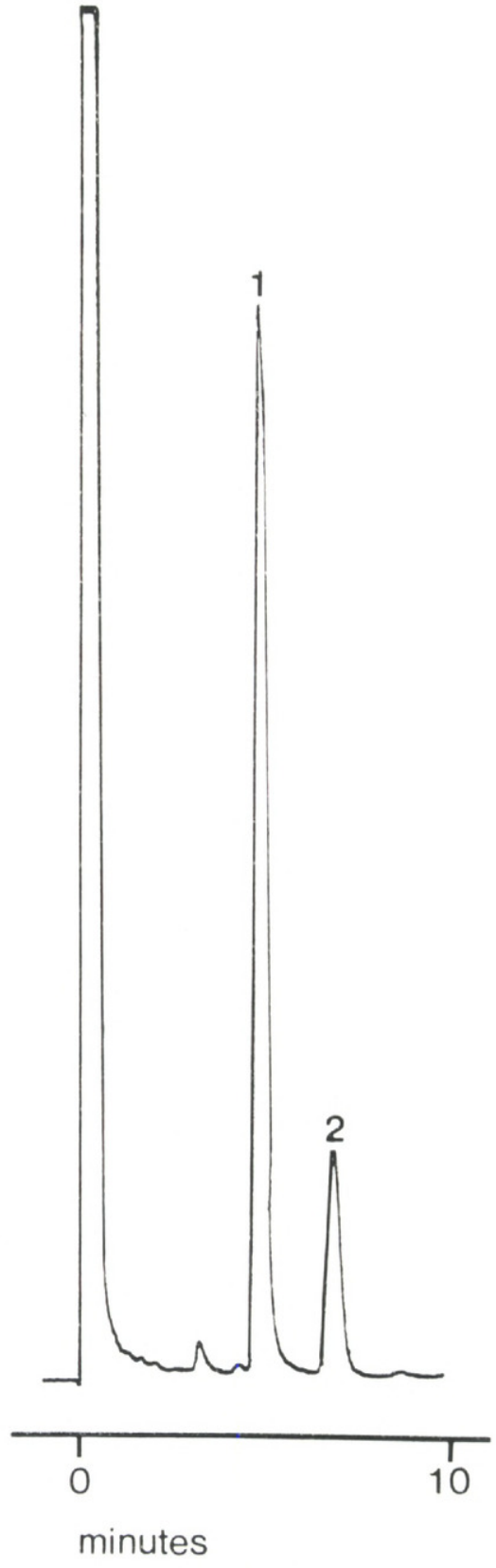
The first chemical investigation of *Latua pubiflora* was that of Vásquez in 1864. Vásquez made both an alkaline and an acid extract of the plant but was not able to find any alkaloids. He compared the resin to that of *Cannabis sativa* and promised continued investigations of its active principles. These never appeared. The next investiga-

TABLE I

DISTRIBUTION OF ALKALOIDS

Species	*Part of Plant*	*Alkaloids: MG/100 g Dry Plant*	*Alkaloids*	*%*
Latua pubiflora No. 2609	Leaves	185	Atropine	70
			Scopolamine	30
	Stem	496	Atropine	87
			Scopolamine	13
Latua pubiflora No. 2643	Leaves	70	Atropine	86
			Scopolamine	14
	Seeds	91	Atropine	86
			Scopolamine	14
	Stem	240	Atropine	92
			Scopolamine	8

PLATE VIII



Gas chromatogram of alkaloid fraction from leaves of *Latua pubiflora* (*Plowman 2609*). Conditions: see Experimental.

tions seem to have been conducted by Pouquet (1914), Alvarado (1918) and Miranda (1918). Miranda has summed up the previous investigations. He himself identified, by the methods available at the time, atropine in *Latua*, using various precipitating reactions, confirming also the parasympatholytic action of the extract on pupillary size of animals and man. Miranda presumably based his original assumption that atropine represents the main constituent on botanical rather than chemical proofs. His finding was confirmed in 1959 by Silva and Mancinelli who isolated 0.015% of atropine from the leaves. Not until 1962 were Bodendorff and Kummer able to identify another alkaloid in the plant: *viz.* scopolamine. The amount of alkaloids calculated on the whole plant was scopolamine 0.08% and atropine (or hyoscyamine) 0.18%. The highest content of alkaloids was found in the leaves. The stem contained less, and the seeds lacked alkaloids. This is in contrast to our own findings. The present examination demonstrates the highest amount of alkaloids in the stem, while the seeds and leaves contained less but a still substantial amount of atropine and scopolamine.

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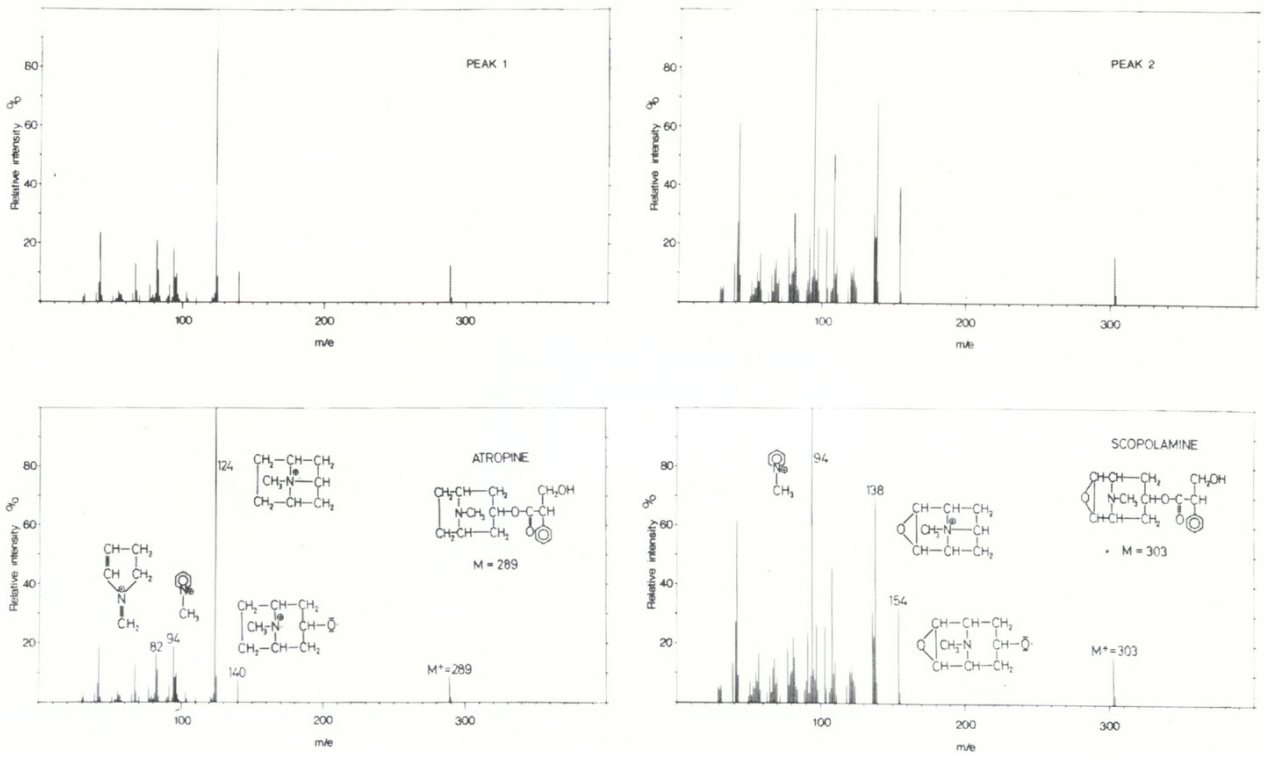

Upper panel: mass spectra of compound in effluent from peak 1 and 2 from alkaloid fraction (Plate VIII).
Lower panel: mass spectra of reference compounds. Conditions: see Experimental.

for sharing with us his notes on *Latua* and to Dr. Benkt Sparre (Museum of Natural History, Stockholm) for permitting us to publish part of his diary. We appreciate the help of Hans Klempau (Universidad Austral) who provided the photographs of *Latua*. Drs. Antonio and Carmen Krapovickas (Universidad del Nordeste, Corrientes, Argentina) kindly lent their excellent laboratory facilities for chromosome studies. We are thankful to Professors Richard Evans Schultes and Bo Holmstedt for their encouragement and support in conducting this work. The following herbaria furnished specimens and information: Gray Herbarium, Cambridge, Massachusetts (GH); U.S. National Museum, Washington, D.C. (US); Royal Botanic Gardens, Kew, England (K); British Museum, London (BM); Systematisch-Geobotanisches Institut, Göttingen, Germany (GOET); Facultad de Química y Farmacia, Santiago, Chile (FARM); Universidad Austral, Valdivia, Chile (VALD).

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