

A MULTIDISCIPLINARY APPROACH TO RITUAL ENEMA SCENES ON ANCIENT MAYA POTTERY*

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Summary

There are various enema scenes on classic Maya pottery, which undoubtedly represent rituals and may very well indicate that the ancient Maya took intoxicating enemas in a ritual context. This idea is quite contrary to the traditional view that the ancient Maya were a contemplative people, who did not indulge in ritual ecstasy. The occasional display of vomiting actors would seem to provide a plausible reason why the Maya opted for rectal application. Some scenes present a fair amount of evidence that an alcoholic beverage may have been taken rectally. Anecdotal experimental evidence suggests that an alcoholic liquid may certainly induce or intensify a state of inebriation, when it is administered via the rectal route. Other scenes open up the possibility that tobacco and the water lily or some other flowering plant may have served as an enema ingredient. The phytochemistry and psychopharmacology of tobacco are well documented and there can be little doubt that this herb may produce toxic effects, when it is taken in the form of a clyster. Unfortunately, little is still known about the constituents and pharmacological activity of the water lily. It is sometimes speculated that this plant is hallucinogenic, but experimental confirmation of this view is still awaited.

Introduction

Pottery of the classic Maya civilization, in particular the polychrome pottery of the late classic period (A.D. 600–900), provides much information

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on this Mesoamerican culture by portraying a variety of scenes like palace scenes, ball games, hunting parties, and special dances after human sacrifice by decapitation (Coe, 1975, 1978, 1982; Hellmuth, 1978; Robicsek, 1978; Robicsek and Hales, 1981). Some years ago, Furst and Coe (1977) added a new theme to this list after they had discovered a polychrome Maya jar showing the actual administration of an enema (see Fig. 1). According to early colonial references, the Maya employed clysters for diarrhoea and chills or for a swollen abdomen (Roys, 1976), and present-day Maya have been reported as taking the purgative castor oil as an enema to treat constipation (Steggerda and Korsch, 1943). Yet the discovered scene was revealing, since it appeared to Furst and Coe (1977) that some non-medicinal ritualistic use of clysters was represented:

Seven male-female pairs, the women easily distinguished by their robes and long hair, are depicted in two horizontal rows. That one woman is fondling a child suggests a familial setting. The activity being portrayed would have brought blushes to the cheeks of the traditional Maya specialist, for while one man is inserting a syringe into his rectum, this delicate task is being carried out for another male by his consort. One male also has a bulbed enema syringe tucked into his belt. Nine vases, identical in shape to the actual vessel, are painted between the couples, and painted dots at the mouth of each represent a foaming, fermented liquid that is probably balche, the common alcoholic drink among the Maya at the time of the conquest. We must conclude that the people on the vase are taking intoxicating enemas, a practice previously unrecorded for this culture.

The discovery of this crucial vessel allowed the identification of other Maya vase paintings as enema scenes (Furst and Coe, 1977), and soon others were also led to believe that the ancient Maya took intoxicating enemas for ritual purposes (Robicsek, 1978; Nicholson and Cordy-Collins, 1979; Anonymous, 1984; Dobkin de Rios, 1984; Torres, 1984; Schele, pers. commun. 1985).

In our opinion, there can be little doubt indeed that the enema scenes on Maya pottery, or at least part of them, represent some kind of ritual. The mere fact that deities or their devotees, and animals or humans, dressed up like animals, are common actors in these scenes leaves little room for another interpretation. This does not automatically signify, however, that the Maya vases show the use of intoxicating retention enemas. Starting from the assumption that these enemas served a specific ritual purpose, an alternative possibility could be raised, viz. purifying evacuation enemas. The concept of ritual purification falls well within the range of established Indian culture traits. The South American Jivaros, for instance, use a solution prepared from *Ilex guayusa* as a ceremonial mouth rinse, which is spat out instead of being swallowed (Karsten, 1935). With respect to the rectal way of administration, ritual purification may be less well documented, but the Peruvian Incas seem to have employed their vilca clysters for cleansing (de Smet, 1983).

Apart from this argument, the idea that the ancient Maya took enemas to reach or intensify a state of intoxication, is a plausible and attractive suggestion. When the Spaniards arrived in Middle America, they found that the

TABLE 1

ETHNOBOTANICAL OVERVIEW OF SOME ESTABLISHED AND REPUTED RITUAL ENEMA INGREDIENTS AMONG AMERICAN INDIANS

Adapted from de Smet, 1983.

Scientific name	Ethnobotanical data
<i>Agave</i> species (Amaryllidaceae)	The use of alcoholic clysters among the Mexican Huastec Indians is mentioned by several early chroniclers
<i>Anadenanthera</i> species (Leguminosae)	Various claims that South American tribes use <i>Anadenanthera</i> seeds as an enema source appear to be partially correct
<i>Brugmansia</i> species (Solanaceae)	The ritual use of <i>Brugmansia</i> enemas among the South American Jivaro Indians is well documented
<i>Ilex guayusa</i> (Aquifoliaceae)	Bundled leaves have been found together with enema syringes in a pre-Hispanic Bolivian grave
<i>Lophophora williamsii</i> (Cactaceae)	The use of a peyote enema among the Mexican Huichol Indians has been reported, but the truthfulness of this story seems to be open to doubt
<i>Nicotiana</i> species (Solanaceae)	The rectal medicinal application of tobacco preparations by American Indians is well established ^a . Also, tobacco fragments have been found with enema syringes in a pre-Hispanic Bolivian grave. However, substantial data on the use of tobacco enemas for ritual intoxication would appear to be lacking

^aThe Mexican Mixe Indians, for instance, are said to have used tobacco smoke enemas to treat certain diseases (Lipp, pers. commun. 1985).

Indians living there were familiar with numerous botanical intoxicants like alcoholic beverages (Gonçalves de Lima, 1956), tobacco (Robicsek, 1978) and hallucinogens (Guerra, 1967), and that the Huastec Indians used the rectal route to administer alcoholic liquids. The latter practice is reported by several early authors, such as the conquistador Diaz del Castillo (1916):

About drunkards I do not know what to say, so many obscenities take place among them; I wish to note only one here which we found in the province of Panuco; they make an injection by the anus with some (hollow) canes and distend the intestines with wine, and this is done among them in the same way as among us an enema is applied.

Table 1 demonstrates that this early report is certainly not the only record on intoxicating enemas in the western hemisphere.

It is also beyond question that intoxicating practices had already occurred in Middle America far before the coming of the white man. The recovery of pre-Hispanic smoking pipes (Porter, 1948), snuffing equipment (Furst, 1974a), peyote buttons (Bruhn et al., 1978), etc. from Mexican archaeological sites all point in this direction. It is therefore worthwhile to trace which ritual intoxicants were known to the Maya, and what evidence for their rectal use

can be found in the enema vase paintings themselves. Taking this as a starting point, our paper first provides an iconographical and linguistic approach to the ritual enema scenes on ancient Maya pottery. These parts are followed by an ethnopharmacological outlook on proven and reputed Maya intoxicants.

A psychoactive plant may only elicit a pharmacologically induced subjective response, if at least one active constituent (or active biotransformation product) reaches an appropriate central site of action in an adequate amount. This amount is governed not only by the dosage of the constituent, but also by its manner of administration and by its subsequent fate in the body, i.e. by the absorption, distribution, metabolism and excretion of the constituent. In other words, the pharmacological validation of the reputed central effects of a native ritual dosage form must take into account that its active constituents, besides having intrinsic pharmacological effects, are molecules with a characteristic pharmacokinetic profile. This ethnopharmacokinetic aspect of native ritual intoxication still has to be fully recognized by many non-pharmacological scholars. To set an example, special attention is paid to the rectal efficacy and pharmacokinetics of possible Maya enema constituents.

Part one: Iconographical approach to Maya enema scenes

Enema syringe

A principal diagnostic trait of the enema scenes on classic Maya vessels is the presence of an enema syringe. Actual insertion of this apparatus into subjects bending forward first appears on some early classic pottery from the 6th century (Hellmuth, 1985), and was later depicted on the late classic vase, which led to the discovery of Maya enema scenes (Fig. 1). The enema syringe often has a clearly visible tube and an oval bulb with a semi-circle at the middle of the top (Figs. 3,4,6) and can thus be distinguished from a round rattle. A striking feature of many enema syringes is their large size (Fig. 6). In modern western practices, enemas larger than 0.2 l are only applied to evacuate the bowels (Fishburn, 1965; Pernarowski, 1975), so if the size of the syringe is realistic, it would seem to suggest a purifying evacuation enema rather than an intoxicating retention enema. In a recent self-experiment, however, one of us could easily retain an alcoholic enema with a total volume of 0.5 l by taking certain precautions (*vide infra*), which takes the edge off this pharmaceutical argument.

Special jug

Many scenes portray the enema syringe on top of a specially shaped jug (Figs. 2,3,4,6). This type of jug is seen so often in the enema ritual that it is assumed to contain the enema liquid (Furst and Coe, 1977; Coe, 1978; Hellmuth, 1978). This assertion about the function of the jug is probably correct, when it occurs in enema rituals, but its appearance is not limited to such

scenes. The jug is also seen, for instance, in scenes of ceremonial self-sacrifice (Stuart, 1975) or in simple palace scenes (Coe, 1978). Occasionally, the jug is of a small, portable size, but most scenes display large jugs, standing in front of a participant or near a throne.

In many scenes, something is shown as coming out or sticking out of the jug: this may be scrolls (Fig. 5), dots (Fig. 1), rod- and plume-like forms (Fig. 8), occasionally arranged in bundles, small circular forms and larger, often black-eyed circular and oval forms, or a large flower (Fig. 5 in Boglár and Kovács, 1983). Even on one bowl, some kind of mammal is shown jumping out of the jug. Since the enema may be present in the jug, a closer look at current ideas on the protruding items is certainly warranted.

Scrolls from jug

In an elaborate enema scene, syringes are emitting scrolls (Fig. 2) similar to those coming out of jugs in other scenes (Fig. 120 in Boglár and Kovács, 1983). This seems to reinforce the idea that the syringes and jugs in enema scenes have the same content. Coe (1978) identifies the scrolls as stylized smoke. This is an acceptable suggestion, since the classic Maya were undoubtedly a smoking people, and their vase painters often depicted smoke in this way (Robicsek, 1978). In another enema scene, cigars and objects that might be small jugs are shown as emitting similar scrolls (Fig. 5). The smoke symbol would be an appropriate sign, if the jug contained the same plant that was smoked. Alternatively, the scrolls might symbolize odour or pungency. A pungent clyster would, of course, be more suitable for cleansing than for intoxication.

Dots from jug

The display of dots at the mouth of a jug (Fig. 1) has its counterpart in pre-Hispanic Mexican codices. In Aztec codices like the Codex Mendoza, such dots indicate the alcoholic drink octli, prepared from the maguey plant (Gonçalves de Lima, 1956; de Barrios, 1971; Ross, 1978). In the Maya Codex Dresdensis from the post-classic period, dots are depicted above a large jug, considered to contain fermented honey wine, because it bears the cib sign (Seler, 1902; Gonçalves de Lima, 1956; Thompson, 1972). In view of such data, Furst and Coe (1977) and Robicsek (1978) may be right to postulate that the dots in Maya enema scenes signify the presence of some fermented liquid, such as the alcoholic honey mead balché. It is not certain, however, that the dots have this specific meaning.

Rod- and plume-like items from jug

A definite interpretation of the rod- and plume-like forms in Maya jugs is not yet available. Even if they are prominent (Fig. 8), it is difficult to come up with a botanical suggestion (Schultes, pers. commun. 1984). The forms should be distinguished from scrolls, for there is a bowl painting where both are coming out of the same jug (Fig. 120 in Boglár and Kovács, 1983). In

one scene in the Codex style, they merely seem to indicate that fluid is spilling out of a tumbling jug (Robicsek and Hales, 1981). Justeson (pers. commun. 1985) feels that the form of the rod-like objects (Fig. 8) is roughly consistent with maguey leaves, but admits that the execution is not distinctive enough to make a specific botanical identification (vide infra). Some forms may possibly be plant segments or actual bird plumes and others might represent cigars or pointed blood-letting perforators. If the correctness of the last suggestion could be proven, this would raise the possibility that the effect of the enema was enhanced by self-torture. The ancient Maya are known to have practised ritual self-mutilation, especially by scarifying the penis or the tongue (Joralemon, 1974; Furst, 1976b; Robicsek, 1978).

Circular and oval items from jug

The circular and oval forms on top of the jug are as enigmatic as the oblong forms. Robicsek (1978) suggests that the small variety indicates the presence of a fermented liquid, but they may also be real objects. The larger variety may also be stacked up in a plate or bowl elsewhere in the scene (Figs. 2,4). Coe (1978) remarks about such round objects in a throne scene; they might be the maize preparation tamales, but they look suspiciously like disembodied death-eyes. If food was ingested during the ritual, this could have a pharmacological bearing, as the presence of food in the stomach often delays drug absorption after oral ingestion (Welling, 1977; Toothaker and Welling, 1980), but this cannot happen after rectal application. We wonder, if the round forms might be some kind of food such as cookie balls or fruits. According to Schultes (pers. commun. 1984), the large round items (Fig. 4) might possibly represent some kind of fruit, which could be eaten or used to prepare a fermented beverage.

Flowers from jug

Figure 5 of Boglár and Kovács (1983) shows a Maya vase painting with a jaguar next to a large jug, from which a huge flower emerges. The jaguar is wearing a netted bib and a netted headdress, both of which are garments worn in the enema ritual (vide infra). There is also an enema scene, in which an indeterminate creature is holding an enormous flower (Fig. 5). These scenes open up the possibility that such flowers served as an ingredient of ritual Maya enemas, which raises the issue of their botanical identity. Rands (1953) associates comparable floral forms in Maya art with the American water lily *Nymphaea ampla*. In accordance with this view, it is tempting to identify the flowers in Maya enema scenes as flowers of the water lily. They are so stylized, however, that their identification as *N. ampla* should not be accepted without reserve.

Drinking cup

The syringe on top of the enema jug is sometimes replaced by a cup, so ritual drinking must have occurred as well. There is a close similarity between

these drinking scenes and the Mural de los Bebedores in the pyramid of Cholula at Puebla in Mexico, which is partly shown on the cover of de Barrios (1971) and on the wrapper of Guerrero Guerrero (1980). As some vases show the drinking cup and the enema syringe together (Fig. 6), both objects could obviously be used in the same ritual. Robicsek and Hales (1981) have elegantly demonstrated that different Maya vases may show successive scenes of one event, so the enema scenes and drinking scenes may well represent different stages of the same intoxication ceremony.

U-shaped object

Occasionally U-shaped objects are displayed on top of the jug or in the hand of actors (Figs. 1,2). In one of the scenes, God N is holding such an object in his left hand, while painting his face with his right hand (Fig. 2). Coe (1978) suggests that it is a paint-pot in this scene, which suggestion corresponds with the painted faces in other scenes showing U-shaped objects (Fig. 1).

Special garment

The participants in the ritual often wear a special garment around the neck as a bib, analogous to an oyster bib (Fig. 1). In one scene, a bib-wearing male has his right hand in the jug, apparently to fill up a syringe or cup. In initial publications (Hellmuth, 1978; de Smet, 1983), we have suggested that the bib is worn in the ritual because of vomiting, as some scenes portray a vomiting creature (Fig. 7). This remains uncertain, for the bib may also be worn as a head-dress (Fig. 1), and not every vomiting personage is wearing the bib. Robicsek (1978) thinks that the bib is in some way related to the iconography of God N, who regularly wears a netted element in his head-dress (Fig. 6). However, the bib is worn by various actors other than God N, so the bib in the enema scenes and the netted head-dress of God N may well be two totally different garments. Whatever the bib may mean, the display of vomiting actors does provide a plausible reason why the Maya opted for rectal application. If a subject is vomiting or is going to vomit, the rectal route of administration offers an obvious advantage over the oral one. It should be noted that the vomiting shown by the Maya painters may even have been induced by the enema itself (vide infra).

Other objects

Other objects, which may appear together with enema paraphernalia, include vegetation decorating the head of a jaguar (Figs. 5,7), cigars or cigarettes (Figs. 3,5), musical instruments like drums and rattles (Fig. 2), and bouquet-like objects (Fig. 9).

A jaguar with a leaf or flower sprouting from the head is often displayed beside a jug and/or with a bib around the neck (Fig. 7). Just like the flower

in Fig. 5 (vide supra), these plant parts are associated with the water lily *Nymphaea ampla*, even to the point that the jaguar in question is indicated as the Water Lily Jaguar (Coe, 1978, 1982; Robicsek, 1978). Once more, however, a botanical reserve should be kept in mind, since it is difficult, if not impossible, to exclude all other plants. In this connection, it should be emphasized that the leaf of the so-called Water Lily Jaguar may be much more acuminate (Fig. 7) than the leaf of *N. ampla*, as judged from photographs of a herbarium specimen (Emboden, 1981a) and of the living plant (Torres, 1984).

The presence of smokers opens up the possibility that the effect of the enema may have been enhanced by smoking, whereas the presence of musicians could possibly signify non-pharmacological potentiation. There is ample ethnographical evidence that the American Indian valued rythmical music as a means of intensifying drug-induced experiences (Wasson, 1980; Dobkin de Rios, 1984).

The bouquet-like objects are so stylized that it is not possible to interpret them as any known psychoactive plant (Schultes, pers. commun. 1984).

Participants

Major participants in several Maya enema scenes are deities or their devotees. Most prominent are God N (Figs. 2,6) and God D (Fig. 3), who appear not only in enema rituals, but also in many other ceremonies on ancient Maya pottery. A full-fledged God N is elderly and wears a shell. On several vases, females are undressing males standing in front of a large jug, on top of which a drinking cup and/or syringe may be displayed. Some of these males are wearing a netted head-dress, which indicates that they represent God N or his devotee (Fig. 6). God D is an elderly slouching god with a characteristic elaborate head-dress, who is often seated on a planetary band throne (Fig. 3). He may have a young woman holding a rabbit behind him, most likely the Moon Goddess and her sexual companion.

At last three vase paintings show a monstrous deity seated in a hut composed of a stack of monster faces (Fig. 2). This officiating personage is generally considered to be God GI, although Coe (1978) identifies him as the Rain Beast and feels that he should be kept separate from God GI.

A second major category of participants are animals, including jaguars, spider monkeys, birds, and reptile-like personages (Figs. 5,7,8). These animals may in fact be humans dressed up as animals. Stuart (1975) and Hellmuth (1978, p. 210) both show Maya vase paintings with paraphernalia related to enemas where obviously not a jaguar, but a human actor wearing a feline costume is represented. There are also enema scenes where personages with bird faces and a human body can be readily recognized as participants with a bird mask.

The most important animal personage would seem to be the jaguar, who is not only a major character in enema rituals, but also in the so-called Dance after Decapitation scenes, which represent a special dance performed after human sacrifice. When he appears in an enema-related scene, there is often

vegetation sprouting from his head (Figs. 5,7), from which feature his name Water Lily Jaguar is derived. When he is engaged in a Dance after Decapitation, he usually wears a red-orange scarf. Interestingly, there is a polychrome Maya vase where a Water Lily Jaguar wearing a bib appears on one side, whereas the other side displays a jaguar with a red-orange scarf. This joint occurrence raises the possibility of a relation between enema rituals and dance after death rituals.

Part two: Linguistic approach to Maya enema scenes

Mostly, the special jug appearing in Maya enema rituals and related scenes has a plain surface or a simple painted design, but some jugs are provided with an obvious glyph, although not always the same glyph is shown (Figs. 3,8,9). Since the jug is thought to contain the enema, the interpretation of such glyphs is of paramount importance. Most of the jug glyphs cannot readily be found in the Maya glyph catalogue of Thompson (1962). This is not surprising, since Thompson focused on glyphs from monuments and manuscripts and not on glyphs from pottery. Some glyphs can be identified, however, and in one case it is even possible to give an interesting interpretation:

(1) In his book on tobacco among the Maya, Robicsek (1978) describes a Multiple Resist vase painting with smoking and dancing skeletons (plate A-14). He interprets the infix on a small portable jug in this scene as *akbal*, the sign of darkness (number 504 in Thompson's catalogue). It should be noted that such small jugs decorated with an *akbal* glyph tend to be associated with Dance after Decapitation scenes rather than with enema scenes.

(2) Justeson (pers. commun. 1985) has found the *manik* glyph, which represents the name of a day (number 671 in Thompson's catalogue), on a large jug (Fig. 8).

In an unpublished manuscript from 1982 on *Hieroglyphic evidence for the languages of the classic Maya*, Fox and his co-author Justeson (pers. commun. 1985) remark on the occurrence of the *manik* glyph on the jug in Fig. 8:

Logographically, this sign represents the day *Manik*. The day name in Yucatec is clearly ancient, since the name is preserved from Chol and/or Tzeltal as [manich] in calendrical names in the Comitan Libro de Bautismos (see Baroco 1970: 138, 146) and the Yajalon Libro de Bautismos y Matrimonios (Campbell in press). This day name corresponds to the day Deer of other Mesoamerican calendars, and the sign is used as a logogram DEER in the codices. The sign is never read phonetically as *ke*, which Yucatecan *ké:h* 'deer' terms would suggest as phonetic generalization: however, there is ample evidence for its value *či*, which presupposes the Cholan-Tzeltalan **čihx* 'deer'. This sign origin supports Cholan-Tzeltalan development of either the sign's phonetic value *či* or semantic value DEER, but indicates nothing concerning a Cholan-Tzeltalan involvement in any spellings which make use of it in either value. Some such spellings, however, do implicate the Cholan-Tzeltalan group. (The figure) illustrates a vase depicting two seated figures, leaning toward a central vessel with cups in their outstretched hands. Long leaves appear to be rising from the (enema?) vase, which is marked with the sign *či*. We suspect that the sign and the leaves are intended to indicate that the

figures are drinking, or are preparing to drink, an alcoholic extract of the maguey. The same sign marks depicted vases in a scene on a polychrome vase which Kerr suggests represents a drunken display. In Cholan and Tzeltalan languages, *čih* means 'maguey'; *či?*, whose basic meaning is 'sweet; delicious', means by extension 'alcoholic beverage' or, as an adjective, 'inebriated', while **a:x-či* is 'drunkard'. These terms are cognate with Yucatecan *kih* 'maguey' and *ki?* 'sweet, delicious, alcoholic beverage; inebriated' and *x-ki?* 'drunkard'.

In this comment on the manik glyph, two separate steps are taken, viz. the reading of the glyph as 'či' and the connection of this phonetic value with terms like maguey (*Agave* plant) and alcoholic beverage. Yucatecan parallels of the latter step are easily found in the literature. According to Roys (1976), the Yucatecan Maya had at least nine names all ending in 'ci' for various



Fig. 1a.

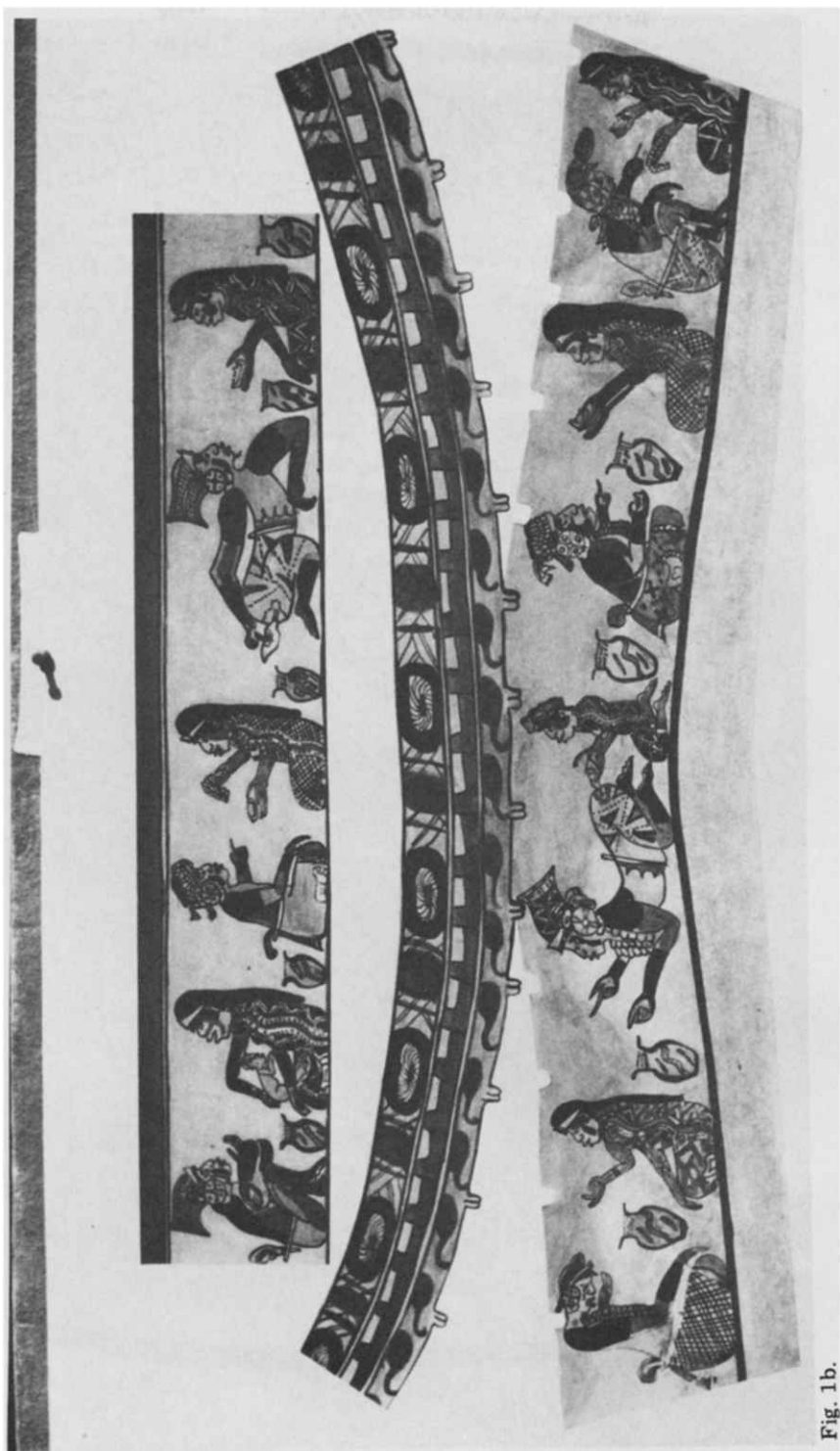


Fig. 1b.



Fig. 2a.



Fig. 2b.



Fig. 2c.



Fig. 2d.



Fig. 3a.

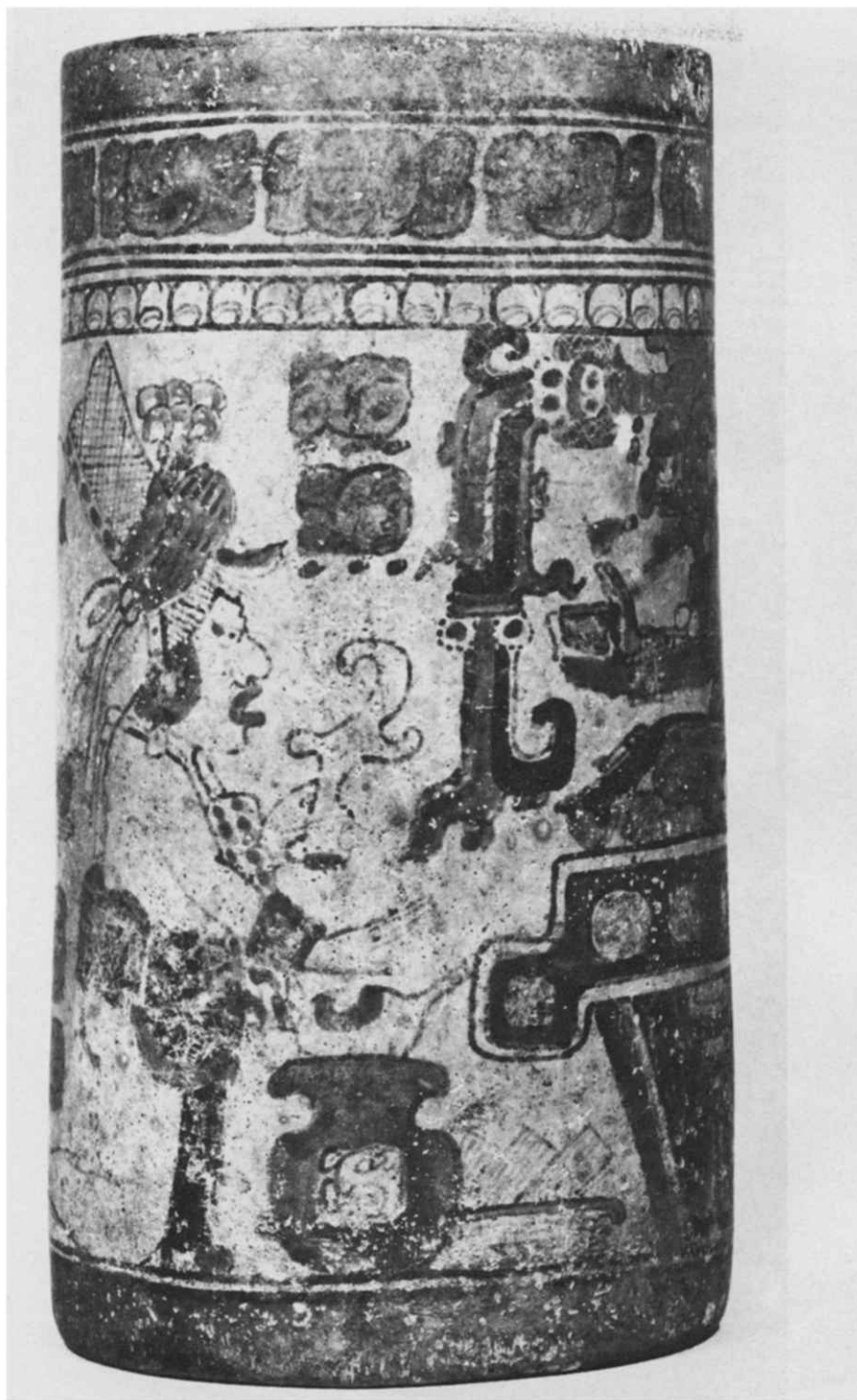


Fig. 3b.



Fig. 3c.

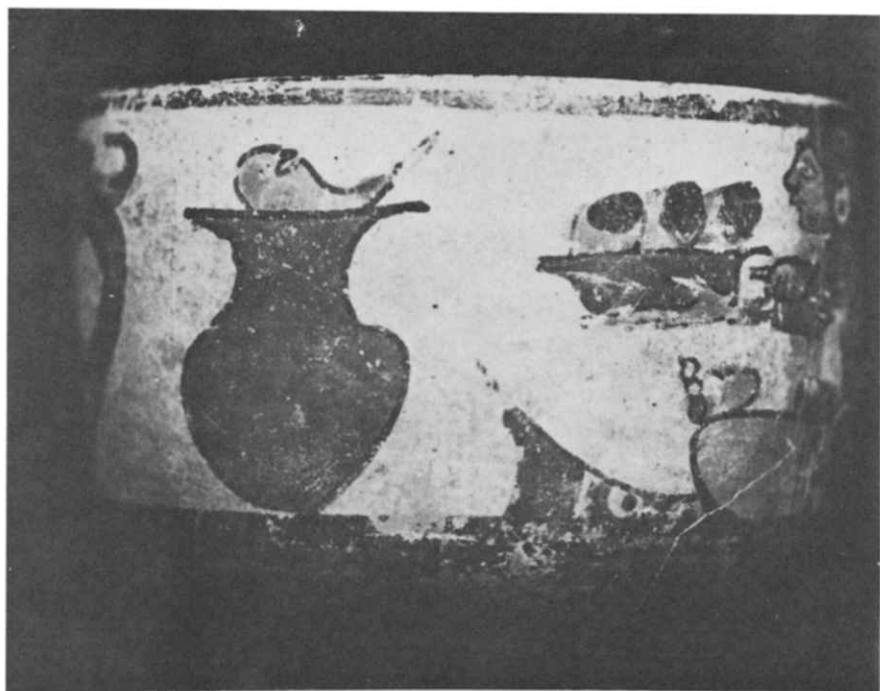


Fig. 4a.

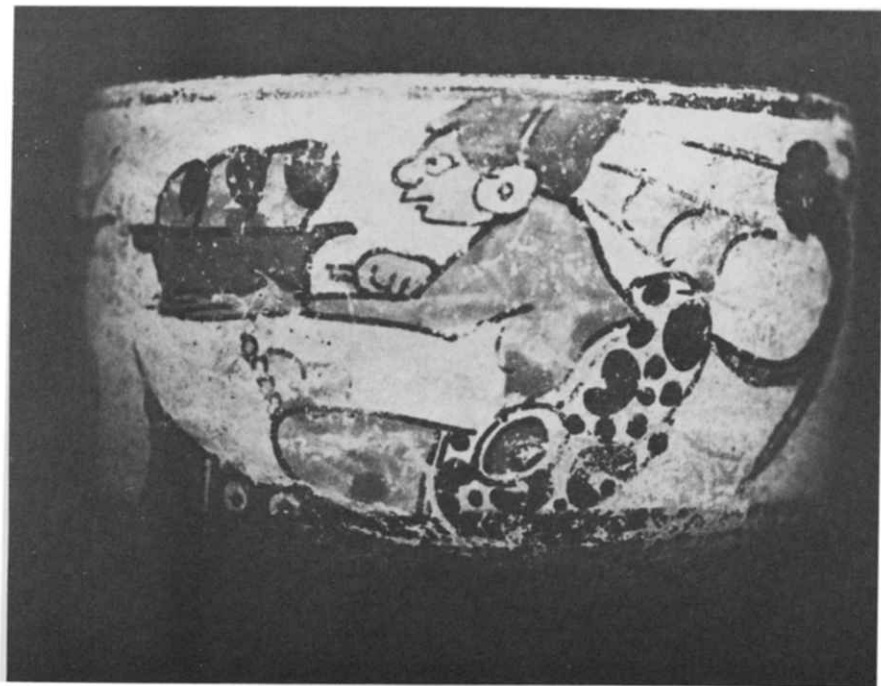


Fig. 4b.

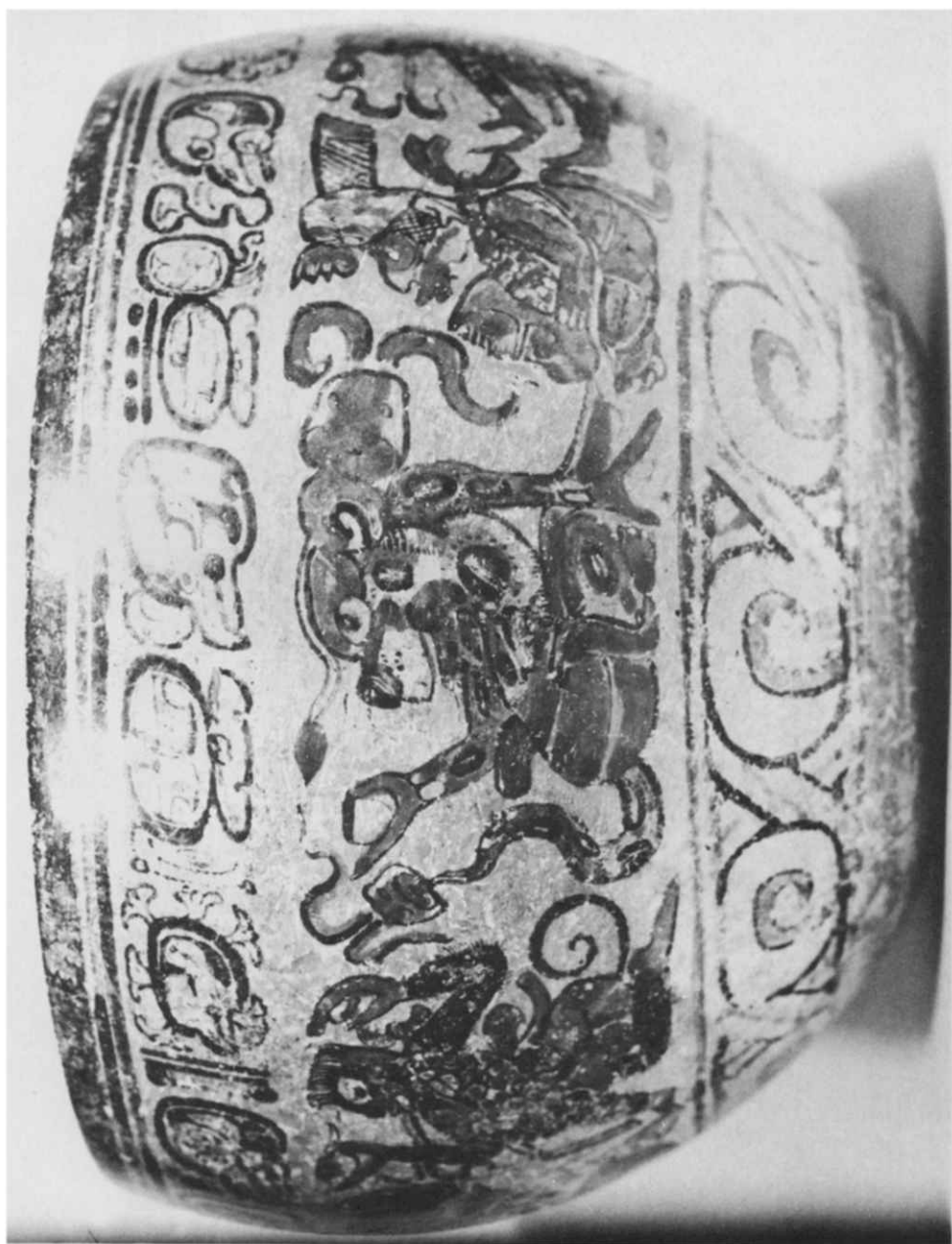


Fig. 5a.

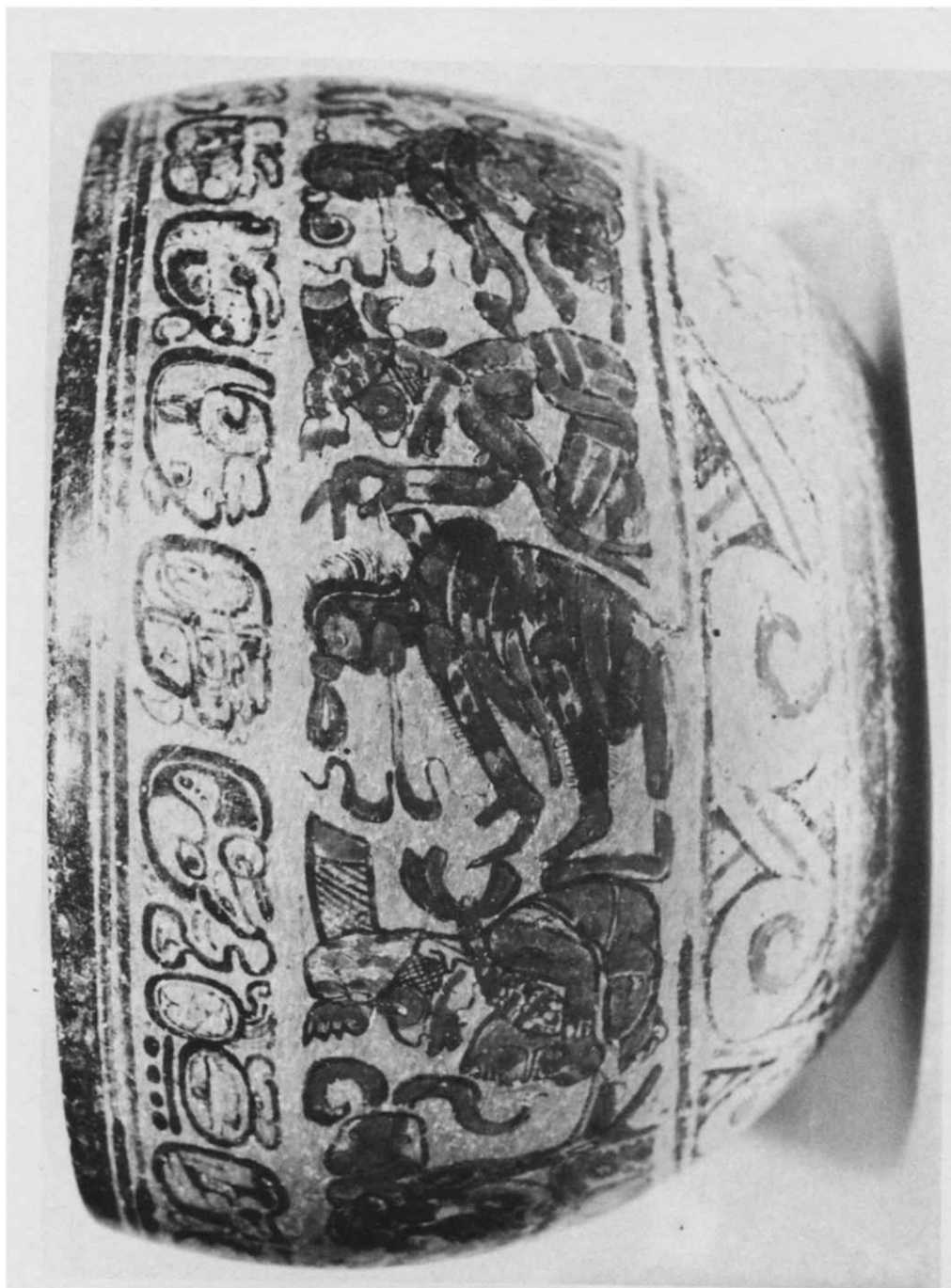


Fig. 5b.

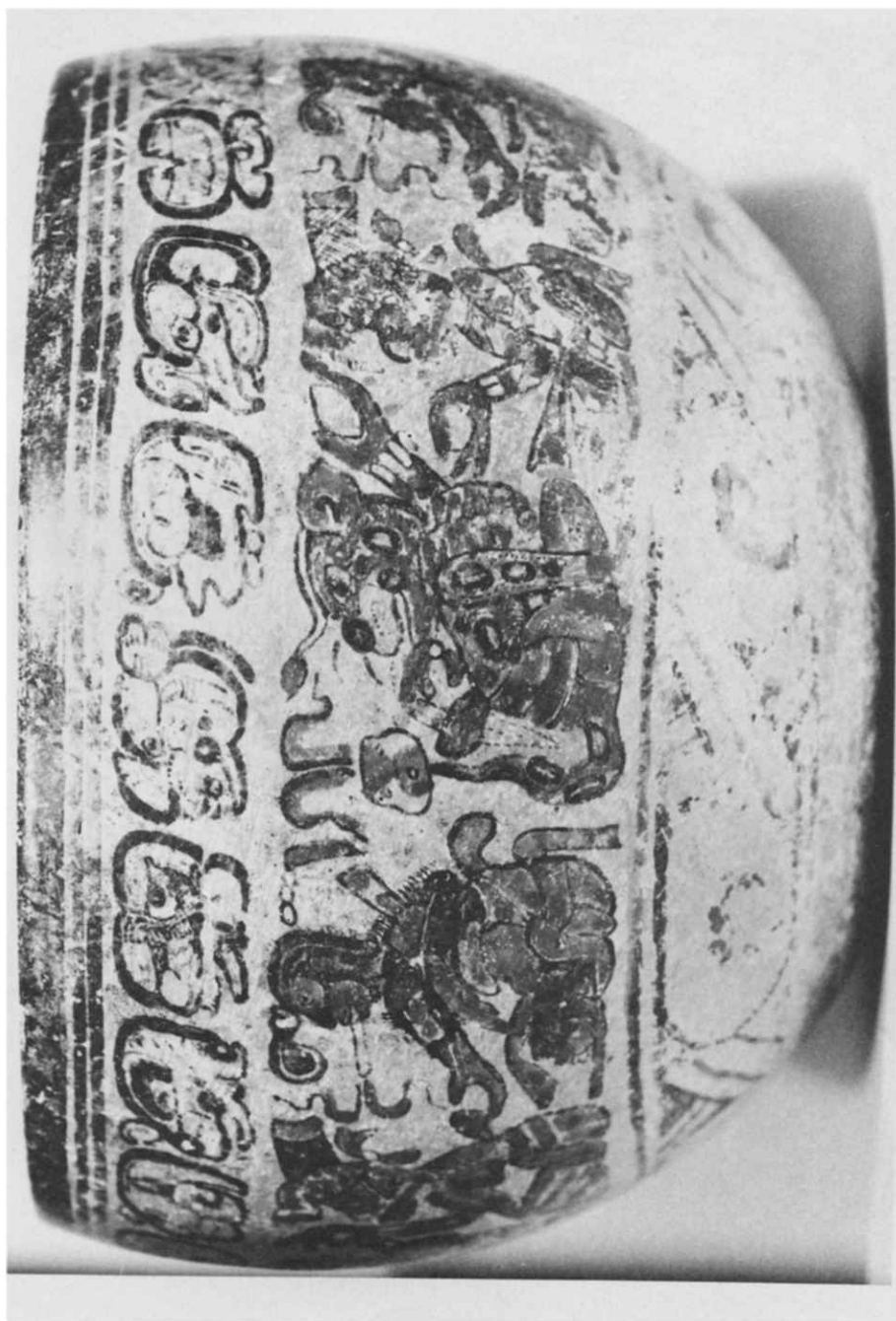


Fig. 5c.



Fig. 5d.

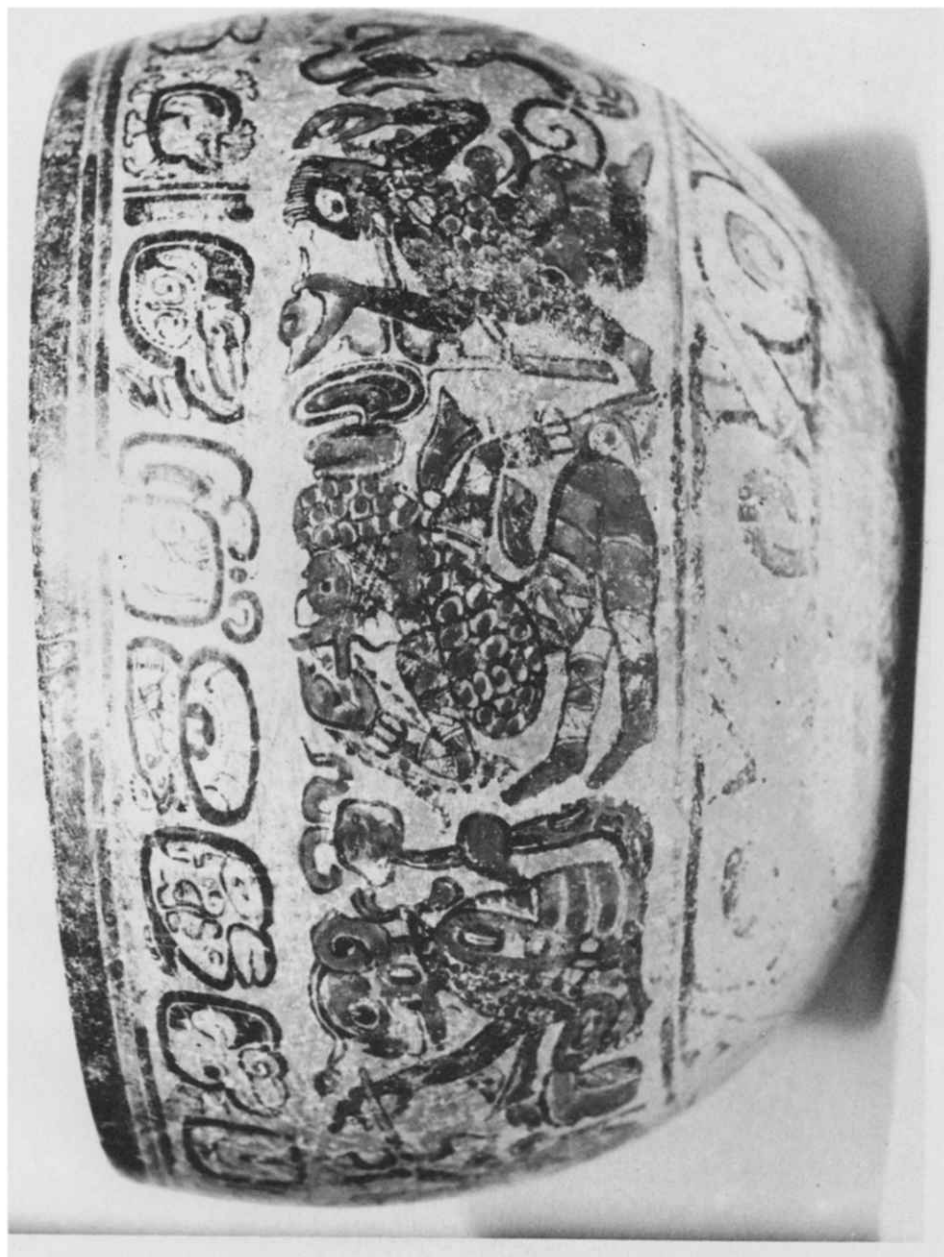


Fig. 5c.



Fig. 6a.



Fig. 6b.



Fig. 7.



Fig. 8a.



Fig. 8b.



Fig. 8c.



Fig. 9.

Fig. 1. Painted polychrome Maya pot. Photographs: Peter Furst. Time period: Late classic, probably Tepeu 1. (Tentative) provenance: Petén, Guatemala. Present location: private collection. Description: (a) shows the actual shape of the vase; (b) is a painting of the whole vase by Diane Peck. It shows seven pairs of a male and a female. One of the females is inserting a syringe into the anus of her companion (bottom middle), and a second male is himself performing this task (top right). Two other males have an enema syringe tucked into the belt (top left and bottom right). Between the couples, there are nine jugs with painted dots at their mouth. Several males have a bib around their neck, and some of them are wearing this garment as a headdress. Most females are holding a U-shaped object in the hand, and some of them offer a bib to their companion. Between the top and bottom, a glyph appears in a repetitive band. Coe (1978) suggests that this glyph may be the sign for the enema ritual., and adds the speculative notion that it represents an anal sphincter muscle.

Fig. 2. Painted polychrome Maya vase. Photographs: Nicholas Hellmuth. Time period: Late classic. (Tentative) provenance: Campeche, Mexico or Petén, Guatemala. Present location: private collection. Condition: repainted. Description: In the left part of the central scene (b), there are two pairs of a male and a female. The females have their hands tucked under the armpits of the companion. In front of the males, there are two jugs with enema syringes on top, and scrolls are being emitted from one of the syringes (bottom). The right part of the central scene (c) shows two female servants (left side), who are facing two males (middle), accompanied by two other females (right). The upper male is fanned by his servant. He has a jug in front of him and the female behind him offers him a bib. The lower servant holds up a mirror to the male who is apparently painting his face. He has a U-shaped object in his left hand, possibly a paintpot. Coe (1978) identifies all the four males as God N. Behind the central figures, three monsters are playing a musical instrument (d). They are almost identical to the one, who is sitting in a hut on the left (a), and who seems to be their conductor. According to Coe (1978), they may represent Rain Beasts. The orchestra instrumentarium consists of a rattle (top), a drum (bottom left), and a turtle shell struck with a deer antler (bottom left). There is a jug with a syringe on top, out of which scrolls are coming, behind the rattle player. A tripod filled with oval forms is shown in front of him.

Fig. 3. Painted polychrome Maya vase. Photographs: Nicholas Hellmuth. Time period: Late classic, Tepeu 2. (Tentative) provenance: Petén, Guatemala. Present location: private collection. Description: The scene shows two males (a,b), who are kneeling in front of God D on a throne (c). The left male has a cup in his hand and a cigarette in his mouth (a). The other one is holding a deer antler in his left hand. He is kneeling next to a jug with a probable enema syringe on top of it. Besides the jug, there is a plate filled with segmented rectangular forms (b).

Fig. 4. Painted polychrome Maya bowl. Photographs: Nicholas Hellmuth. Time period: Late classic. (Tentative) provenance: Campeche or Yucatan, Mexico. Present location: private collection. Description: The scene shows a large jug with a probable syringe on top (a) and seated figures holding a bowl full of large black-eyed forms (a,b).

Fig. 5. Painted polychrome Maya bowl. Photographs: Nicholas Hellmuth. Time period: Late classic, Tepeu 1. (Tentative) provenance: Petén, Guatemala. Present location: private collection. Description: The scene shows three Water Lily Jaguars with objects that might be small jugs at the tip of their tail (a middle; c middle; e left). Out of the objects the same scrolls are coming as out of the cigarette held by one of the Jaguars, who also has a jug in front of him with a possible syringe on top (d right). Besides the Jaguars, there are four monkeys, each of them with a cigarette from which scrolls are being emitted (b middle;

c left; d middle; e right). One of the smoking monkeys seems to hold up an enema syringe, while the figure in front of him is conspicuously holding his hand near his anus (e middle). There are four of such indeterminate creatures in the scene (b left; b right; c right; e middle). Hellmuth (1978) suggests that they are frogs, but this view is not shared by Robicsek (1978). One of them is holding something that might be a water lily flower in his hand (b left). Several personages are wearing a bib.

Fig. 6. Painted polychrome Maya vase. Photographs: Nicholas Hellmuth. Time period: Late classic. (Tentative) provenance: Petén, Guatemala. Present location: private collection. Condition: repainted. Description: A male is standing in front of a large jug with a syringe and a drinking cup on top of it (a), while a female companion is untying his loin-cloth (b). The netted head-dress of the males indicates that they represent God N's or his devotees. This vase painting is one of a series, all of which show females undressing males.

Fig. 7. Painted polychrome Maya vase. Photograph: Nicholas Hellmuth. Time period: Late classic, probably Tepeu 1. (Tentative) provenance: Petén, Guatemala. Present location: private collection. Description: A vomiting Water Lily Jaguar with a bib around his neck is standing next to a jug with a cup on top of it.

Fig. 8. Painted Maya vase. Photographs: John Justeson. Time period: Late classic. (Tentative) provenance: Highlands or Motagua, Guatemala. Present location: ? Description: A large jug with protruding rod-like objects (b) is surrounded by an animal personage (a) and a human figure (c) with a cup in their hand.

Fig. 9. Painted polychrome Maya vase. Photograph: Nicholas Hellmuth. Time period: Late classic, probably Tepeu 1. (Tentative) provenance: Petén, Guatemala. Present location: private collection. Description: A man who is sniffing or closely looking at a bouquet-like object, is standing next to a large jug with a row of things on top of it.

species of *Agave*. Bolles (1981) indicates that 'ci' in Yucatecan texts may be translated as wine. With respect to the former step, Justeson sent us a second letter (1985) detailing the following:

The evidence for the *či* value is varied. First the contrast between it and the sign T534 *la* in the words for 'west' and 'east' (*čik'in* and *lak'in*) are generally acknowledged, and this is the context that initially suggested the reading. Other good examples in the codices are the spelling *k'u-č* (*i*) for *k'uč*, which verifies the consonant at least; the spelling is in position to be the name of the bird depicted, which is the *k'uč* 'buzzard'. The sign is in alteration with T669, which has the two values *k'a* and *ča*, in spelling what should be the same word in different pages of the Madrid Codex, namely *pa-č* (*a*) and *pa-č* (*i*). At Chichen Itza, a preposition is spelled *i-č-i-l* (*a*) that must have the function of marking a day as falling within or in a given tun in the long count; only the prepositions *ti?*, *ič*, and *ič-il* could serve that function, so the spelling *i-T671-l* (*a*) makes a prima facie case for both the consonant and vowel of the *či* value. The sign is used for the day Deer, and **čihx* (or *chihj* in Spanish-based orthography; i.e., my *x* is the velar fricative, not the *š* or *sh* sound) is the word for 'deer' in proto-Tzeltalan, proto-Cholan-Tzeltalan, and perhaps proto-Cholan (I think proto-Cholan is actually **čih*, but I'm not positive; the choice depends on data I don't have concerning accent in Chontal, an

accented form pointing to **čihx* and an unaccented for pointing to **čih*). Also, the form of the sign is a pan-Mayan gesture for eating; **či?* is proto-Yucatecan for 'to bite; to eat meat' from proto-Mayan **ti?* A telling case that the sign T765, used as a verb for enter, represents Yucatecan **ok*, Cholan **oč* 'to enter', being also the sign for the day name Oc (i.e., **ok* or perhaps **o:k*); at Tortuguero, which is demonstrably a Cholan site and thus would have read this verb as **oč*, there is an infix or suffixed T671, presumably for *či* as a phonetic complement to indicate the final *č* of *oč* and perhaps the *i* as a grammatical suffix. The sign is also used in the Madrid in varying spellings of the word for 'bathing, baptism', in texts accompanying baptism scenes; the spellings are somewhat defective, but can be interpreted as *i-č* (*i-ki*) or as *i-č-i-VL* for *ič-k-il* 'baptism'; the variation is in order of signs, the first *i* sometimes being last, but the words are clearly the same so reordering must be assumed.

I think all of this evidence is reasonably solid, with the possible exception of the gestural origin for the *či* value in pYu **či?*. Other contexts that may be interpretable in terms of the *či* value do not have as much solid semantic control or linguistic control over the terms that are being represented. In all the above examples, it would take special pleading to see other terms or values being involved.

As Justeson's linguistic interpretations have great ethnobotanical implications, it appeared essential to obtain an independent expert's comment on the manik glyph. When asked for this second opinion, Schele (pers. commun. 1985) first expressed some reservations:

Justeson's suggestions seem very plausible to me. He reads the 'manik' hand as *chi* (he uses linguistic orthography so the diacritic in his comments indicates a phoneme we would record in our alphabetic system as *chi*). He apparently assumes the pot read in Cholan-Tzeltalan and comments that there is no substantiation for a *ki* value for the 'manik' hand, which I agree with. The 'deer' term is part of the *k/ch* correspondence set in Yucatec (*keh* 'deer')/Cholan (*chih* 'deer'). Therefore, his suggested reading does not require a Yucatec *chi* value for the 'drunken' term is in the same correspondence set. His proposal is possible, even probable. My only reservation is that there is evidence from the west glyph (Yucatec *chik'in*/Cholan *ti-k'in*) and from other substitutions that the 'manik' hand participated in the correspondence set that requires *ch* in Yucatec and *t* in Cholan. The latter glyphs in which the 'manik' hand replaces signs with the value of *ti* do not have accepted readings as words, so they can only be taken as supporting evidence for the *ch/t* correspondence set. The 'deer' set is equally strong evidence for the other side. However, the *chi* reading for the pottery glyph does not have an equivalent in the codices and, therefore, does not require a *ki* reading in Yucatec. In other words, the 'manik' hand may be used on the pot solely as a phonetic glyph without a meaning assigned to it. I would rate Justeson's reading as a good possibility to be further tested by watching for new examples, but I would not consider it secure enough to be used to prove the 'manik' hand was used for the *k/ch* correspondence set in the inscriptions, as he seems to be doing. I think the question is still open.

In a second letter, however, Schele (pers. commun. 1985) informed us that her former doubts have waned substantially:

In the process of pursuing other research in the last months, I have found evidence sufficient to convince me that the manik hand T671 was indeed phonetic *chi* in the Classic period and not *ti*. I have also been able to see a great many photographs of pottery scenes that include pots, especially the round bodied ones, that have the manik

hand on them. The weight of this evidence now makes me about 90% certain that John is correct in his reading of the *chi* glyphs as 'sweet' and 'intoxicating'.

Since the scene in Fig. 8 fails to show any specific enema related object, it could be argued that the jug with the manik glyph in this scene contains an oral drink rather than an enema liquid. There is another scene, however, where a probable enema syringe is lying on top of a similar jug which is unquestionably ornamented with the same manik sign (Fig. 3). There is a prefix on the left of this glyph, but it is rather problematic to identify this side-sign (Justeson, pers. commun. 1985):

The best match in form I think is with T238, AH5, and this would make sense as *Ah Chih*, 'Maguey' or 'He of Maguey' (or 'Liquor' or 'He of Liquor').

According to Bolles (1981), the phrase 'ah ci' occurs in colonial Yucatecan Mayan texts and may be translated as drunk or drunkard.

Part three: Ethnopharmacological approach to reputed ritual Maya intoxicants

The principal ethnopharmacological question is, of course, which intoxicating enemas the Maya may have taken. An alcoholic liquid, tobacco and hallucinogens have all been proposed as possible ingredients (Furst, 1976a; Furst and Coe, 1977; Robicsek, 1978; Torres, 1984).

Alcoholic beverages

As outlined above, the enema scenes themselves present a fair amount of evidence to support the first suggestion. It is well established that alcoholic beverages were known to the Maya in early-contact times (Tozzer, 1913; Landa, 1978). Rectal use of such preparations has not been recorded for the Maya, but it is reported for other early native inhabitants of Middle America (vide supra). The balché drink of the Maya has been described as a mild intoxicant, concocted of fermented honey and water, to which was added the bark or root of the balché tree *Lonchocarpus violaceus* (= *L. longistylus*). This admixture is not known to contain any hallucinogenic principle (de Smet, 1983). According to early sources, there were other alcoholic beverages as well: their base is said to have been pineapples and sugar-cane (Tozzer, 1913), or honey, together with maize or the root of an *Agave*, and roots of unidentified plants (Roys, 1943). It should be added, however, that sugar-cane cannot have entered into the composition of pre-Hispanic Maya drinks, as this plant was introduced by the Europeans (Schultes, pers. commun. 1984).

The chemistry and psychopharmacology of early Mesoamerican alcoholic drinks have been reviewed in a previous paper (de Smet, 1983).

Tobacco

The use of tobacco among the Maya has been reviewed extensively by Robicsek (1978). In contrast with the sources on alcohol, early historical records on the Maya relating to tobacco appear to be questionable and confusing. There can be no doubt, however, that numerous Maya vase paintings from the classic period portray fumigatories, which are often provided with smoke scrolls (Fig. 5). As pointed out above, enema paraphernalia are occasionally shown to emit similar scrolls. With respect to the botanical identity of the fumigatories on Maya pottery, Robicsek (1978) rightly remarks:

Of course, the only way to state with absolute certainty that the ancient Maya indulged in tobacco smoking would be to discover tobacco cigars or cigarettes or pipes stuffed with tobacco (preferably still smoking) in Classic graves. Unfortunately, the only bona fide discovery of tobacco at a Maya site was the cache of cigars discovered by C. Rudy Larios in Group H at Tikal. This (review), however well supported, is, therefore, speculative. The only thing we know for certain is that the Mayas smoked something. This something was most likely tobacco, a conclusion based on archaeological material found at Classic and post-Classic sites, stone monuments, ceramic artifacts, and codices.

The chemistry and psychopharmacology of Mesoamerican tobacco species have been reviewed in a previous paper (de Smet, 1983).

Psilocybian mushrooms

The only hallucinogen which is suggested again and again as a possible ritual Maya intoxicant, is the psilocybian mushroom (Dobkin de Rios, 1974; Robicsek, 1978; Torres, 1984). Apart from the chemical and pharmacological data (de Smet, 1983), the evidence includes linguistic findings (entries found in early Maya vocabularies relating to inebriating mushrooms), botanical findings (psilocybian mushrooms found in the Maya region), and archaeological findings (mushroom-shaped stone objects found at pre-Hispanic Maya sites) (Greene Robertson, 1972; Lowy, 1977; Mayer, 1977; Wasson, 1980; Torres, 1984). Not every scholar, however, considers the mushroom-shaped stone objects as substantial evidence of the Maya mushroom use in early times (Brown, 1984). It should also be noted that the evidence of such use is not associated with the central Maya area, from which most enema vase paintings originate, but with other Maya regions, especially with the Highlands. Even though it cannot be excluded that mushrooms could have been brought into the central region by trade (Brown, 1984; Mayer, pers. commun. 1984), it is certainly not safe to claim that the Maya prepared ritual enemata from mushrooms. The vase paintings fail to provide any evidence for this conjecture. The mushroom-shaped objects, which sometimes appear in front of a face on classic Maya pottery, unquestionably represent nose-beads.

The chemistry and hallucinogenic nature of psilocybian mushrooms have been reviewed in a previous paper (de Smet, 1983).

Fly agaric

The fly agaric *Amanita muscaria* occurs in the Maya highlands and it has sometimes been suggested that it is represented in post-classic Maya codices (Lowy, 1972; Torres, 1984), but the objects interpreted as mushrooms might also be rattles, maces or fans (Thompson, 1972; Robicsek, 1978). At present, there would not seem to be paramount evidence that the ancient Maya may have preferred the fly agaric to psilocybian mushrooms (Mayer, pers. commun. 1984).

Amanita muscaria is frequently classified as a hallucinogen. Its major active principles are stated as being ibotenic acid and muscimol, which is probably not a genuine constituent but an artifact formed during drying or extraction (de Smet, 1983). Clinical evidence for hallucinogenic activity is not so impressive as it is in the case of psilocybian mushrooms. Ott (1976) ingested about 30 g of dried caps, and this resulted in sedation and slight visual phenomena. McDonald (1978) drank an aqueous extract from 30 g of the dried mushroom, and did not experience hallucinations or obvious visual distortions. He also gave an oral dose of 12 g/72 kg body wt to healthy volunteers, who partly reported visual and auditory distortions, but not overt hallucinations. Plomp (1982) felt some heightened perception of colours and deeper awareness, but 'no sensational action' from oral doses up to five fresh caps. A truly visionary experience has no more been found in clinical experiments with isolated constituents. In healthy subjects, ingestion of 7.5–10 mg of muscimol elicited changes in mood, affective detachment and loss of concentration, but hallucinations did not occur. In the same study, ibotenic acid in a dose of 75 mg produced a weaker and less characteristic effect (Theobald et al., 1968). In schizophrenics, oral administration of 7–10 mg of muscimol caused exacerbations of certain psychotic manifestations, but deterioration of hallucinations was not observed (Tamminga et al., 1978). Studies on the fate of tritiated muscimol in the mouse indicate substantial metabolism and poor penetration of the intact substance into the brain (Ott et al., 1975; Maggi and Enna, 1979), so it is open to question that the behavioural effects of muscimol are due to the compound itself.

Water Lily

Dobkin de Rios (1974) has put forward that the Maya may have taken the water lily *Nymphaea ampla* in a ritual context, but other scholars did not generally approve of this idea. More recently, the available evidence for the suggestion that the water lily was a ritual Maya plant has been surveyed by Emboden (1981a,b) and by Torres (1984). Enema paraphernalia and plant parts associated with the water lily are known to occur together in Maya vase paintings. In one case, a possible water lily flower is even shown to emerge from the specially shaped jug, which features in enema scenes on other vases (vide supra). This raises the possibility that the flower could have entered in-

to the composition of ritual Maya enemas. It is still insufficiently clear, however, whether or not *Nymphaea ampla* can serve to induce a central intoxication (vide infra). Consequently, it would be unwise at this stage to discard alternative explanations, such as nutritional, sexual, or symbolic purposes, as being impossible. There is a vague claim, for instance, that the farinaceous rootstocks of *N. ampla* are edible (Sturtevant, 1972). This corresponds with a herbarium annotation that the bulbs of an indeterminate *Nymphaea* species from Mexico are dug and eaten during the dry season (von Reis Altschul, 1973). Furthermore, the rootstock of *N. ampla* is said to be considered an aphrodisiac in Yucatan (Morton, 1981). It should be noted that these ethnobotanical data refer to the submerged parts and not the flowers. A non-materialistic suggestion is offered by Furst (pers. commun. 1982) who feels that the Maya water lily "is a perfect visual metaphor for the connection between the surface of the water, or the earth, and the watery lower regions".

The Old World species *Nymphaea caerulea* has been tested by Emboden (1979b; pers. commun. 1984) who twice drank a decoction of its flower buds. The effect of the decoction was very mild and more akin to a hypnotic, but there were alterations in visual and auditory perception. With respect to *Nymphaea ampla*, the water lily of the New World, Torres (pers. commun. 1985) has recently informed us of an experiment with negative results:

About 2 months ago, a psychiatrist friend, tried to experience the hallucinogenic effect of *Nymphaea ampla* collected in Lake Petén Itzá (in the center of the Maya Classic area), in Petén, northern Guatemala, with absolutely no effects. The experiment was done according to instructions given me by Emboden.

Various sources indicate that *N. ampla* contains apomorphine-like alkaloids (Emboden, 1979a, 1981a; Schultes and Hofmann, 1980a; Dobkin de Rios, 1984; Torres, 1984). For instance, Emboden (1979a, 1981a) claims that apomorphine-like compounds as well as nupharine and nupharidine were found in the flowers of *N. ampla* and that aporphine could be extracted from its bulbs and roots. All such statements are said to be based on the analytical work of Díaz on *N. ampla* (Emboden, pers. commun. 1984; Dobkin de Rios, pers. commun. 1985; Torres, pers. commun. 1985). So far as we have been able to ascertain, however, this investigator has merely reported the isolation of an unidentified alkaloid from the leaves (Díaz, 1976, 1977) and several unspecified alkaloids from the submerged parts (Díaz, 1979). As to the possible psychopharmacology of *N. ampla*, Díaz (1976) points at the presence of tetraisoquinoline, benzylisoquinoline and aporphine alkaloids in other Nymphaeaceae, and subsequently at the central dopaminergic activity of apomorphine, which has an aporphine structure. It should not be overlooked, however, that only aporphines like apomorphine and *N*-propylaporphine, which have (or obtain in vivo) an intact dopaminergic moiety in their structure, may be expected to have substantial dopaminergic activity (de Smet, 1983). In a later publication, Díaz (1979) reports on auto-experiences with the intact bulb and extracts. On one occasion, 7 g

of the pulverized dried bulb were ingested and on another, an aqueous extract equivalent to 35 g of the bulb was taken. There were no detectable psychological modifications. It should be noted that Díaz (1976, 1977, 1979) does not provide experimental data on the flowers of *N. ampla*. This is rather unfortunate, for if the Maya used the water lily as a ritual intoxicant, this anatomical section is the most likely plant part to have served this purpose (vide supra).

Toad poison

Dobkin de Rios (1974) has also suggested toad poison as a ritual Maya intoxicant, but this conjecture was not generally approved of either. There is a classic Maya vase which displays one or more jugs together with a toad-like creature, characterized by its "ear" with three dots, but it is unclear whether it is a toad or a frog.

The chemistry and pharmacology of poison from the skin glands of *Bufo* species have been discussed in a previous paper (de Smet, 1983).

Tsité

The divinatory tsité tree of the Popol Vuh, a famous epic of the Quiché Maya, is said to have been an *Erythrina* species (Girard, 1960; Schultes, 1972). In 1970, Furst (1974b) presented a paper about this subject at the Annual Meeting of the Society for American Archaeology in Mexico. This paper is no longer available (Furst, pers. commun. 1985). Rumours that Guatemalan shamans ingest *Erythrina* beans for ritual purposes are still extremely tenuous and open to doubt (Schultes and Hofmann, 1980b).

The genus *Erythrina* appears to be rich in alkaloids, many of which have a peripheral curare-like action (Deulofeu, 1959; Boekelheide, 1960; Hill, 1967; Dyle and Quessy, 1981). Central depressant and convulsant activity has also been reported for some *Erythrina* alkaloids, but the intensity of action was considerably lower than that observed in the case of peripheral activity (Boekelheide, 1960). Pharmacological evidence for hallucinogenic properties appears to be lacking (Schultes and Hofmann, 1980b; Dyke and Quessy, 1981).

Toh-ku

The Maya flora is known to include *Datura candida* (Hopkins, 1974), but Schultes (pers. commun. 1982) doubts very much that this tree occurred in Central America in ancient times, as all the *Brugmansia* species are South American. Toh-ku, of which the Maya made many medicines for hemorrhoids, has been identified as *Datura innoxia* (Roys, 1976), but there is no ethnobotanical record that the Maya intoxicated themselves with this plant. And, its characteristic spiny fruit does not occur in classic enema scenes. Litzinger

(1981) has reported that ceramics resembling the spiny fruit of *Datura* have been found in the Maya area, but we feel that these represent the stem of the *Ceiba* tree rather than the fruit of *Datura*. The latter view is supported by the cylindrical form of such spiny ceramics. What is more, Litzinger (pers. commun. 1982) himself informed us that the present-day Lacandon Maya still make spiked ceramic vessels, and refer to the spikes as to those of the *Ceiba* tree, which is an important symbolic plant for them.

The chemistry and psychopharmacology of herbaceous *Datura* species have been reviewed in a previous paper (de Smet, 1983).

Part four: Ethnopharmacokinetic approach to reputed ritual Maya intoxicants

Drug uptake from the rectum does not appear essentially different from that in other parts of the gastrointestinal tract. Passive diffusion through a lipid membrane is probably the main governing mechanism of absorption. In contrast to the small intestine, the rectum has no primary function as an absorbing organ. It is approximately 15–20 cm long, and there are no villi and microvilli on the rectal mucosa. Consequently, the absorption surface is far more limited than that of the duodenum. Under normal conditions, the rectum merely contains 2–3 ml of inert mucus, so the small intestine has much more fluid available than the rectum for drug dissolution from solid dosage forms. Despite these potential disadvantages, it has been demonstrated that numerous drugs reach effective plasma levels when given rectally, and in many countries rectal therapy is generally viewed as a convenient alternative to oral dosing (Senior, 1974; Moolenaar, 1979; Thoma, 1980; de Boer et al., 1982).

Systemic therapy via the rectal route is considered particularly useful when the patient is unwilling or unable to take his medicine by mouth, e.g. because of nausea and vomiting. Some Maya scenes would seem to suggest that the ancient Maya have not failed to notice this obvious advantage (vide supra). The potential advantage that rectal application may have in this respect over oral administration, can be twofold: (1) if vomiting occurs, this will not lead to the premature loss of unabsorbed drug; (2) drug-induced emesis may be avoided, provided that this effect is caused by a local irritating action on the gastrointestinal tract. With respect to the latter point, it should be noted that drug-induced vomiting may also be due to a systemic effect. For instance, the emetic responses to alcohol (Forney and Harger, 1965) and to nicotine (Taylor, 1980) are known to have a central component. As these substances are both suggested as active principles of ritual Maya enemas (vide supra), this raises the interesting possibility that the vomiting displayed on ancient Maya pottery may have been provoked by the ritual Maya enema itself.

The presence of food in the stomach delays the absorption of many drugs when they are taken orally (Welling, 1977; Toothaker and Welling, 1980), but this is impossible in the case of rectal application. In other words, when

a patient has just enjoyed a meal, drug absorption may be more rapid following rectal administration than it would be after oral dosing.

Another advantage of rectal application may be that the breakdown of acid-labile drugs by the stomach is avoided. Sometimes the rectal route is also recommended as a means to prevent first-pass elimination by liver enzymes (Ansel, 1976). There is considerable doubt, however, that an enema usually provides the advantage of adequately bypassing hepatic inactivation. It is true that, while the upper rectal vein drains into the hepatic circulation, the inferior and probably also the middle rectal veins pass directly into the systemic circulation. A complicating anatomical factor, however, is the presence of anastomoses between the rectal veins. Also, rectal dosage forms do not remain in the lower parts of the rectum, but move upward into a higher region. Studies on the degree of enema penetration indicate that penetration as far as the ascending colon may be achieved and that, depending on the enema volume, penetration at least as far as the descending colon is likely. Therefore, a large enema cannot be expected to provide a substantial by-pass of the liver. A study on lidocaine has shown that in principle the use of a micro-enema can result in partial avoidance of a hepatic first-pass effect, but in various experiments with other drugs the systemic availability of a micro-enema did not substantially surpass that of an oral dosage form (de Smet, 1983). It certainly cannot be concluded from these data that a high-clearance drug will generally show higher systemic availability when it is taken as an enema. Unless the compounds tested so far were well absorbed after oral ingestion and poorly absorbed following rectal application, this implies that substantial first-pass metabolism may not be avoided even when a non-voluminous enema is used.

The principal drawback of rectal administration is the risk of interrupted drug absorption by the inability of the subject to retain the dosage form. For instance, retention time was a major determinant of bioavailability in studies on aminophylline suppositories (Zuidema et al., 1976; Anonymous, 1980).

A second problem may be a lack of patient acceptability. Rectal therapy is generally recognized as useful in West European countries on the continent, but it is far from common in Britain and in the United States. In a large British study on phenylbutazone suppositories in general practice, 10% of the patients refused to participate, because they were not prepared to accept a suppository, and half of them did not complete the eight-week course (Anonymous, 1983). Opposite views on rectal administration are not only seen in western civilisation, but also in the native societies of South America. The Peruvian Omagua Indians even distributed enema syringes to their guests (De La Condamine, 1778), but such instruments were less appreciated among the Abipones of Paraguay (Dobrizhoffer, 1822):

They will not even bear the mention of an enema. In the town of St. Jeronymo, a Spanish soldier who professed the art of medicine, being requested by Father Brigniel

to attend upon a sick Abipon, declared the necessity of an injection. No sooner did the sick man feel the syringe applied to him, then he started furiously out of bed, snatched up a lance, and would have slain the soldier physician, had he not saved himself by hasty flight.

Another disadvantage of rectal administration arises from the relatively small absorption surface of the rectum. As a consequence, the usefulness of the rectal route may vary considerably with the physicochemical properties of the drug substance and with the biopharmaceutical properties of the dosage form. These aspects of rectal drug administration and their clinical implications are extensively discussed in recent reviews by de Blaey and Polderman (1980), Thoma (1980), and de Boer et al. (1982).

Alcoholic beverages

Taken orally, ethyl alcohol can be readily absorbed from the gastrointestinal tract. Since most absorption occurs in the small intestine, the absorption rate depends on the rate of gastric emptying, which in its turn is determined by factors like the properties of the beverage and the presence of food in the stomach (Wilkinson et al., 1977; Ritchie, 1980; Eckardt et al., 1981).

In view of the good oral absorption characteristics of alcohol and of its physicochemical properties (Windholz, 1983), a rapid and complete absorption should also be possible, if it be rectally administered. To test this theoretical view, one of us (P. de S.) twice took 0.5 l of 5% v/v alcohol, once as an oral drink and once in the form of clysters. At the time of the experiment, he was a non-inhaling smoker and a regular user of coffee and beer. Solutions were prepared by diluting 26 ml of 96% v/v alcohol (OPG, Utrecht) with tap water to 0.5 l. A percentage of only 5% was chosen, since a clyster with an alcoholic content of 20% is quite irritating to the rectal tissue (Moolenaar, pers. commun. 1982), and since the early Indian drinks also had low alcohol percentages (Erosa Barbachano, 1976). Because of this choice, the oral drink and the enema had to be voluminous to provide a substantial dose of alcohol. According to the pharmaceutical literature, the volume of an enema should be less than 0.2 l, if it is to be retained in the intestine (Fishburn, 1965; Pernarowski, 1975). Therefore the total rectal volume was divided in four equal parts, which were administered within 25 min with the aid of a Flex-Klis flacon (Spruyt-Hillen, Vianen). The clysters had been warmed to body temperature before administration, and they were taken in a prostrate position. Due to these precautions, rectal retention of as much as 0.5 l turned out to be quite easy.

As the sole purpose of the experiment was to obtain an impression of alcohol absorption via the rectal route, alcohol blood levels were not monitored by blood analysis, but by simple breath testing with an Intoxilyzer Model 4011 A (CMI, Mintum). The manufacturer of this equipment guarantees an absolute error of less than 0.1 mg/ml. In a calibration test of the

used apparatus, zero set values turned out to be more accurate than test mode values and did not deviate more than 0.02 mg/ml from actual blood levels (Zweipfenning, pers. commun. 1984). The results presented here are therefore not test mode values, but zero set values.

The oral dose was taken after an overnight fast, and resulted in maximal blood levels of 0.4 mg/ml at 30–45 min, followed by a practically linear decline to 0.2 mg/ml at 120 min. Similar data were reported by Wilkinson et al. (1977), who tested 30 ml of 95% of alcohol (diluted to 150 ml) in fasting subjects. In the next 25 min, the total rectal dose was administered, and it produced a rise from 0.2 mg/ml to 0.6 mg/ml at 165 min, whereafter at 240 min the level fell again to 0.4 mg/ml in a practically linear way. These results certainly support the theoretical suggestion that alcohol is absorbed well from an enema.

Tobacco

Oral nicotine is said to be largely inactivated during its first passage through the liver (Russell et al., 1976; McNabb et al., 1982). It is also said that after oral ingestion of tobacco, the absorption of nicotine is apparently delayed because of slowed gastric emptying, so that vomiting caused by the central effect of the initially absorbed fraction removes much of the tobacco remaining in the stomach (Taylor, 1980). Nevertheless, oral tobacco infusions are considered quite toxic and may even be lethal (Harrison, 1964; Opitz, 1982).

When tobacco is injected into the rectum, it might sometimes operate as a cathartic (Osol and Farrer, 1955), but in official Western medicine tobacco enemas certainly are considered obsolete because of their toxicity (List and Hörhammer, 1977). Rectal infusions prepared from 15 to 20 g of tobacco (Fabre et al., 1957) or even as low as 2 g (List and Hörhammer, 1977) are said to have caused fatal intoxications, although recovery after 15 g rectally has also been observed (Lewin, 1962). A recent case report described nausea and confusion followed by hypotension and bradycardia due to unorthodox self-medication with an enema prepared apparently from 5 to 10 cigarettes (Garcia-Estrada and Fischman, 1977). Furthermore, nicotine could be recovered from the urine of a male non-smoking subject, who had received this alkaloid via the rectal route (Jenner et al., 1973). In view of these data, there can be no doubt that a tobacco clyster can produce systemic effects.

Psilocybian mushrooms

Experimental data on the rectal application of *Psilocybe* alkaloids do not seem to be available. The physicochemical properties of psilocybin (Windholz, 1983) are not suggestive of a good and rapid absorption from rectal dosage forms.

Fly agaric

Muscimol has extreme water-solubility, but also a low molecular weight (Eugster, 1967). It is rather difficult to predict from these properties, whether or not muscimol will be absorbed well after rectal application.

Water lily

Since there are no adequate phytochemical data on *Nymphaea ampla*, it is impossible to discuss the rectal efficacy of its constituents.

Toad poison

There is considerable evidence to suggest that the *Bufo* alkaloid bufotenin and related tryptamines undergo extensive first-pass metabolism by intestinal and hepatic MAO and by hepatic microsomal enzymes (de Smet, 1983). Since it is likely that the availability of drug metabolizing enzymes in the gut wall decreases in the direction jejunum, caecum, colon, rectum (de Boer et al., 1982), it may be speculated that inactivation by intestinal MAO is avoided by rectal application. There is considerable doubt, however, that the use of an enema is a reliable way to escape hepatic first-pass elimination (vide supra), so tryptamines may still be inactivated following rectal administration. Experimental data on the rectal efficacy of bufotenin do not appear to be available. There is some anecdotal information on the activity of an enema containing the closely related dimethyltryptamine (DMT). This information was obtained by one of us (P. de S.), who took enemas containing up to 125 mg (1.6 mg/kg) of DMT in self-experiments. Even though this dose was much larger than 30 mg, the reported threshold dose of intramuscular DMT (Szára, 1957), there was no discernible effect (de Smet, 1983). The most likely explanation for the inactivity is that first-pass elimination was not completely avoided. Further experiments in more than one volunteer are needed, however, especially with still higher doses, to ascertain whether or not any partial avoidance is possible. So long as such testing has not been done, it can neither be safely excluded nor concluded that tryptamines like DMT and bufotenin produce systemic effects, when orally inactive amounts are taken in the form of an enema.

Tsité

We are not aware of experimental data concerning the rectal efficacy of *Erythrina* alkaloids.

Toh-ku

The synthetic quaternary compounds butylscopolamine and methylatropine are very poorly absorbed after rectal administration (Soeterboek et al.,

1980), but the naturally occurring tropane alkaloids scopolamine, hyoscyamine and atropine are tertiary compounds, which should allow better rectal absorption. Suppositories containing belladonna liquid extract were included in the British Pharmacopeia of 1948 (Reynolds, 1982). However, there are only vague and conflicting experimental data on the efficacy of naturally occurring tertiary tropane alkaloids, and well-designed studies on their rectal usefulness are still awaited.

Tardos et al. (1959) studied the mydriatic activity of rod-shaped suppositories with atropine sulphate in the rat. They reported a very large difference between equivalent intravenous and rectal doses of atropine, viz. 0.02 mg/kg vs. 0.5 mg/kg, for rods prepared from cacao butter, and the difference was even larger when the rod base was carbowax.

Neuwald et al. (1962) examined the mydriatic effect of fatty suppositories with atropine base or atropine sulphate in rabbits. A dose of 20 mg atropine or atropine sulphate produced mydriasis in all animals tested, but a suppository with 10 mg of the sulphate did not have this effect in each rabbit. According to the authors, the large difference in mydriatic efficacy between a rectal dose of 20 mg (6–8 mg/kg) in the rabbit and a systemic dose in man should be attributed to the insensitivity of the rabbit for atropine.

More recently, Hendrickx and Govaerts (1980) compared enemas with 0.00, 0.01, and 0.02 mg/kg of atropine in small children. Apparently, they did not find statistically significant differences in cardiac and anti-sialogogic activity, but their report is too confusing to permit firm conclusions.

In other investigations, rectal preparations containing one or more natural tropane alkaloids were found to be useful as premedication for children and for the facilitation of delivery. All these studies were uncontrolled, however, and each tested drug preparation contained at least one other active substance besides the tropane alkaloid or alkaloids (de Smet, 1983).

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