Otomi Bark Paper in Mexico: Commercialization of a Pre-Hispanic Technology[1]

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The Otomi village of San Pablito in northern Puebla has preserved the tradition of making bark paper for over 400 yr, and today is the only papermaking center in all of Mexico. In the past 20 yr, bark paper has become highly commercialized and several aspects of the Otomi papermaking process have changed. Unprecedented production levels have caused the total depletion of traditional sources of raw material. In response to this situation, the Otomi have been forced to change the types of bark that are utilized, the logistics of bark collection, and the treatment of the bark fiber prior to use. The majority of the paper currently produced in San Pablito is made from the bark of Trema micrantha *imported from the state of Veracruz. A plantation of this species is being established near San Pablito to reduce the Otomi dependence on outside sources of raw material.*

Paper made from tree bark has been produced in various parts of Mexico for over 1,400 yr. Bark paper, or *papel amate,* played an important cultural role during pre-Hispanic times, and many indigenous groups, e.g., the Aztec, Toltec, and Mixtec, developed papermaking technologies. After the Spanish conquest, the tradition of making bark paper gradually started to disappear in Mexico, and only in the Otomi village of San Pablito in the Sierra Norte of Puebla was the practice preserved up to the present. Although the point is seldom emphasized in much of the recent literature on the subject (Bell 1983; Christensen and Martí 1971), papermaking in San Pablito has not gone unchanged with the passage of time. Bark paper is currently a valuable handicraft in Mexico (Fig. 1), and the commercialization of this product has had a notable impact on the Otomi. The purpose of our report is to describe the current status of bark paper production in San Pablito, to show how market conditions and poor forest management have produced a critical shortage of raw material, and to outline the steps that have been taken to remedy this situation.

The results presented here are based on a series of visits made to San Pablito, Puebla, from February to June 1984. Interviews were conducted with numerous members of the community including papermakers, bark collectors, and individuals directly involved with the marketing and sale of bark paper. Voucher specimens of all the tree species used as raw material in the manufacture of bark paper are deposited in the herbarium of the Instituto Nacional de Investigaciones sobre Recursos Bióticos (XAL), Xalapa, Veracruz, Mexico. The local abundance of each species was also assessed. Laboratory and field studies were used to develop management plans for increasing the supply of locally available bark fiber.

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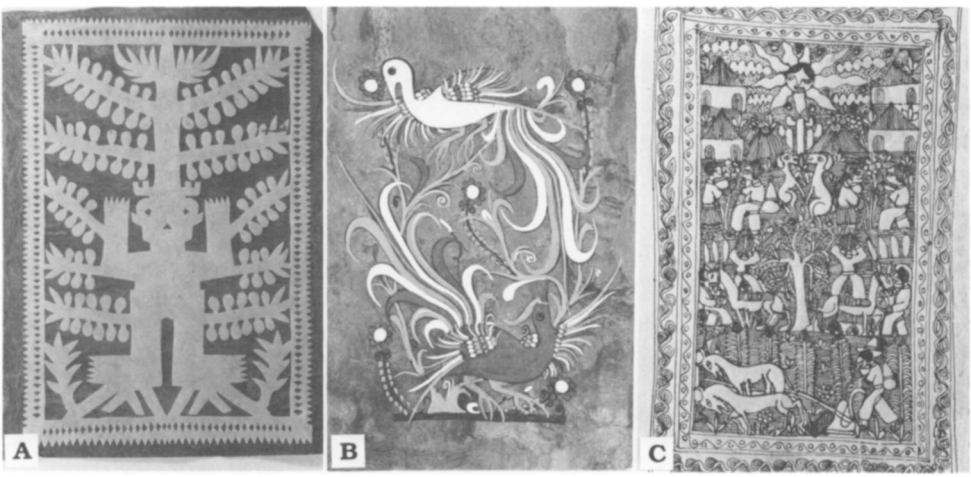

Fig. 1. Typical bark-paper designs produced in Mexico. All paper made from *Trema micrantha* bark by the Otomi of San Pablito, Puebla. **A.** Tissue paper cut-out mounted on bark paper representing the spirit of the coffee plant. **B.** Decorative motif painted by the Nahua artists of Xalitla, Guerrero. **C.** Daily life in a Nahua village. Whitish paper produced by bleaching the bark.

COMMERCIALIZATION OF OTOMI BARK PAPER

As has been documented in many reports, the quantity of bark paper produced in Mexico before the arrival of the Spanish was surprisingly large. One source, the *Codex Mendoza* (1938), or *Matricula de tributos,* stated that over 480,000 sheets of bark paper were sent in annual tribute to the royal house of Motecuhzoma II in Tenochtitlán. Upon arrival in the imperial city, the paper was destined for use in religious ceremonies, for adorning temples and altars, and for making codices. The paper appears to have been produced by 42 separate villages within the Aztec empire, and Lenz (1948), in his exhaustive study of bark paper in Mexico, presents a list of these pre-Hispanic papermaking centers. After the fall of Tenochtitlán, the total production of bark paper in Mexico was undoubtedly reduced. Those villages that continued to manufacture paper probably did so to satisfy a limited local demand for the product.

The Otomi first moved in to the San Pablito area in the early 16th century (Manrique C. 1969), and papermaking was probably initiated soon thereafter. As has been described in detail by Christensen (1942), Lannik et al. (1969), and Sandstrom (1981), paper was used traditionally in San Pablito as part of agricultural rites, folk medicine, and witchcraft. Images of spirits or deities cut from bark paper were used in various ceremonies, or *costumbres,* to assure a good harvest, to exorcise evil spirits, or to cast spells (Fig. 1A). Based on the specific objective of a *costumbre,* figures were cut from either white (good spirits) or dark (evil spirits) bark paper. It is doubtful that large quantities of paper were required to satisfy these ceremonial needs, and papermaking by the Otomi most likely remained at a low level for several centuries.

In the early 1960s, an architect, Max Kerlow, and a painter, Felipe Ehrenberg, gave several sheets of Otomi bark paper to a group of Nahua artists as a simple experiment. These native artists, primarily from Xalitla and San Agustin Oapan

in Guerrero, were renowned for their intricate paintings on clay pots and wooden masks. The new material was received with much enthusiasm, and in 1963 the first exhibition of Nahua paintings on bark paper was held in the Centro de Arte y Artesanias in Mexico City (Mauricio and Saldivar 1979). This exhibition was a great success, and soon the demand for bark-paper paintings began to increase rapidly.

Today, bark-paper paintings represent one of the most successful and widely distributed types of folk art in Mexico. They are sold in tourist centers throughout the country (Fig. 2A) and are exported in large quantities to American, European, and Japanese markets. Two basic motifs are available: *decorativos,* which show birds, flowers, or animals in vivid colors (Fig. 1B), and *espontaneos,* which depict scenes from the daily life of Xalitla and San Agustin Oapan (Fig. 1C). The production necessary to satisfy the commercial demand for bark-paper paintings has been estimated to exceed 100,000 sheets in some months (Stromberg 1983), or more than twice that sent in annual tribute to Motecuhzoma II. The important distinction is that San Pablito is the only remaining papermaking center in Mexico, the small village being the sole supplier of this enormous quantity of bark paper.

IMPACT OF COMMERCIALIZATION

The drastic increase in the demand for bark paper in the last 20 yr has had a marked effect on several aspects of the papermaking process in San Pablito. In response to an ever-increasing need for raw material, the Otomi have been forced to substitute new types of bark in place of traditionally favored species and to intensify greatly their exploitation of local forests. The net effect has been the gradual depletion of local sources of raw material. The introduction of new bark types with different physical characteristics has produced subtle changes in the papermaking process and in the size and shape of the finished product. Finally, the commercialization of bark paper has caused notable changes in the socioeconomic structure of this Otomi community.

Substitution of raw material

Papermaking in San Pablito was first observed in 1898 by Frederick Starr; since then numerous reports about Otomi bark paper have been published. Most accounts have included a listing of the types of bark used; if these are arranged in chronological order a general picture of temporal changes in raw material use can be obtained. Such a listing is shown in Table 1, together with the local names for each tree.

As is shown in Table 1, early visitors to San Pablito (León 1924; Starr 1901) agree that *amate* or *xalama* and *moral* were the species most commonly used for bark paper. Dark-colored paper was obtained from the bark fibers of *amate,* and *moral* produced a whitish paper. Miranda (1946) later identified the *amate* and *moral* used in San Pablito as *Ficus tecolutensis* (Liebm.) Miq. (Moraceae) and *Morus celtidifolia* H.B.K. (Moraceae), respectively. Lenz (1948) published a detailed description of Otomi papermaking and reported that three distinct types of *amate* were used in addition to *moral,* and that a new species, *teochichicastle,* also served as raw material for bark paper. In later publications, the number of bark types reported to be used by the Otomi continued to increase. Christensen

Fig. 2. **A.** Stacks of bark-paper paintings for sale in a crafts market in Mexico City. **B.** Bark merchant arranging a shipment of *Trema micrantha* bark from Martínez de la Torre, Veracruz. Each roll or *madeja* of bark weighs ca. 2.5 kg. **C.** Otomi using strips of *T. micrantha* bark to make a sheet of paper. Softened bark fibers hang in the background. Note flattened stone or *muinto* used for pounding the bark fibers together.

TABLE 1. SPECIES USED TO MAKE BARK PAPER BY THE OTOMI OF SAN PABLITO, PUEBLA.

References	Species	Common names[a]
Starr (1901)	—	Amate (S), xalama (N)
	—	Moral (N)
León (1924)	—	Amate (S), xalamatl (N)
	—	Moral (N)
Lenz (1948)	*Ficus* sp.	Xalamatl grande (N), ntá-po-potzá (O)
	Ficus sp.	Xalamatl bayo (N), popotzá (O)
	Ficus tecolutensis (Liebm.) Miq.	Xalamatl limon (N), muxi-coni (O)
	Morus microphylla Buckl.	Moral (N), tzá-secuá (O)
	Morus celtidifolia H.B.K.	Teochichicastle (N), ix-ná (O)
Christensen (1963)	*Ficus petiolaris* H.B.K.	Amate (S)
	Ficus padifolia H.B.K.	Amate (S)
	Ficus tecolutensis (Liebm.) Miq.	Amate (S)
	Ficus cotinifolia H.B.K.	Amate (S)
	Ficus involuta (Liebm.) Miq.	Amate (S)
	Ficus elastica Roxb.	Amate (S)
	Morus nigra L.	
	Morus celtidifolia H.B.K.	Teochichicastle (N)
Christensen & Martí (1971)	*Ficus goldmanii* Standl.	Xalamatl (N)
	Ficus sp.	Xalamatl grande (N)
	Ficus sp.	Xalamatl bayo (N)
	Ficus tecolutensis (Liebm.) Miq.	Xalamatl limon (N)
	Morus celtidifolia H.B.K.	Moral (N)
	Urera baccifera (L.) Gaud.	Teochichicastle (N)
Torres (1983)	*Ficus tecolutensis* (Liebm.) Miq.	Xalama limon (N), mushi-coni (O)
	Ficus sp.	Xalama grande (N), napopotzá (O)
	Ficus sp.	Xalama bayo (N)
	Morus celtidifolia H.B.K.	Moral (N), tsazecua (O)
	Urera sp.	Chichicastle (N), tzaná (O)
	Heliocarpus sp.	Jonote colorado (S), xangaconi (O)
	Bursera simaruba (Sw.) Sarg.	Chacá (S)
This study[b]	*Ficus padifolia* H.B.K. (*Peters 132*)	Xalama limon (N)
	Ficus cotinifolia H.B.K. (*Peters 128*)	Xalama con hojas redondas (S)
	Ficus tecolutensis (Liebm.) Miq. (*Peters 129*)	Xalama (N)
	Morus celtidifolia H.B.K. (*Peters 161*)	Moral (N)
	Urera baccifera (L.) Gaud. (*Peters 126*)	Chichicastle (N)
	Trema micrantha (L.) Blume (*Peters 162*)	Jonote colorado (S)
	Myriocarpa longipes Liebm. (*Peters 160*)	Chichicastle (N)

[a] (N) = Nahua, (O) = Otomi, and (S) = Spanish.

[b] Voucher specimens deposited in the herbarium of the Instituto Nacional de Investigaciones sobre Recursos Bióticos (XAL).

(1963) listed eight species, six of which pertain to the genus *Ficus*; Christensen and Martí (1971) described seven species, four of which are of *Ficus*; and Torres (1983) reported 10 different bark types, five being species of *Ficus*. Seven species were found to be used for bark paper in our study, only three being *amates*.

It should be noted that there are obvious taxonomic discrepancies in Table 1. For example, the *moral* described by Lenz (1948) as *Morus microphylla* and by Christensen (1963) as *M. nigra* is really *M. celtidifolia.* Similarly, *teochichicastle,* reported by Lenz and Christensen as *M. celtidifolia,* is *Urera baccifera* (L.) Gaud. (Urticaceae). The latter misidentification is somewhat surprising given the common name for the tree (from Nahua, *teo* = god, *titzicastli* = castigate) and the stinging hairs characteristic of the genus *Urera.* Finally, *jonote colorado,* reported by Torres (1983) as *Heliocarpus* sp. (Tiliaceae), is in fact *Trema micrantha* (L.) Blume (Ulmaceae). *Heliocarpus donnell-smithii* Rose is also known locally as *jonote,* but the Otomi do not use its bark for paper as they say it is too *resbalosa* or slippery.

A basic limitation to the type of analysis being used here is that a simple species list provides little information about the quantity of each type of bark used. As a result, the relative importance of each bark type during a given period cannot be determined. Nevertheless, a definite trend can be appreciated in the chronological list of bark types used in San Pablito. Whereas for many decades *amate* and *moral* were the only species used for paper, in the past 10–15 yr there has been a diversification in the types of raw material used with a pronounced shift toward the use of species such as *teochichicastle* and *jonote colorado.* Currently in San Pablito, *jonote colorado* is by far the most extensively exploited tree, and bark from *Ficus* trees, of whatever species, is only rarely used. In essence, the modern-day Otomi have removed all traces of *amate* from *papel amate.*

Resource availablity and procurement

San Pablito, one of 10 communities in the municipality of Pahuatlán, is situated on mountainous terrain within the Sierra Madre Oriental at an elevation of about 1,200 m. The climate is humid, yet temperate, with a marked seasonality in rainfall and a pronounced drop in temperature at night. In view of its elevation and climate, the region represents a transition zone between the tropical lowlands and the temperate highlands. The local forests, which can be described as temperate deciduous forest or *bosque mesofila de montaña* (Rzedowski 1978), contain a mixture of both tropical and temperate species (Miranda and Sharp 1950).

Although *amate* and *moral* historically have been the species most widely used by the Otomi, both of these trees have a very limited distribution around San Pablito. The genus *Ficus,* a typically tropical group of trees, reaches its altitudinal limit in eastern Mexico at around 1,500 m and is usually not encountered much above 1,200 m (Miranda 1946). *Ficus* trees, therefore, are found only as scattered individuals in the forest. *Morus celtidifolia,* on the other hand, normally is found in more temperate climates, but the species displays an affinity for moist, shaded ravines and never occurs in abundance near San Pablito.

Given the relative scarcity of these trees, it would seem that the Otomi were restricted to a very narrow resource base. However, both species possess the capacity to regenerate their bark after it has been stripped away. The few individuals that did exist in the vicinity of San Pablito, therefore, could be harvested repeatedly. To facilitate the healing process, bark usually was collected from branches rather than the main trunk of the tree (Torres 1983). One problem with the use of *amate* and *moral* is that the bark can be harvested only during certain

months of the year. Only during April, May, and June, i.e., at the onset of the spring rains, can long strips of bark be removed intact.

As long as the use of paper in San Pablito was limited to witchcraft and other ceremonies, a sufficient amount of bark fiber could be obtained from *amate* and *moral.* When the demand for bark paper began to increase, the Otomi were forced to remove larger strips of bark and to increase the frequency of collection. The bark was not allowed to regenerate, entire trunks were denuded, and, with time, the few *amate* and *moral* trees in the area began to die. The recentness of this phenomenon is indicated by the decaying trunks of these trees that can still be seen along the road to San Pablito.

During this same period, changes in regional land use further aggravated the scarcity of raw material for bark paper. A number of gravel roads leading into the municipality of Pahuatlán and extending to San Pablito were constructed in the early 1970s, and the long geographical isolation of the Otomi was ended. In response to the increased accessibility provided by the roads, agricultural activity near San Pablito was accelerated and much of the existing forest was cut and burned. The climate of this region is favorable for a variety of crops; sugarcane, mangoes, coffee, and citrus trees were planted over large areas. Pastures were established and livestock also was introduced.

The expansion of agriculture in the region virtually eliminated the use of *amate* and *moral* for bark paper. Areas formerly in forest soon were covered with communities of woody pioneer species. *Myriocarpa longipes* (Tiliaceae), *Trema micrantha,* and *Urera baccifera* are all characteristic secondary species (Pennington and Sarukhán 1968), and some time in the early 1980s the Otomi started to make paper from the bark of these trees. These species present several distinct advantages as raw material for paper. They naturally occur in dense aggregations and not as isolated individuals, they grow extremely fast, and their bark can be harvested at any time of the year. The disadvantage is that apparently none of these trees can regenerate its bark. Bark can be harvested only once, and, if excessively large strips are removed, the tree dies. The need for increasing quantities of bark fiber soon led to overexploitation; within 3–4 yr, local supplies of *T. micrantha, U. baccifera,* and *M. longipes* were depleted.

The paper currently being produced in San Pablito is made from *T. micrantha* bark, which is brought in by truck from Martínez de la Torre in Veracruz, a distance of over 250 km. The bark merchants or *jonoteros* bring about 1.5 t of *jonote* bark every 2 wk (Fig. 2B), and the entire supply is quickly bought up by Otomi craftsmen. During May and June, small quantities of *Ficus* spp. bark also are trucked in from Martínez de la Torre, this material commanding a much higher price. As can be appreciated, an ordinary sheet of Otomi bark paper follows a long and complicated route before arriving at its final destination. The raw material is shipped from Veracruz, the paper is manufactured in Puebla, and the final painting is done in Guerrero.

Papermaking technology

The traditional method of making paper as practiced by the Otomi is a relatively simple process. After collection, the fibrous inner bark (essentially phloem fibers in *T. micrantha*) is separated from the outer bark; if *amate* or *moral* is being

used, the strips are rinsed several times to remove any latex. This material is then boiled for 4–6 h in water containing wood ash to soften the fibers and to make them easier to separate. The strips are rinsed again prior to use. Paper is made by arranging the softened bark strips in a grid-like pattern on a smooth board and then beating the fibers together with a flattened, rectangular stone known as a *muinto* (Fig. 2C). When the fibers have been interlaced sufficiently to form a sheet, the board containing the paper is set in the sun to dry.

This method of making paper appears to have remained unchanged for several centuries, the basic procedure being identical to that described by the Spanish botanist Francisco Hernández in the 16th century (Hernández 1790). However, the rising demand for bark paper and the almost exclusive use of *T. micrantha* as a raw material have modified this process. As is shown in the SEM micrographs of Fig. 3, the bark fibers of *T. micrantha* are thicker and more rigid than those of *amate* and *moral,* and, as a result, they must be boiled for a longer period of time before they can be used. In addition, a 50 kg bag of lime is mixed with each batch of bark to soften the fibers further. Bark from *T. micrantha* produces a brown paper, but in many cases the Nahua artists prefer a white background for their paintings. Given the scarcity of *moral* bark, the Otomi produce a white paper by bleaching the boiled fibers of *jonote* with commercial Clorox (sodium hypochlorite).

Commercialization also has produced changes in the size and shape of the bark paper that is made by the Otomi. Traditionally, standard-sized sheets of 12 × 25 cm were manufactured (Lenz 1948; von Hagen 1943). Today, the size of the bark paper produced in San Pablito is controlled completely by consumer demand. Business cards, envelopes, lamp shades, wall hangings, and even pseudo-parquet floors made of bark paper are available. The small figures formerly used for witchcraft are also mounted on bark paper and sold (Fig. 1A).

Socio-economic considerations

Although a detailed analysis of the socio-economic impact of the commercialization of bark paper is outside the scope of this report, several observations merit discussion. Papermaking currently is the principal economic activity of the 2,500 inhabitants of San Pablito. Whereas women formerly were the sole producers of paper (Christensen 1942), men, women, and children now dedicate themselves to this activity. This shift has caused a notable reduction in the agricultural productivity of the community, every year there being fewer and fewer families who are willing to farm. The amount of money earned by making bark paper, however, is minimal. Besides the costs associated with buying the raw material, lime, and bleach, the value of a blank sheet of paper is only a fraction of that gained from the sale of a painted one.

Of perhaps even greater consequence to the Otomi tradition of papermaking is the importation of bark fiber. The inhabitants of San Pablito have become isolated completely from their resource base. They have no control over the price of the raw material, and the continual process of experimentation that led to the use of *Trema micrantha, Urera baccifera* and *Myriocarpa longipes* has been interrupted. As long as the producers also were responsible for the procurement of raw material, Otomi papermaking was a dynamic process that could adapt to drastic changes

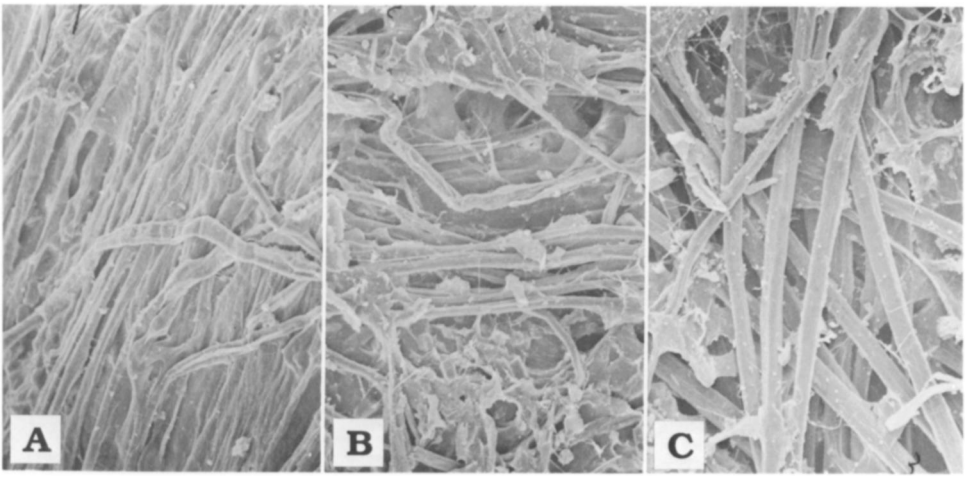

Fig. 3. SEM micrographs of bark paper made from: **A.** *Ficus tecolutensis,* **B.** *Morus celtidifolia,* and **C.** *Trema micrantha* (130×, taken with JEOL scanning electron microscope, Model GSMT-20).

in supply and demand. The depletion of local sources of bark as a result of commercialization and poor forest management would seem to limit the continued evolution of this cultural tradition.

ESTABLISHMENT OF BARK PLANTATIONS

An additional objective of our study was to re-establish a local source of bark fiber for the Otomi. Although it was thought initially that silvicultural techniques could be used to enhance the regeneration of the original *amate* and *moral* populations, the scarcity and poor condition of existing trees made this plan untenable. It was decided, therefore, that plantations of bark-producing species should be established near San Pablito. Due to its rapid growth and capacity for year-round exploitation, *T. micrantha* was selected for planting. This species is relatively easy to propagate, attains a harvestable size in 3–4 yr, and is well adapted to the high light conditions of a plantation. If desired, the more shade tolerant *Ficus* and *Morus* can later be planted under the *Trema* trees once canopy closure has occurred. A nursery containing 10,000 *jonote* seedlings was established on the outskirts of San Pablito in 1984. Land for outplanting was donated by a local farmer.

A serious limitation to the use of *T. micrantha* is its apparent inability to regenerate bark tissue. Controlled experiments, however, revealed that the species can, in fact, regenerate its bark if the bare trunk is protected from dessication. If wrapped with tin foil, banana leaves, or any locally available material, the trunk starts to produce new bark within 6–8 wk. Bark regeneration is enhanced if less than 50% of the surface area of the trunk is harvested each time.

Given the enormous amount of paper produced in San Pablito, it is doubtful that one plantation can satisfy the raw material needs of the entire community. Nevertheless, the plantation should serve to reduce somewhat the dependency on imported bark fiber, and may demonstrate that a pre-Hispanic paper production system can be self maintaining, even in a 20th century market economy.

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