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Abstract

ARENAS, P. & M. E. SUÁREZ (2007). Woods employed by Gran Chaco Indians to make fire drills. *Candollea* 62: 27-40. In English, English and French abstracts.

The aim of this research project was to study the materials and the techniques used by Gran Chaco Indians to make fire drills, as well as their use. Men and women from nine contemporary indigenous peoples were interviewed on fire drills, and an extensive bibliographic investigation of historical, ethnographic, and ethnobotanical sources was also conducted on that topic. The resulting documentation informs of the plant species and the characteristics of the instruments used, as well as details on the methods of fire drilling. Twenty-two species were recorded as raw material, including bushes, trees and lianas, all of them typical of the Gran Chaco flora. Fire drills were used by Gran Chaco Indians until the 20th century, but are now obsolete.

Key-Words

Argentina – Paraguay – Gran Chaco – Ethnobotany – Fire drill – Indian – Woody plant

Résumé

ARENAS, P. & M. E. SUÁREZ (2007). Bois employés par les indiens du Gran Chaco pour la confection de forets servant à la production de feu. *Candollea* 62: 27-40. En anglais, résumés anglais et français.

Le but de cette étude est de connaître les matériaux et les techniques utilisés par les peuples autochtones du Grand Chaco pour faire des forets servant à la production de feu, ainsi que leur utilisation. Des hommes et des femmes issus de neuf groupes ethniques indigènes contemporains ont été interviewés relativement à l'utilisation de forets pour produire du feu, en complément des recherches bibliographiques étendues sur des sources historiques, ethnographiques et ethnobotaniques ont été menées sur ce sujet. Les informations recueillies ont permis de connaître les espèces employées et les caractéristiques des instruments utilisés, ainsi que les détails des techniques utilisant les forets pour la production de feu. Vingt-deux espèces ont été reconnues comme étant utilisées, incluant des arbustes, des arbres et des lianes tous caractéristiques de la flore du Chaco. La production de feu par forets a été utilisée par les indiens du Grand Chaco jusqu'au XX^e siècle, mais n'a plus cours aujourd'hui.

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Introduction

Fire is a primary need for humans in their daily life; it is an essential source of heat and light, and for cooking meals. It is also used for other purposes, such as making tools, hunting, and religious ceremonies. Various scientific disciplines, such as ecology, anthropology of food and agronomy, deal with this topic, either because of the importance of fire in daily domestic life, or because of its significance as a modifying element of the environment. However, ethnobotany does not give fire the significance it deserves. Although its use directly involves important categories of use such as the supply of suitable firewood, fire fans, tinder boxes, controlled burning and cooking, among others, they are not usually considered in a study of the subject. This research project outlines and deals with one of those particular topics; it brings together uses and knowledge on the traditional instruments used by Gran Chaco Indians to make fire.

The indigenous groups of the Gran Chaco were hunters, gatherers and fishers, who also developed an incipient agriculture based on a relatively low number of cultivated plants. Traditional ways of living still exist in those indigenous settlements located far away from urban centres. Data on their ethnography, social organisation and other information about their traditional lives have been summarised by several authors (BALDUS, 1931; MÉTRAUX, 1946; SUSNIK, 1974; CORDEU & DE LOS RÍOS, 1982; BRAUNSTEIN, 1983; SUSNIK & CHASE-SARDI, 1995; BRAUNSTEIN & MILLER, 1999; ARENAS, 2003).

It is quite common to find that in studies concerning the relations of Gran Chaco societies with nature, a large number of stories and other formal narratives rise during fieldwork that refer to events that occurred in mythical times. Among the first narratives, stories about the origin of fire appear almost at the same time as those about the origin of humans. Certainly in the past Gran Chaco Indians did not make figurative artistic expressions (pictograms, sculptures, painted ceramics, etc.) to represent the discovery of fire. However, oral narratives – definitely their most outstanding artistic expression – abounded in stories that reveal two contrasting worlds: one of dispossessed humankind lacking firemaking methods, and another of humankind already benefitting from the possession of fire. This substantial change is greatly valued in all of these narratives, which also stress that fire is a transcendent gift given to humans by cultural heroes or divinities. There are many references to this topic in the anthropological literature concerning the different indigenous groups (NORDENSKIÖLD, 1912; MASHNSHNEK, 1972; MASHNSHNEK, 1973; BÓRMIDA, 1974; BÓRMIDA & CALIFANO, 1978; ARENAS, 1981; WILBERT & SIMONEAU, 1982; SUSNIK, 1984-1985).

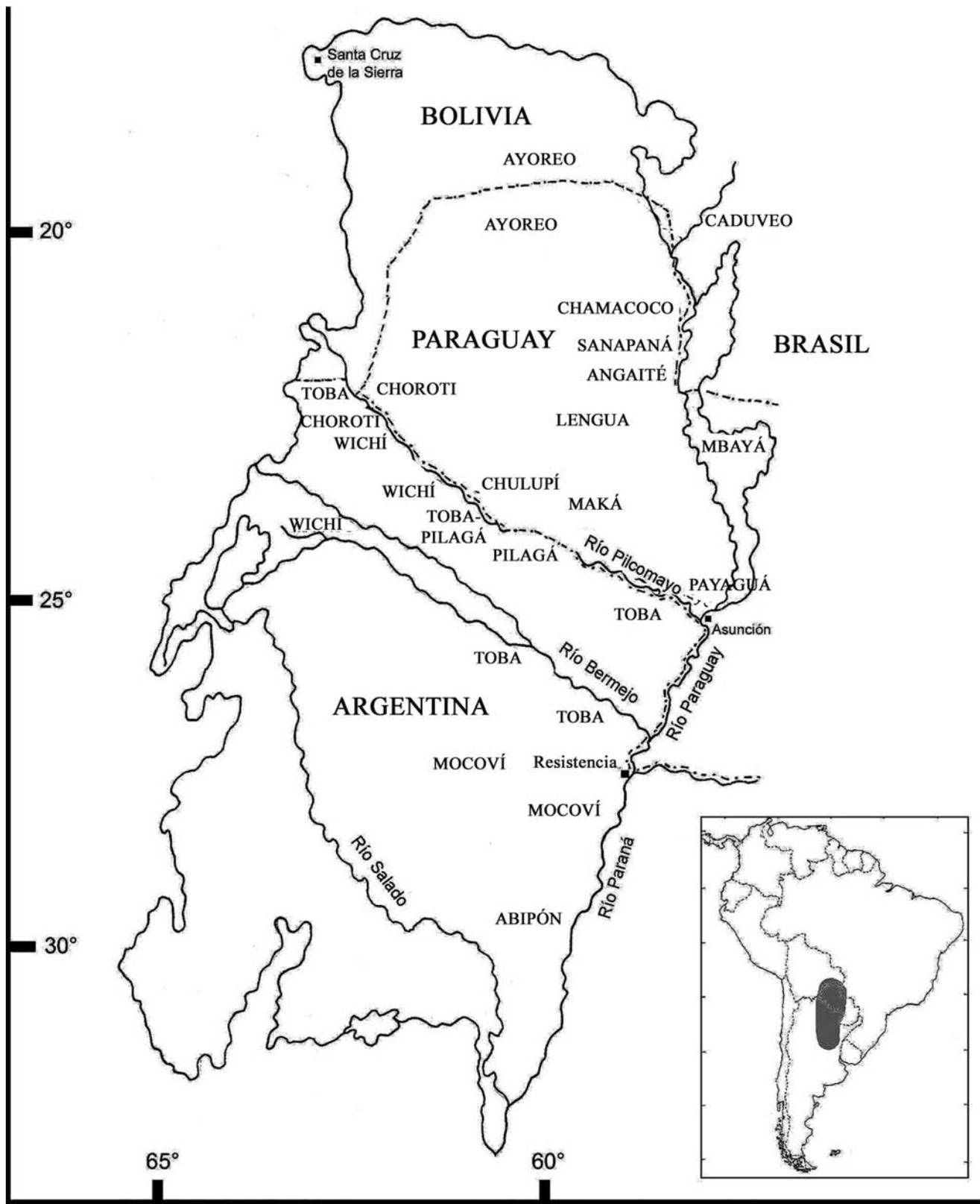
Several authors have tried to devise a typology of archaic techniques of firemaking (MONTANDON, 1934: 261-269; COOPER, 1949: 283-292; PERLÈS, 1977: 31-41; GARCÍA, 1985:

13-17; LEROI-GOURHAN, 1992: 65-74). MONTANDON (1934: 261-269) has developed a typology which was particularly useful for guiding this study, basically because of its simplicity and depth. He states that there are four aboriginal methods of firemaking: a) friction, b) percussion, c) air compression and d) concentration of the rays of the sun. The documentation concerning South American Indians excludes the last two and states that the use of any specific method basically depended on the raw material available in the surrounding environment (NORDENSKIÖLD, 1929: 73; MONTANDON, 1934: 261-269; COOPER, 1949: 283; LEROI-GOURHAN, 1992: 66). Gran Chaco Indians in particular would have exclusively resorted to wood because of the lack of stones and metals in the region. The instrument that is the subject of this research is commonly known as «fire drill», «hand drill» or «simple hand drill». It was used throughout South America, except in Tierra del Fuego (NORDENSKIÖLD, 1929: 73; MONTANDON, 1934: 261-269; COOPER, 1949: 283). Friction is the technique applied to the use of hand drills, specifically a kind of friction known as «simple rotary friction» (GONZALO, 1998: 248), «friction by circular percussion» (MONINO, 1987: 586-587; LEROI-GOURHAN, 1992: 69), or «friction by simple turn» (MONTANDON, 1934: 262).

The aim of this study is to compile the wooden resources employed and the characteristics of fire drills among the various Amerindian groups of the Gran Chaco. Details about the technique of fire drilling and the instrument's use in the region at the present are also emphasised. In a more general aspect, this paper is part of an extensive ethnobotanical research project, whose main purpose is to document the knowledge, employment and representations of plants among the indigenous populations in the region.

Materials and methods

The information and materials on which this study is based were collected between 1973 and 2005, in the course of ethnobotanical research explorations among nine indigenous peoples of the Gran Chaco (Fig. 1): Ayoreo, Choroti, Chulupí, Lengua-Maskoy, Maká, Pilagá, Toba, Toba-Pilagá and Wichí, which belong to four different linguistic families. During the fieldwork, oral testimonies were collected from qualified Amerindian interviewees, both male and female. The criterion used for the selection of informants was a person's reliability and depth of knowledge. In general, the best informants were older men and women who were alive at times when their culture was subjected to fewer of the changes induced by contact with contemporary society than today. Each of the nine indigenous peoples we worked with has its own language, and in all cases this is the language they use for communication in



their everyday lives. Interviews were carried out using contact languages: Spanish or Guaraní. In cases in which the person did not speak either of these languages, the assistance of a translator was required. Data were recorded on tapes and in field books.

Originally, obtaining information on fire drills was not the main or specific purpose of our research. In every case, data on this topic were obtained from general ethnobotanical surveys which had the classifying index «Fire» among their specific items (ARENAS, 1995: 167). In each indigenous group, a variable number of people were interviewed, depending on a range of circumstances such as time of permanence in situ, degree of transculturation in the village, and specificity of the research work carried out with the different indigenous peoples.

Surveys were always conducted with at least five qualified persons in each case, and if the time of permanence in the village was long and the research work was going well more than thirty people could be interviewed. The basic text of the surveys, inspired by other similar surveys (MURDOCK & al., 1960; BOUQUIAUX & THOMAS, 1987; SUSNIK & UNGER, s.d.), consists of a series of subjects to be dealt with during the interview, a scheme that can be followed while interviewing the person, as an aide-memoire. They do not have a structure of direct questions and answers but are thematic guides that help the researcher to lead into conversations on the different topics. Their application thus took the form of an «interview» rather than a «survey».

Each interview was more or less specific according to the informant's knowledge and skills, and frequently led to conversations with multiple derivations. On occasion these conversations extended to a whole afternoon and included a whole range of information on topics such as mythical tales, types of baking, bonfires or forest fires. Therefore, bearing in mind the methodology applied, it was not possible for us to apply any quantitative analyses in the present study, and as this was basically intended to be a contribution for the reconstruction of traditional practices and ways of life, they would be of only minor relevance.

The classifying index «Fire» in the ethnobotanical survey is transcribed below:

- fire, its invention, knowledge and use (narratives): traditional tales about this topic;
- preferred firewood, collectors; non-usable plant species such as firewood (fast-burning soft woods), or woods that give off an unpleasant smell; firewood used for light; firewood that give strong and persistent fire; firewood for the oven; firewood for night (to ward off dangers); firewood for the homes in winter; storage of firewood for rainy days;

- fire drill, flint and steel: materials, morphology and use; different parts of the fire drill; names, materials; number of holes in the hearth, number of times they can be used; idem for the drill-stick; handle and replacement of the active end of the drill-stick;
- tinder and tinder-boxes: tinder-box (armadillo's tail, horns); materials used as tinder and previous processes applied;
- fireguards (of leaves or wings); preparation of wings for the fireguard (opened by means of ashes or by heat; birds used); fireguards are dealt with in the respective item;
- pokers; woods used.

Apart from fieldwork and laboratory investigations, extensive bibliographic research on mainly historical, ethnographic and ethnobotanical sources was carried out. As a result, information obtained from bibliographical sources is mentioned in this study as «data». These sources include previous studies published by one of the authors of this paper (ARENAS, 1981; ARENAS & SCARPA, 1999; ARENAS, 2003) as well as studies by other authors that touched on this topic (PELLESCI, 1897; HAWTREY, 1901; NORDENSKIÖLD, 1912; BALDUS, 1931; MÉTRAUX, 1946; SUSNIK, 1957; MARTÍNEZ CROVETTO, 1964; SUSNIK, 1976; BÓRMIDA & CALIFANO, 1978; SEELWISCH, 1978; SUSNIK, 1982; GRUBB, 1993; GONZALO, 1998; SCHMEDA-HIRSCHMANN, 1998; TERÁN, 2003). Due to the fact that the use of the fire drill has practically been abandoned, we consider this data to be «elaborated information», despite the fact that it might have been obtained for other purposes (GUBER, 2004). Bibliographical references are crucial in completing information that no longer exists, and therefore we use them in the same way as other disciplines, such as history. Moreover, in some cases, bibliographical information allowed us to check our original data.

Plant samples and their vernacular names were collected in the company of informants and were used for the preparation of voucher plant materials, which were deposited in the herbarium of the Museo Nacional de Historia Natural «Bernardino Rivadavia» (BA) in Buenos Aires, Argentina (see Appendix 1).

Results

The information gathered during fieldwork together with the documentation found in the literature consulted allow us to present a synthesis that will shed light on new information about the presence of fire drills in the Gran Chaco region.

The instrument in the literature

Hand drills were already being mentioned in 18th-century texts by missionaries, travellers and explorers, of what are now considered to be classics in the literature of the Río de la Plata.

Jesuit Fathers Sánchez Labrador, Dobrizhoffer and Paucke, from the Compañía de Jesús, describe their observations of the Gran Chaco Indians, with whom they carried out their missionary activities. SÁNCHEZ LABRADOR (1910: 94) alludes to the «eslabón de los Mbayá» (the Mbayá link), but he gives enough information about this utensil for us to be sure that he is referring to a hand drill. Beyond doubt, it is PAUCKE (1944: 254-255) who presents the most detailed and complete information about this instrument in the ethnographic literature concerning Gran Chaco Indians. In his study he specifically refers to hand drills of the Mocoquí. DOBRIZHOFFER (1968: 119-120) reveals precise data on Abipón's fire drills and on the woods they used to make the instrument; curiously enough four species are mentioned in the Guaraní language. Similarly, albeit rather briefly, Spanish explorer Félix de Azara, describes the hand drills of the Payaguá (AZARA, 1847: 218-219). A fairly accurate and clear description of the instrument and the technique of fire drilling is found in FONTANA's (1881: 169-171) «El Gran Chaco».

Despite the existence of these primary sources, serious limitations and lack of precisions were found during the bibliographic research in both historical and ethnographic references related to the ethnobotany of the Gran Chaco, such as:

- a lack of references on plants used for making fire drills;
- references to plants using their vernacular names, which are of dubious interpretation;
- wrong scientific names of the species involved, or references to plants that do not grow in the region;
- a lack of data on the characteristics of the fire drills and on the method applied for firemaking.

Several ethnographic references reveal information on the instrument's characteristics and on the method applied, but do not indicate the plants involved: PÉREZ DIEZ (1974: 37) for the Choroti and Wichí, GOBELLI (1914: 30) and GONZALO (1998: 248-254) for the Wichí, NORDENSKIÖLD (1912: 36-37) for the Gran Chaco Indians in general, SEELWISCHE (1978: 15-16, 1979: 58) for the Chulupí, HAWTREY (1901: 286) and GRUBB (1993: 40) for the Lengua, SUSNIK (1976: 89) for the Lengua and Chulupí, and SUSNIK (1957: 132) for the Chamacoco. In some other cases, authors use the vernacular name of the plants involved, but this should be treated with caution. For example, according to PELLESCI (1897: 213), the Wichí made fire drills from «chilca» wood, but this name alludes to several botanical species. In the same way, TERÁN (2003: 22-24) informs of firemaking in the past of the Toba, giving details of their hand drills and indicating the vernacular names of two species involved. A similar situation can be found for the Ayoreo (BÓRMIDA & CALIFANO, 1978: 66; ANONYMOUS, 1992: 105; BARRIOS & al., 1995: 39, 191, 241) and for the Lengua (HAWTREY, 1901: 286; GRUBB, 1993: 40).

Other authors suggest botanical identifications of the plants involved, which prove to be mistaken, like those given by CORYN (1922: 233) for the Lengua, BALDUS (1931: 16-17) and SUSNIK (1982: 114) for the Chamacoco, or MÉTRAUX (1946: 299) for the Chaco Indians in general. Finally, some authors, such as MARTÍNEZ CROVETTO (1964: 321, 324), SCHMEDA-HIRSCHMANN (1998: 18, 24) and ARENAS & SCARPA (1999: 47), do mention the species' scientific names, but the rest of the information is rather poor.

Description of the instrument

The details and features of each part of the fire drills and the technique employed vary, even within a single Amerindian group. However, more generally, morphology, the method applied, and several other characteristics of the instrument are practically identical among the different indigenous populations of the Gran Chaco.

Here we present a brief summary that compiles data and direct observations on the instrument and the technique of fire drilling.

To make a fire drill, two pieces of wood are needed: a hearth (Fig. 2A, E) and a drill-stick (Fig. 2B, F, G). In order to make fire it is essential that both pieces are extremely dry, and they should also be scraped or peeled off when the bark is thick or rough. The hearth is a flattened or cylindrical piece of wood, wider than the drill-stick; the latter is a wooden stick which is circular in section, and one of its ends is obtuse (Fig. 2C). Part of the data states that the drill-stick and the hearth are made of different woods, the one harder than the other. One or more circular sockets or pits are made in the surface of the hearth (Fig. 2D), in which the obtuse end of the drill-stick will be inserted. In the edge of each socket a canal or notch is cut, which connects the pit to the bottom of the hearth (Fig. 2D); this notch is usually known as the «lateral» or «functional» groove or slot (HARRISON, 1925: 33-34; MÉTRAUX, 1946: 299; COOPER, 1949: 283; GONZALO, 1998: 250). In order to make fire, the hearth is placed directly on the soil or on a cloth and is held with the feet or a knee; if two men are working together, the second one holds the hearth with his hands (Fig. 2I). Historical and ethnographic literature also mentions that the hearth is often placed on a knife's blade or on a metallic lanceolate arrowhead, thus separating the wood from the ground (GRUBB, 1993: 40; MÉTRAUX, 1946: 299; PAUCKE, 1944: 255) (Fig. 2H). The next step is to put tinder [dry or charred fibers of «chaguar» (*Bromelia hieronymi*, *Deinacanthon urbanianum*), little pieces of the spongy dry wood of the «cardón» (*Stetsonia coryne*), dry grass, dry dung, pieces of cloth, cotton] underneath the hearth, in the lateral groove, or in the pit (between the two pieces of the drill). The obtuse end of the drill-stick is then fitted into the socket. Keeping the stick in a vertical position the operator starts to twirl it very rapidly between his hands,

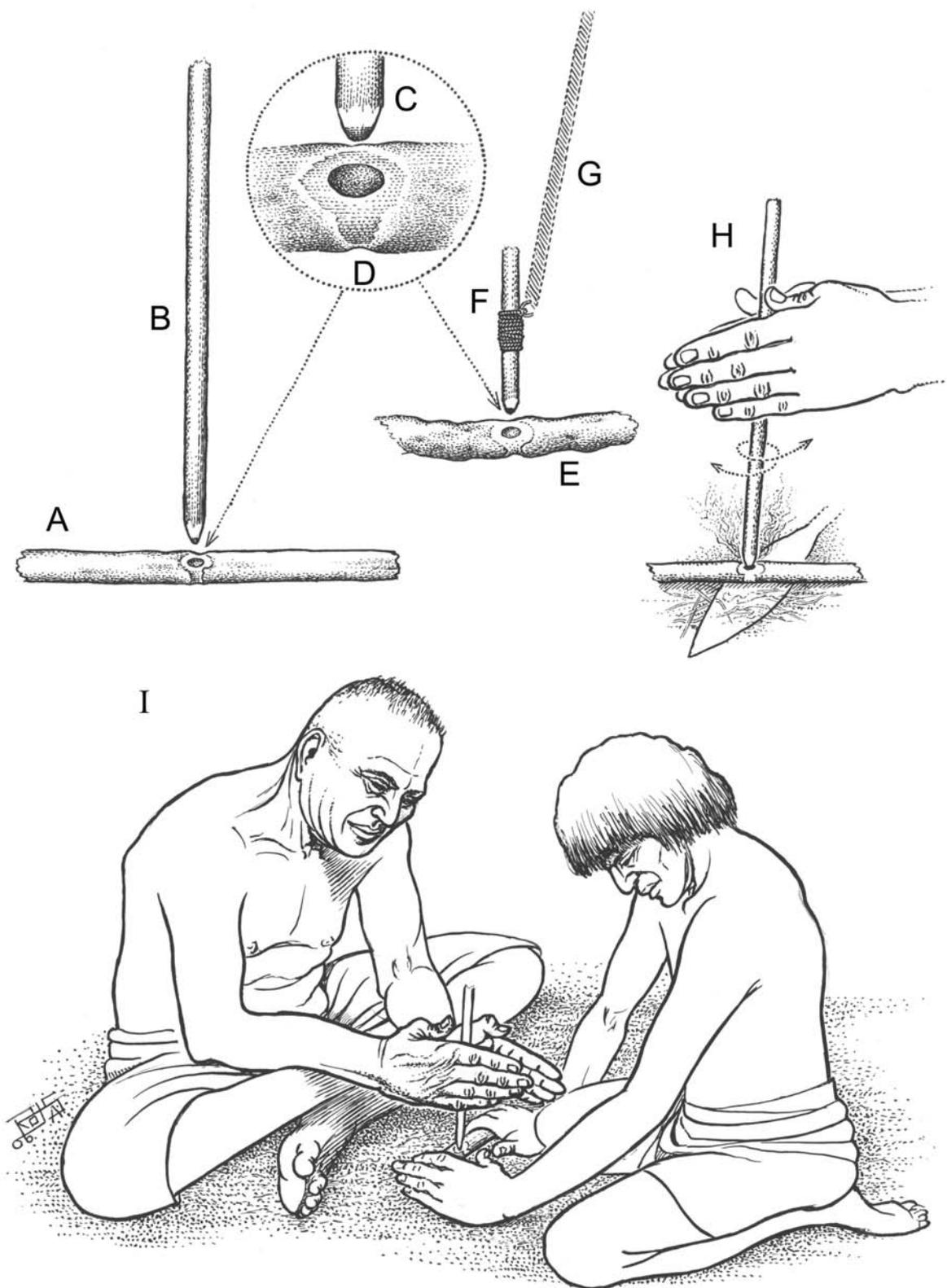


Fig. 2. – **A-B.** Fire drill of the Lengua-Maskoy, **A.** Hearth (29 cm long), **B.** long drill-stick (43 cm long). **C.** Obtuse end of the drill-stick. **D.** Circular pit and lateral groove. **E-G.** Fire drill of the Toba-Pilagá, **E.** Hearth (16,5 cm long), **F.** Short drill-stick (12 cm long) with a cord to fit it into a longer stick, **G.** Accessory wooden stick. **H.** Fire drilling technique (the arrows indicate the twirling of the drill-stick). **I.** Typical fire drilling scene with two operators.

while pressing downwards upon the hearth (Fig. 2H). Because of the permanent friction between the two pieces of wood, wood-dust is produced, which escapes from the pit into the lateral groove, thus coming into contact with the tinder (MONTANDON, 1934: 264; COOPER, 1949: 283-284). As friction continues, the temperature begins to increase in the pit and as a consequence the wood-dust and then the tinder ignite. The operator gradually adds more tinder and minute pieces of firewood to the incipient fire, and by gently blowing on it at intervals, a flame is finally produced.

According to most of the authors, the utilisation of hand drills is the technique that requires the greatest skill amongst the different archaic methods of firemaking, and they remark that fire drilling is a truly tiring and laborious activity (FONTANA, 1881; LEROI-GOURHAN, 1992).

The plants used for making fire drills

The plant material employed for making fire drills appears in a single table (Table 1), containing all the information obtained during fieldwork and bibliographic research. The only literary references included in this table are those that reveal data not recorded during our fieldwork that reliably identify species (meaning that the authors gathered herbarium samples that can be checked). Although we have compiled the vernacular names of all the plants in each of the indigenous groups we worked with, we decided not to include them in this table as they belong to indigenous languages from four different linguistic families, each with its own particular phonetic notation. For this publication we consider it is better not to include this information.

The ethnographic context

In the interviews, both men and women gave information about this instrument and the plants involved, with exactly the same degree of accuracy. Several men and two women who knew the technique perfectly well were observed while using the fire drill. In the past this instrument would certainly have been included in the equipment carried by any person who went into the forest to perform his or her activities. During this investigation, we were able to gather additional data that revealed to us the contexts in which the fire drill was employed, as well as many peculiarities of the apparatus. The custom of fitting a short drill-stick into a longer stick is often mentioned in most of the records obtained among the different indigenous groups. When this additional stick is a wooden rod, it is fastened to the drill-stick by means of a cord; if it is a cane arrow shaft, the drill-stick is fitted into the free hollow end of this shaft. There is no exclusiveness involved in choosing these accessory appliances; the only requirement is that the stick has to be straight, resistant and of an adequate thickness. The literature on Gran Chaco Indians confirms the common existence of this habit. Thus, NORDENSKIÖLD (1929: 73) mentions that the Choroti and Chulupí fit the drill-stick into an

arrow shaft when they are about to make fire. PALAVECINO (1933: 532) for the Pilagá, ARENAS (2003: 229) for the Toba-Pilagá, GRUBB (1993: 82-83) for the Lengua, GONZALO (1998: 248-253) for the Wichí, and MÉTRAUX (1946: 299) for the Gran Chaco Indians in general mention similar data.

As regards the repeated use of the instrument, some informants claim that it can be employed only once, while others say that each pit on the hearth can be used several times, or else that the drill-stick is the piece with most prolonged use. In the past, Indians used to carry fire drills while hunting, fishing or gathering. This apparatus had a particular relevance for the collection of honey and bees and wasps' larvae, because smoke is essential to this activity. Among the Lengua, who immediately discard each fire drill after using it, several units of the apparatus were carried inside a bag (ARENAS, 1981: 67). The Toba-Pilagá used to carry the drill-sticks inside a cane (*Arundo donax*), as this piece was only replaced after being used several times (ARENAS, 2003: 229). FILIPOV (1996: 71) mentions that the Pilagá transported the utensil in little leather or net bags, where they also carried objects for personal use (tobacco, pipes).

A remarkable piece of information is that fire drills have to be small and of scarce weight, so they would not be a problem for the hunters or gatherers while they performed their activities. The fact that the instruments transported in the carriage bags must be portable is one of the essential conditions for this kind of equipment, typical of the material culture of semi-nomadic groups of hunters, gatherers and fishermen. Given the accessibility to raw material, the easy replacement of the fire drill is another distinguishing feature among these societies.

Discussion

Descriptions of fire drills often lack information about the woods or plants involved, or else the data is inaccurate. One of the concrete difficulties found when dealing with this topic is that Gran Chaco Indians stopped using hand drills decades ago. Therefore, the information we were able to compile, preferably based on memories, is mostly partial, and on some occasions the raw material and other crucial information were actually unknown: the interviews held over recent years revealed that many informants were unaware of the woods employed in the past to make fire drills or of the name of the instrument, while others sustained that any wood could be used. This clearly demonstrates that the use and knowledge of fire drills among societies that have suffered profound cultural changes are already very distant in time, and even the most elemental data are gradually being lost forever. Nevertheless, people aged fifty or older living in certain villages that still conserve part of their traditional customs usually know both the raw material and the method of fire drilling.

Table 1. – Plants employed by different indigenous peoples of the Gran Chaco to make fire-drills.

Botanical family	Botanical species	Ethnic group	Piece of fire drill made from the wood	Bibliographic references
<i>Achatocarpaceae</i>	<i>Achatocarpus praecox</i>	Choroti	Hearth and drill-stick	
<i>Asclepiadaceae</i>	<i>Funastrum gracile</i>	Lengua-Maskoy	Hearth and drill-stick	
		Pilagá	Hearth and drill-stick	
		Toba-Pilagá	Hearth and drill-stick	
		Wichí	Hearth	
		Choroti	Hearth and drill-stick	
	<i>Morrenia odorata</i>	Choroti	Hearth and drill-stick	
<i>Asteraceae</i>	<i>Baccharis salicifolia</i>	Wichí	Hearth	
	<i>Tessaria dodoneaeifolia</i>	Pilagá	Drill-stick	
	<i>Tessaria integrifolia</i>	Wichí	Hearth	
<i>Bignoniaceae</i>	<i>Arrabidaea corallina</i>	Choroti	Hearth and drill-stick	
	<i>Tabebuia nodosa</i>	Lengua-Maskoy	Hearth and drill-stick	
		Maká	Hearth and drill-stick	
		Ayoreo	–	SCHMEDA-HIRSCHMANN, 1998: 18, 24
		Pilagá	Hearth and drill-stick	
	Choroti	Hearth and drill-stick		
	Wichí	Hearth and drill-stick		
<i>Boraginaceae</i>	<i>Cordia bordasii</i>	Choroti	Hearth and drill-stick	
<i>Cactaceae</i>	<i>Stetsonia coryne</i>	Wichí	Hearth	
		Chulupí	Hearth	
		Choroti	Hearth	
	<i>Monvillea spegazzinii</i>	Choroti	Hearth	
<i>Capparaceae</i>	<i>Capparis tweediana</i>	Lengua-Maskoy	Hearth and drill-stick	
		Wichí	Hearth and drill-stick	MÉTRAUX, 1946: 299
		Choroti	Hearth and drill-stick	MÉTRAUX, 1946: 299
		Pilagá	Drill-stick	
		Toba-Pilagá	Hearth and drill-stick	
	<i>Capparis salicifolia</i>	Choroti	Hearth and drill-stick	
	<i>Capparis speciosa</i>	Choroti	Hearth and drill-stick	
<i>Capparis retusa</i>	Choroti	Hearth and drill-stick		
<i>Celastraceae</i>	<i>Maytenus vitis-idaea</i>	Lengua-Maskoy	Hearth and drill-stick	
<i>Euphorbiaceae</i>	<i>Sapium haematospermum</i>	Maká	Hearth and drill-stick	
		Toba	–	MARTÍNEZ CROVETTO, 1964: 324
<i>Fabaceae</i>	<i>Chloroleucon tenuiflorum</i> (sub <i>Pithecellobium scalare</i>)	Toba	–	MARTÍNEZ CROVETTO, 1964: 321
<i>Polygonaceae</i>	<i>Ruprechtia triflora</i>	Lengua-Maskoy	Hearth and drill-stick	
		Wichí	Drill-stick	
		Ayoreo	Hearth and drill-stick	
		Choroti	Drill-stick	
<i>Solanaceae</i>	<i>Lycium cuneatum</i>	Toba-Pilagá	Hearth and drill-stick	
		Wichí	Hearth	
	<i>Lycium americanum</i>	Choroti	Hearth and drill-stick	
	<i>Solanum glaucophyllum</i>	Pilagá	Drill-stick	

The oral information and the data based on written sources compiled in this study reveal that the morphology of fire drills and the technique employed in using them are very varied. Without doubt, these variations are due to the diversity of the indigenous peoples studied, each one having their own cultural rules and habits, and also to particular circumstances, and other practical factors. A cautious analysis of the material in Chaco collections in ethnographic museums around the world would throw much light on ergology details.

During this research project, it was not unusual to find that a particular plant species was employed by more than one Amerindian group (*Capparis tweediana*, *Funastrum gracile*, *Ruprechtia triflora*, *Stetsonia coryne*, *Tabebuia nodosa*). This consensus clearly reveals that those species represent the most valuable woods for making fire drills. The reasons for these preferences may be, on the one hand, efficiency and the relative ease of making fire with them and, on the other hand, the accessibility of these plants, which grow in the most diverse Chaco habitats and are thus easily found when needed.

In other cases the opposite occurs since the use of some species seems to be limited to only one particular indigenous peoples (for instance: *Chloroleucon tenuiflorum*, *Maytenus vitis-idaea*, *Solanum glaucophyllum*). A very good example to illustrate this situation is *Cordia bordasii*. The information on this species was obtained exclusively from the Choroti who live in the Paraguayan Chaco, whilst there were no records of this plant among populations inhabiting the Argentine Chaco. An explanation for this observation can be found by analysing the geographical distribution of *Cordia bordasii*: this bush grows in the Paraguayan Chaco, but its presence was never recorded in Argentina, thus explaining the lack of references in the latter country. It should also be taken into account that many uses and memories about plant resources have been lost in time, and therefore they cannot be recorded nowadays. Probably, the list of species for making fire drills was somewhat longer in the past than the one we are able to document. It should also be considered that our research did not include several contemporary indigenous groups of the Gran Chaco: the Chamacoco, Sanapaná and Angaité of the Paraguayan Chaco, the Caduveo of the Mato Grosso (Brasil), and the Mocoví of the Argentine Chaco, on whom there are still no ethnobotanical data, and the Chulupí and Toba of the eastern Chaco, whose ethnobotany is only partially known (Fig. 1). Studies among these Amerindian groups may lead to an increase in the number of species used for making fire drills.

As regards the criteria for selecting the woods for making fire drills, we could observe that twelve very dissimilar botanical families are represented; thus this particular data does not reveal any taxonomic group with more potential than the others for this particular purpose. Certainly, the circumstance concerning the employment of Asteraceae and Capparaceae

species deserves a comment, since there is a surprisingly high number of recorded species belonging to these two families. Capparaceae is best represented by four arboreal *Capparis* species. This high number may be due to the fact that in the Gran Chaco region these plants are particularly useful for the natives' domestic life, and availability is guaranteed as a consequence of their extensive distribution throughout the Gran Chaco region and of their frequent presence in both the bushy and low-arboreal layers of the forest. In the case of the Asteraceae used, they are bushes or little trees of similar morphological characteristics which are very frequently found in sandy soils and wetlands. Between *Tessaria integrifolia* and *T. dodoneaefolia* differences only become evident after a scrupulous analysis of their microscopic botanical features, which are certainly not obvious to native people. Therefore, when both species are growing together, Indians tend to give them the same vernacular name and use. They identify the third species -*Baccharis salicifolia*- correctly, but because of its qualities they use it in similar or equal ways to the other two. Thus, any of the three species may substitute the other two, according to their availability in the region at a particular time or area. In this way, the high number of cited plants belonging to the Asteraceae family can be explained.

Apart from the botanical families, the geographical distribution of species does not seem to be a determining factor in the selection of woods either, as some plants are typical of the Gran Chaco region (like *Achatocarpus praecox*, *Lycium americanum*, *L. cuneatum*, *Monvillea spegazzinii*, *Ruprechtia triflora*, *Stetsonia coryne*), whilst others are more extensively distributed (like *Baccharis salicifolia*, *Sapium haematospermum*, *Solanum glaucophyllum*, *Tessaria integrifolia*),. The same can be maintained for the habit or life form (trees, bushes, lianas) of the species involved: no correlation between that variable and the selection of the plants to make fire drills was observed.

Literature often mentions that simple rotary friction involves two kinds of wood: a hard one for the drill-stick and a soft one for the hearth (SÁNCHEZ LABRADOR, 1910: 94; PERLÈS, 1977: 34; GARCÍA, 1985: 13-17; MONINO, 1987: 586-587). During our research, we found data referring to the employment of the same wood for making both pieces, as well as information on fire drills made according to the typology mentioned above.

One or more intrinsic properties of the woods may be determining their usefulness for making fire drills. The ease and speed in making fire depend not only on the operator's skills but also on the woods employed. Unfortunately, scarce bibliographic data exist on the physical and mechanical properties of the woods listed in this study. In relation to hardness, they reveal that these woods are soft (*Sapium haematospermum*, *Tessaria integrifolia*), semi-soft (*Capparis tweediana*) or semi-hard

(*Chloroleucon tenuiflorum*, *Ruprechtia triflora*, *Tabebuia nodosa*), but the species cited in this study are never as hard as the hardest among the Gran Chaco arboreal flora (*Aspidosperma quebracho-blanco*, *Bulnesia sarmientoi*, *Prosopis alba*, *Prosopis kuntzei*, *Prosopis nigra*, *Schinopsis lorentzii*, just to mention the most representative species) (TORTORELLI, 1956; CRISTIANI, 1962; GIMÉNEZ & MOGLIA, 2003), which were never cited for firemaking. A simple and probable explanation for this observation is the evident greater difficulty in drilling a hard wood than a softer one, either for making the pits or for obtaining wood-dust by the friction between the two pieces of the instrument. Thus, very hard woods would not be chosen for this purpose. Without doubt, besides hardness other physical, mechanical and anatomical features of the woods employed exist to make them suitable for making fire drills; however, at this point in time we do not know which they are. The next step in this investigation will be to study them.

Nowadays, hand drills are no longer used in the Gran Chaco. Since the first decades of the twentieth century several references have revealed the gradual abandonment of this utensil, which was first replaced by the flint and steel, or a stone and a piece of metal, together with the tinderbox; these elements were progressively substituted by matches and lighters (HAWTREY, 1901: 286; CORYN, 1922: 234; NORDENSKIÖLD, 1929: 73; PALAVECINO, 1933: 531-532; FILIPOV, 1996: 71). However, different data from diverse human groups of the Gran Chaco state that the fire drilling technique is still applied when emergencies and the need for fire suddenly require it. These contingencies often appear when a person gets lost in the forest without his matches or lighter, or when he finds a beehive full of honey, or he wants to cook some fish on the river bank after several hours of abstinence. Hunter-gatherer and fishing societies of the Gran Chaco tend to emphasise the importance of preserving their traditional knowledge, which has proved to be vital in ensuring their survival in risky situations resulting from the fluctuating economy of their countries and to the adverse impacts of world markets. Although some of the cited plants do not seem to have any distinguishing practical or economic value, like *Arrabidaea corallina*, *Capparis tweediana*, *Chloroleucon tenuifolium*, *Cordia bordasii*, *Lycium cuneatum*, *Solanum glaucophyllum*, or *Tessaria dodoneaefolia*, the results of this research show that in a not very remote past they played an important role in a substantial event in life: the making of fire.

The extensive knowledge of the qualities of the plants of the Gran Chaco flora is a consequence of a long process of exchanges between different societies and their environment. Unfortunately, many uses of plants have been lost in time in the face of rapid technological advances. If records about fire and hand drills are still available it is because Gran Chaco societies have kept alive their oral narrative, and details of those distant events can be found in stories and speeches about their

tradition and myths. In the particular case of fire drills, other instruments gradually replaced them, erasing them from the memory of those who once depended on them to get fire. One of the specific purposes of ethnobotany is to register the memories of people in relation to the use of vegetation in their environment. This study is therefore a contribution to the ethnobotany of fire drills among Gran Chaco Indians and documents their geographical distribution. It is also a form of salvage ethnobotany to document a disappearing traditional knowledge and practice.

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Appendix 1. – Vouchers of the wood species used by Gran Chaco Indians to make fire drills deposited in the herbarium of the Museo Nacional de Historia Natural «Bernardino Rivadavia» (BA) in Buenos Aires, Argentina. The Amerindian group from which the plants come is shown between square brackets at the end of each item.

ACHATOCARPACEAE

Achatocarpus praecox Griseb.

PARAGUAY. Dpto Boquerón: Colonia Fernheim, Colonia 22 (Neuwiese), 22°14'S 60°12'W, 27.II.1981, *Arenas 1818* (BA); 07.XI.1987, *Arenas 3301* (BA) [Choroti].

ASCLEPIADACEAE

Funastrum gracile Schltr.

PARAGUAY. Dpto Presidente Hayes: Colonia Menno, Paratodo, 22°35'S 60°20'W, 15.III.1974, *Arenas 479* (BA); 08.XII.1974, *Arenas 1080* (BA); 28.I.1976, *Arenas 1437* (BA, SI) [Lengua-Maskoy].

ARGENTINA. Prov. Formosa. Dpto Patiño: Pozo Navagán, Reducción de Indígenas Pilagá, 24°15'S 60°00'W, 18.I.1982, *Arenas 1959* (BA) [Pilagá]. **Dpto Matacos:** Ing. G. N. Juárez, Toldería Toba, 1 km N del pueblo, 23°54'S 61°51'W, 21.XII.1983, *Arenas 2257* (BA) [Toba-Pilagá]. **Dpto Bermejo:** Pozo de Maza, 23°34'S 61°42'W, 17.I.1989, *Arenas 3361* (BA) [Wichí]. **Prov. Salta. Dpto Rivadavia:** Misión La Paz, 22°24'S 62°30'W, 13.II.1982, *Arenas 2094* (BA) [Choroti].

Morrenia odorata Lindl.

ARGENTINA. Prov. Salta. Dpto Rivadavia: Misión La Paz, 22°24'S 62°30'W, 13.I.1984, *Arenas 2622* (BA) [Choroti].

ASTERACEAE

Baccharis salicifolia Pers.

ARGENTINA. Prov. Formosa. Dpto Bermejo: Pozo de Maza, 23°34'S 61°42'W, 04.II.1989, *Arenas 3400* (BA). **Prov. Salta. Dpto Rivadavia:** El Colgado, 23°45'S 63°02'W, 11.I.1983, *Maranta & Arenas 106* (BA) [Wichí].

Tessaria dodoneaefolia (Hook. & Arn.) Cabrera

ARGENTINA. Prov. Formosa. Dpto Patiño: Riacho Monte Lindo, 5 km N de E. del Campo, 25°03'S 60°06'W, 01.II.1982, *Arenas 2058* (BA) [Pilagá].

Tessaria integrifolia Ruiz & Pav.

ARGENTINA. Prov. Formosa. Dpto Bermejo: Pozo de Maza, 23°34'S 61°42'W, 09.II.1989, *Arenas 1418* (BA). **Prov. Salta. Dpto Rivadavia:** Misión La Paz, 22°24'S 62°30'W, *Maranta 588* (BA) [Wichí].

BIGNONIACEAE

Arrabidaea corallina (Jacq.) Sandwith

ARGENTINA. Prov. Salta. Dpto Rivadavia: Misión La Paz, 22°24'S 62°30'W, 16.I.1984, *Arenas 2664* (BA) [Choroti].

Tabebuia nodosa Griseb.

PARAGUAY. Dpto Presidente Hayes: Colonia Menno, Loma Plata, 22°20'S 59°50'W, 04.XII.1974, *Arenas 1051* (BA) [Lengua-Maskoy]; Fortín General Bruguez, 24°45'S 58°50'W, 05.I.1980, *Arenas s.n.* (BA, BACP 1613) [Maká]. **Dpto Boquerón:** Misión Santa Rosa, 21°45'S 61°35'W, 11.II.1981, *Arenas 1650* (BA) [Choroti].

ARGENTINA. Prov. Formosa. Dpto Patiño: Pozo Navagán, Reducción de Indígenas Pilagá, 24°15'S 60°00'W, 20.I.1982, *Arenas 2001* (BA) [Pilagá]. **Dpto Bermejo:** Pozo de Maza, 23°34'S 61°42'W, 17.I.1989, *Arenas 3371* (BA) [Wichí]. **Dpto Patiño:** El Descanso, 24°08'S 60°27'W, 24.XI.1991, Filipov & Arenas 34 (BA) [Pilagá].

Prov. Salta. Dpto Rivadavia: Misión La Paz, 22°24'S 62°30'W, 13.II.1982, *Arenas 2098* (BA); 16.I.1984, *Arenas 2663* (BA) [Choroti]; Juan Solá (Morillo), Barrio Mataco, 23°28'S 62°53'W, 08.I.1983, *Maranta & Arenas 117* (BA) [Wichí].

BORAGINACEAE

Cordia bordasii Schinini

PARAGUAY. Dpto Boquerón: Misión Santa Rosa, 21°45'S 61°35'W, II.1982, *Arenas 1684* (BA) [Choroti].

CACTACEAE

Monvillea spegazzinii Britton & Rose

ARGENTINA. Prov. Salta. Dpto Rivadavia: 10 km SE de Santa María, 22°10'S 63°00'W, 26.II.1982, *Arenas 2170* (BA) [Choroti].

Stetsonia coryne Britton & Rose

PARAGUAY. Dpto Presidente Hayes: Estancia Loma Pyta, 23°40'S 59°35'W, 08.XII.1978, *Arenas s.n.*, (BA, BACP 669) [Chulupí].

ARGENTINA. Prov. Salta. Dpto Rivadavia: Misión La Paz, 22°28'S 62°22'W, 12.II.1982, *Arenas 2128* (BA) [Wichí]; 18.I.1984, *Arenas 2674* (BA) [Choroti]; Juan Solá (Morillo), 23°28'S 62°53'W, 08.I.1983, *Maranta & Arenas 129* (BA) [Wichí].

CAPPARACEAE

Capparis retusa Griseb.

PARAGUAY. Dpto Boquerón: Misión Santa Rosa, 21°45'S 61°35'W, 11.II.1981, *Arenas 1665* (BA) [Choroti].

Capparis salicifolia Griseb.

PARAGUAY. Dpto Boquerón: Misión Santa Rosa, 21°45'S 61°35'W, II.1981, *Arenas 1664* (BA) [Choroti].

Capparis speciosa Griseb.

PARAGUAY. Dpto Boquerón: Misión Santa Rosa, 21°45'S 61°35'W, II.1981, *Arenas 1667* (BA) [Choroti].

Capparis tweediana Eichler

PARAGUAY. Dpto Presidente Hayes: Colonia Menno, Loma Plata, 22°20'S 59°50'W, 4.XII.1974, *Arenas 1054* (BA) [Lengua-Maskoy].

ARGENTINA. Prov. Formosa. Dpto Patiño: Pozo Navagán, Reducción de Indígenas Pilagá, 24°15'S 60°00'W, 18.I.1982, *Arenas 1964* (BA); Las Lomitas, Colonia Muñiz, 24°42'S 60°36'W, 18.VI.1985, *Dell'Arciprete 37* (BA) [Pilagá]. **Dpto Maticos:** Ing. G. N. Juárez, Toldería Toba, 1 km N del pueblo, 23°54'S 61°51'W, 20.II.1983, *Arenas 2219* (BA) [Toba-Pilagá]. **Dpto Bermejo:** Pozo de Maza, 23°34'S 61°42'W, 16.I.1989, *Arenas 3358* (BA) [Wichí]. **Prov. Salta. Dpto Rivadavia:** El Colgado, 23°45'S 62°60'W, 11.I.1983, *Maranta & Arenas 265* (BA) [Wichí]; Misión La Paz, 22°24'S 62°30'W, 09.I.1984, *Arenas 2605* (BA) [Choroti].

CELASTRACEAE

Maytenus vitis-idaea Griseb.

PARAGUAY. Dpto Boquerón: Colonia Menno, Loma Plata, 22°20'S 59°50'W, 7.XII.1974, *Arenas 1057* (BA) [Lengua-Maskoy].

EUPHORBIACEAE

Sapium haemospermum Müll. Arg.

PARAGUAY. Dpto Presidente Hayes: Fortín General Bruguez, 24°45'S 58°50'W, 7.I.1980, *Arenas s.n.* (BA, BACP 1627) [Maká].

POLYGONACEAE

Ruprechtia triflora Griseb.

PARAGUAY. Dpto Presidente Hayes: Colonia Menno, Paratodo, 23°20'S 59°40'W, 10.XII.1974, *Arenas 1117* (BA); Misión Nueva Vida, 23°05'S 59°40'W, 28.XI.1977, *Arenas s.n.* (BA, BACP 161) [Lengua-Maskoy]. **Dpto Boquerón:** Colonia Fernheim, Filadelfia, 22°20'S 60°05'W, III.1981, *Arenas 1843* (BA) [Ayoreo].

ARGENTINA. Prov. Formosa. Dpto Bermejo: Pozo de Maza, 23°34'S 61°42'W, 09.II.1989, *Arenas 3419* (BA) [Wichí]. **Prov. Salta. Dpto Rivadavia:** Misión La Paz, 22°28'S 62°22'W, 15.II.1982, *Arenas 2113* (BA) [Choroti]; Los Blancos, Barrio Maticos, 23°36'S 62°35'W, 24.I.1983, *Maranta & Arenas 186* (BA) [Wichí];

SOLANACEAE

Lycium americanum Jacq.

ARGENTINA. Prov. Salta. Dpto Rivadavia: Misión La Paz, 22°24'S 62°30'W, 13.I.1984, *Arenas 2626* (BA) [Choroti].

Lycium cuneatum Dammer

ARGENTINA. Prov. Formosa. Dpto Maticos: Ing. G. N. Juárez, Barrio Obrero, southern part of town, 23°54'S 61°51'W, 25.II.1983, *Arenas 2310* (BA) [Toba-Pilagá]. **Prov. Salta. Dpto Rivadavia:** Misión San Patricio, 23°53'S 62°33'W, 07.II.1983, *Maranta & Arenas 262* (BA). **Dpto San Martín:** Misión Chaqueña «El Algarrobal», 23°15'S 63°43'W, 25.II.1984, *Maranta & Arenas 559* (BA) [Wichí].

Solanum glaucophyllum Desf.

ARGENTINA. Prov. Formosa. Dpto Patiño: Pozo Navagán, Reducción de Indígenas Pilagá, 24°15'S 60°00'W, 20.I.1982, *Arenas 2000* (BA) [Pilagá].