Pre-Columbian Flute Tuning in the Southern Andes

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ZUSAMMENFASSUNG

Eine alte Art der Flötenstimmung ist in Chile bis heute erhalten. Sie basiert auf einer spezifischen Auffassung von Musik als kompositorischem, orchestralem, sozialem und rituellem Prozess, in dem alle Fragen der Tonhöhe wie auch melodische und rhythmische Merkmale der Klangfarbe untergeordnet sind. Dieser Prozess und diese Anschauung werden präkolumbischen Instrumenten gegenüber gestellt, und so soll ermöglicht werden, das Wesen dieser Instrumente besser zu verstehen, ebenso wie den möglichen Kontext, in dem diese Instrumente gespielt wurden.

INTRODUCTION

An ancient pre-Columbian way of tuning flutes still survives in the southern Andes. It is related to obtaining a specific sound colour rather than a specific pitch of the instruments. The study of archaeological evidence and their comparison with other ethnographic, ethnohistoric, and historic records made it possible to reconstruct a coherent view of the process of continuity of this phenomenon over the last 2900 years. The subject of our investigation will be presented in two main areas: one covering a description of present day traditional in Central Chile, and the second devoted to the prehispanic traces of it. Finally we will discuss briefly the methodological implications of these studies to the understanding of American prehispanic music. We will present an ample overview of the subject together with a more detailed discussion on our main subject, the tuning process and its implications. Parts of the subject have been presented in detail in many publications that will be listed in the bibliography.

The investigation that underlies this presentation has been going on for over ten years, and is in debt to a number of persons, institutions and written sources all of which will be found in the notes.[1]

I. PRESENT DAY CHINOS TRADITION

The *chinos* of Central Chile are ritual music groups formed by fishermen, farmers or miners to honour their saints.[2]

Chinos use a special kind of flute defined by its sound, called *sonido rajado* ('tear sound'). Flutes are very simple, and permit only a single sound, but this *sonido rajado* is so complex that the whole musical universe of the chinos is constructed around it.

In the near past almost every group had its own flute-maker, thus its sound was unique to its design. Today there are only a few flute makers who provide instruments to a great number of groups, but as each musician considers himself able to adapt his instrument to his preferences (an adaptation that sometimes has negative sound results), and because there are differences in the playing technique between groups, there are subtle differences in the sound of each *baile* ('dance'). An experienced chino can distinguish from far away which flutes are playing, and thus which group from another village is coming.

For our purposes, we will approach our subject – the *sonido rajado* – in a series of successive layers of organisation: the sound of the flute, the sound of a pair, the sound of a *hilera*, the sound of the group and the sound of the fiesta. We will observe

1 The investigation was made possible through a FONDECYT (92-0351) grant, and also with the support of the Museo Precolombino. The investigator Claudio Mercado, with his experience of having become one of the best chino in the region, is in support of the core of the present investigation.

2 The name chino is kechua, meaning servant. Present day chinos do not speak kechua (this language was still in use when Incas invaded central Chile in 1470, ending 66 years later when the Spaniards invaded in 1536. The permanence of this name, and the permanence of this archaical musical system is one of the fascinating aspects of this study.

that the passage between two consecutive layers tends to be as smooth as possible in order to dissolve the barriers between the music made by one and the whole. Also we will analyse the importance of special states of consciousness produced by the sound.

The sound of the flute, named *sonido rajado*, is loud, strong and dissonant, with a great vibrato. Its harmonic structure extends from low frequencies to high upper partials.

Of the many specific aspects of this sound, only the vibrato is mentioned by the *chinos*. They speak and share information about this vibrato, giving it many names: *gorgoreo*, *garganteo*, *ganseo*, *catarreo* and *llorona*. The last two names in fact designate special kinds of flutes that are defined by their special kind of vibrato; they are the most costly and the most rare; there are only two of them in a group, and only very few groups have them.

Chinos also perceive in this vibrato a sense of duality, as they told us that the flute *suena como dos* ('sounds like two').

The analysis of a series of *sonidos rajados* made by H. K. Wright and D. M. Campbell[3] shows that frequencies and higher partials are not constant, and that playing technique can cause small but significant changes in the partial frequencies. The lowest partials are 40 or 50 dB below the strongest partials; however, weak perception of a fundamental is audible. This weak fundamental is not important for *chinos*.

Chinos know of three ways of sounding the flutes with other than *sonido rajado*: *pitiar*, *botella* and *bombeado*. The first is a bad sound, with many high harmonics but no bass ones, a weak and unbalanced one, normally the sound given by an apprentice. The two latter are two kinds of soft sounds, formed by pure fundamentals without partials. They are seldom used, as when entering the temple, or in the funeral of a *chino*.

In order to learn the secrets in the construction of the acoustic tube that produces these sounds we asked Daniel Ponce, one of the best masters in this craft, to construct for us a complete set of flutes as for a new *baile*.[4] This gave us the opportunity to have a close view of an experienced *chino* in the construction and acoustics of the flutes.

To construct the flutes, Daniel chose material from the local woods. Preferred woods are *sauce*, *nogal* or *mañío*. He chose round sticks of about 6 cm diameter and a maximum length of about 70 cm. Then, at home, he cut pairs of them to calculate the length necessary to obtain a certain series of pitches. The exact pitch of each is unimportant, provided that they are in a sequence from big to small in size, so from high to low in pitch.[5]

Measurements are done 'by eye', based on Daniel's experience about the length-pitch relation. This imprecision reveals the unimportant aspect of the fundamental in the *sonido rajado* concept (Fig. 1).

After cutting all the sticks, he constructed the acoustic tube (Fig. 2). For this he has a manual 5/8 inch drill and three round metal rods of 5/8 inch, ? inch and 8 mm. First he puts the three rods on the fire to turn them burning red. Then he measures the half length of the stick, using a chord, and marks this on the 5/8 inch drill, and opens the tube with this drill up to the mark, and burns the interior walls of the tube with the 5/8 inch hot metal rod, giving it an extra smoothness.

After finishing the broader section of the tube he introduces the hot ? inch rod, pressing it at the centre of the bottom part of the tube, repeating this process two or three times until it opens up at the rear of the stick. After that, he introduces the hot 8 mm rod to smooth the wall of the narrow section of the tube. This characteristic form of the acoustic tube, with a broader open section and a narrower closed one, we will refer to as the 'composite tube'.[6]

The smoothness of the interior walls, and also of the *descanso*, the section where the tube changes from broad to narrow, is critical. After finishing it water is poured into it to assure a better smoothness, and only then the desired sound can be reached. The slightest imperfection on the tube, due to a node on the wood or a moth adhered to its walls causes the sound to fail. Pouring water provides the best way to smooth and to clean the tube, and this is the normal process before playing at any time.

After the tube is finished, Daniel carves the mouthpiece to obtain a comfortable piece, producing a sharp edge where to blow upon. At this stage, water also provides the way to shorten the tube experimentally, covering the bottom hole with a finger, controlling the amount of water that rests at the bottom end of the tube, and playing it again and again until Daniel is satisfied with the sound results. At this stage the broader part of the tube can be lengthened with the burning rod. The tuning process is indeed the search

3 Wright and Campbell 1998, 51-63.
4 Pérez de Arce et al. 1994, 32-33.
5 We have found ronco and clarita used as local names for 'high' and 'low' pitches.
6 This is the name given to it by Haeberli 1979; Bolaños 1988 uses the term 'fusion type': 39 41.

for the maximum amount of dissonance that characterises the *sonido rajado* (Fig. 3). If the proper sound is not reached, which happens only rarely, the flute is thrown into the fire and another one is attempted. For doing this Daniel has many extra sticks.

If the sound satisfies Daniel, he proceeds to put a plug in the rear end of the tube, introducing it slowly and trying the sound until it improves, then cutting this plug while it protrudes from the rear. After this Daniel models the exterior of the stick and the flute is finished.

Later on, when the flutes reach the musicians, they paint them with extra colour and designs of their group. It is common that then, as mentioned, each *chino* carves the mouthpiece to improve the sound, or to make it more suitable to his mouth.

Rough as they seem, the flutes are indeed very fragile; a small moth, an internal scratch or the shaking of the plug can modify and even destroy the sound quality. Utmost care must be taken in the storage of the flutes which must rest upside down in a cool and dry place. Good flutes are rare and very appreciated, some of them handed down from father to son, their sounds having been acquired through long forgotten secrets of craftsmanship and many years of playing.

The technique of blowing the instrument is precise and extreme, involving the maximum amount of air, great control over lip position, and pressure. The playing technique consists of an uninterrupted series of violent attacks that accomplish the *sonido rajado*. Flutes are played while doing a kind of dance that involves jumps, turns and other exercises that also influences the sound production. This is maintained over a long time during fiestas, sometimes for one hour or more. This strong physical effort limits the use of flutes to men in good physical condition, and it also involves the hyperventilation of the musician, creating an altered state of consciousness that we will comment on later.

Flutes are always played in pairs, one after the other alternating their single blow, sometimes connecting both sounds as to produce a continuity. They say a good pair of flutists *suenan como un solo* ('they sound as one') giving a *sonido compacto* ('compact sound'). To obtain this, both musicians must have similar playing techniques, and both instruments must sound alike as much as possible (Fig. 4).

The sound of the flute pairs as constructed by Daniel tends to be similar. This is planned out when choosing similar lengths between pairs of sticks and before drilling the tubes, but the final sound of both can deviate more or less, and this is not important. It happens that, when forming a pair, one of the chinos carries his own flute which does not match the other, and this is also permitted. However, we can observe a clear intention of matching pairs of flutes as to constitute a unity, like one single flute constituted by two halves, a flute that can be played for hours without stopping and that is able to give an uninterrupted sound for a long time. This aim is reached with special precision in the pair of catarras. As already mentioned, these flutes are scarce, difficult to obtain, and not produced anymore, so they are much appreciated. They are noteworthy not only by their high vibrato, but also by the permanence they achieve in a single, uninterrupted sound as if produced by a single flute; the listener should not be able to distinguish which one is sounding.

The paired playing technique implies a basic coordination between both musicians. Although simple, it requires a mutual understanding that furthers friendship and mutual support. The paired flutists' sound is based on a symmetrical and complementary duality, one of the bases for Andean cosmology.

The flutes are also organized in a *hilera*, a row ranging from shorter to longer flutes. The row constructed by Daniel has ten flutes ranging from 300 to 700 mm approximately. All of them are played simultaneously, producing a single *sonido rajado* but multiplied, expanded, enriched, enlarged and diversified by ten.

Control of tuning between flutes is, again, not important. It results from the cutting of the sticks at the first stage of construction. In our control group we find a total variation from 3 to 65 cm between extreme flutes, in a more or less regular sequence, but even with negative values between some of them (see Fig. 1).[7]

The imprecision of this scale-tuning is that it is not conceived as a scale, but as a chord. The purpose of the row is to produce a unique sound, in which each individual is lost. We can observe that the same aim of the pair is here reinforced in another direction. Each row is organised by the puntero, the lower and potent flutes played by the most experienced and respected musicians who go in front, to the coleros at the rear, the children who are beginning to learn and play the highest and weak flutes. The total sound is the sum of all these acoustic and social differences.

The musical group, named *baile chino*, comprises approximately twenty or more flutes

7 Measurements made by Wright and Campbell 1998, 54.

8 Pérez de Arce et al. 1993, 19-24 ; see also Mercado and Galdamez 1997 ; the baile is complemented with an alferez who knows the sacred chants and whose participation is alternated with the flutes during the whole ritual day ; see Uribe 1958.

divided in two rows, plus one or two drums and a bass drum. The flutes are played in groups with a strict organisation.[8] As each player has his pair, both rows repeat this scheme, producing a continuity between both row and sound. The sound of the group must be heard as a single *parejo*, *fuerte*, *grueso* ('plain, loud, dense') and both rows must be balanced. If one row sounds stronger, the sound is *cargado*, a defect that must me corrected.

Both rows play alternately for more than one hour, sounding like a single gigantic flute. Changes in the dance steps, led by one drummer between both rows, produces a permanent smooth variation in the pulse and intensity of the sound. No melody, no consonance, no tonality is sought.

The norms of duality, reciprocity, solidarity and loss of individuality define the social relation of the group, reinforcing the basics of Andean society. The group achieves an amplification of the flute – and pairs of flutes – characteristics that disregard all individual ones. Through all this process the only characteristics that is emphasised is the colour, or timbre, of the sound. Melody, rhythm and other sound characteristics are totally dismissed for that sake.[9]

It is impossible to define a cutting line between the timbre of a single flute, a pair, a row, a group. All are acting as a single unity of sound, all representing a sonic image that identifies the social group.

The first time one comes to a *Fiesta de chinos* the sound of it is sensed as total chaos, that reaches a magnificent, strenuous, and extended sound when the great fiestas congregate 20 or more *bailes chinos*. Each baile represents a valley, a fishermen's group, a small rural community, identified through clothing, flute painting, dance and sound.[10]

The spatial structure of the group sound extends as a bar of about eight meters long and three meters wide, with a high and a low – pitch ends. In the ritual procession, groups organize in a long line, say one kilometre, creating a sound formed by the different sounds of the bailes chinos overlapping, in a complex and changing polyphony. Since all *chinos* sound alike, their sum creates a monstrous *sonido rajado*.[11]

We can hear multiple 'ghost melodies' (casual melodies produced by the mixing of different flute sounds), polyrhythms (casual mixing of different pulses) and other complex acoustic features. All this changes depending on the space it moves in and how we move with respect to it. In Loncura, a typical coastal fiesta, the procession moves through the narrow streets, then near the hills, then through the open beach and into the church, each time producing acoustical differences that makes the whole acoustic impression varied and enriched (Fig. 5).[12]

Each orchestra that plays tries not to copy the next one's pulse. This is very hard because of the proximity and loudness of the mass of sound. This is conceived as a sign of superiority between bailes and is used as a basis for judging between them. They conceive this participation in the fiestas as a competition, comparing it with a sport like futbol. The clash between two sounding orchestras is named *estrellon* or *choke*, while *apagar* and *perder* refer to the aim to mute or to disrupt the rhythm of the opposing orchestra, and which uses certain precise musical rules and tactics.[13] *Parar* refers to the final stage of disruption, when the opposing orchestra must stop playing.

We can observe that the general organisation of sound in the *fiesta* depends on chance to a great extent, but at the highest level it is controlled by the ritual norms that determine which groups are invited, how they organise in space and time, and how their practices will be involved in their mutual relations.

The ritual special states of consciousness are a specific aspect of the playing of these flutes. The exhausting exercise of dancing and playing combined with the hyperventilation, the saturated sonic atmosphere, the competition, the need for concentration and the proximity of the sacred – all these trigger altered states of consciousness. This is described as *emborrachiamento* ('drunk state') or *marihuanendos* ('drugged') and also as a total identification with the sound, state of abundance, disembodiment and other universal sensations common to trance states.[14]

These phenomena are easily understood as part of the general purpose of the fiestas, that is, to bring men and the divinity close. Trance has been the normal way to do this in ancient times, as we will se in more detail below.

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9 There are, nevertheless, some interesting melodic and harmonic situations that result from the azar, see Pérez de Arce 1996.

10 The ritual fiesta usually lasts one day, where instrumental and vocal parts alternate. We are only referring to the instrumental parts. The fiesta follows a number of rules regarding space and pulse organisation, all this encompassing a general ritual scheme.

11 Pérez de Arce 1993a. This is a sort of idealized fiesta, seldom observed today, when other types of ritual organisation have emerged that disturb the sonic equilibrium, see Mercado 2000; Cervantes 1985; for disturbances produced by the Catholic Church see Mercado 2001; Arnold 1991, Ruiz 1994; Ruiz 1995: Nevertheless, it represents the ideal type of fiesta as expressed by the chinos, and is the better way to understand its particular sound system.

12 Pérez de Arce 1993c, a recording of this music appears in Claro 1979; Dannemann und Wenzel s/f ; Pérez de Arce 1994a, Pérez de Arce 1994b. An excellent video is available in Mercado 1994.

13 Experiences bailes know how to change the pulse gradually, a difficult technique that, while enriching the musical context, disturbs the neighbours' coordination, see Pérez de Arce 1996.

14 Mercado 1993a; Mercado 1993b;Mercado 1995/1996.

Sometimes the sole experience of hearing the sonido rajado can trigger heavy alterations in the normal consciousness of people who are listening to the music, such as nausea, or loss of sleep for days.[15]

To sum up the chinos reality, we have a complex acoustic system whose complete structure is based on and supported by the special acoustics of the flutes and whose final purpose is to make a link between men and the divinity. These flutes are used only for ritual, and thus it is impossible to draw a line between the flute as an instrument, isolated from the rest, and the total mass of sonic events interacting at the *fiesta* level. *Bailes chinos'* sonic aesthetics can be interpreted as an amplified, extended, varied, multiplied, changing and unpredictable *sonido rajado* of great proportions.

To understand the transcendence and deep cultural implications of this ritual sound system, we must consider it as a part of a Southandean system. The chino tradition extends through 800 km from Chile Central to Norte Chico. Some minor variations throughout this area did exist: Central Chile tradition appears to be the most developed acoustically.[16]

The native people who live in the neighbourhood of the *chinos* are the Mapuche, some 700 km south, and the Aymara people, living some 1500 km north. Both use part of the same ritual-acoustic system: Mapuche use the same instrument named *pifilca*,[17] Aymaras do not use *sonido rajado*, but the *tara* flute sound, similar to it in various ways.[18] They also use flutes with dense, complex and dissonant sounds in paired playing and in musical competitions. They have complex music produced by orchestras of high internal organisation, and thus have an explicit way to define acoustics and its social, cosmological and organological levels.[19] They use flute orchestras where there is a combination between the 'normal' way of tuning (according to a determined scale) simultaneously with the Andean way of tuning, producing slight dissonance between the different registers of flutes. Musical identity in the Andes is determined by the density of the sound that results from the simultaneous use of the dissonant registers, sometimes isolated from other musical attributes, as in *chinos*.[20]

The trance, as made possible through the sound of the flutes, is part of a more general search for trance by means of dense and complex sounds like those of waterfalls.[21]

As we can see, the ethnographic evidence shows a specific Andean way of understanding acoustics, through an aesthetic focused on the enriched colour of instruments, its multiplication through similar instruments in orchestras, and the search for trance through these same acoustics.

II. THE PREHISPANIC TRADITIONS

The archaeological record[22] shows that the flutes that are capable to give sonido rajado cover the complete Southandean area. We find that the chino flutes were used by Aconcagua people, who lived in Central Chile between the years 900 and 1470 A. D. These flutes are of stone, instead of wood, and they have an asymmetrical body, with one handle on the side (Fig. 6).[23]

The knowledge and craftsmanship necessary to make these instruments of stone is much greater than for the present day wooden ones.[24] When compared with other stone artefacts of the Andes, these flutes are among the best in terms of design and manufacture, although maintaining an external simplicity.

In the south of Chile we observe the same situation. The prehistoric *pifilca* of pre-Mapuches also were stone made, showing a dedicated and specialised craftsmanship (Fig. 7). Their abundance is a sign of the great popularity they achieved as an instrument and also as an offering to accompany their owner after death.[25] The same can be said of the Diagita flutes from the Norte Chico region (Fig. 8).[26]

15 See Mercado 1993c.

16 For differences inside chinos tradition see Pérez de Arce et al. 1994 ; Aguilera et al. 1985 ; Borquez 1987 ; Pumarino y Sangueza 1968 ; Quezada s/f ; Uribe 1974.

17 For a summary comparison between both systems, see Pérez de Arce 1997; Pérez Bugallo 1987; Pérez de Arce 1995.

18 See Gerard 1997, where tara is referred to as dos sonidos ('two sounds') because of ist vibrato, and also the references to sound behaviour depending on the blowing intensity, with different sonic qualities alternating to create this vibrating quality. See also Stobart 1996

19 Aymara say that pairs are complementary and opposite halves, rows are organised in register, with defined names, roles, and rules. Competition is part of the tinku ritual combat between halves during carnival time that represents the savage, chaotic side of reality. See Baumann 1996; Langevin 1990; Urton 1993; Valencia 1981; van Kessel 1981.

20 We have defined the main common attributes to orchestral-ritual music in the southern Andes as Armonia Andina, Pérez de Arce 1991a.

21 Mercado 1992. This model of multiple sonic layers offering multiple possible interpretations is the best way to generate the trance states, as proposed by Dobkin and Katz 1975.

22 Pérez de Arce 1997, 141-150. In this paper we will omit all references to the ethnohistorical record, because of its minor importance for our purpose. See Godoy 1994; Mercado 1993d; Mercado 1995; Pérez de Arce 2000.

23 Pérez de Arce 1988 ; Pérez de Arce 2000.

24 Little has been investigated about the lithic industry, see Balbuena 1980.

25 Pérez de Arce 1987.

26 Busquet 1995; Iribarren 1957; Iribarren 1969.

A clear line links present day instruments with their prehispanic ancestors, maintaining their regional differences: bigger in Central Chile, smaller in Norte Chico and even smaller in the south of Chile.

But in the prehispanic times there also existed another instrument, now extinct, that replicated the *pifilca* tube four times. These instruments, that we will refer to as *antara*,[27] vary in their exterior form from one culture to another, in the same way that the pifilca did: rounded with two handles in pre-Mapuche (Fig. 9), more squared, asymmetric and with a serrated corner in Aconcagua (Fig. 10),[28] and with a more stepped profile in Diaguita (Fig. 11). The only scientifically excavated instrument shows us clear signs of its importance: it belonged to a specific individual, with a rank different from the rest, who was laid to rest with the flute covering his head.[29]

All these prehispanic *pifilcas* and *antaras* have composite tubes similar to the *chinos* flutes. All tested instruments in good enough condition to be sounded when blowing using present day chinos technique, sounded with perfect *sonido rajado* of the best class, showing good *ganseo* and even *catarras* or *lloronas*.[30] This sound is impossible to obtain by chance; it had to be the result of careful polishment, even the careful construction of the *descanso*, where the broader and narrower parts meet. My hypothesis is that Aconcagua intended to produce four *catarra* flutes in one flute carved from a piece of stone.[31] This implies a state of knowledge far greater than that of the present day, and this is coherent with the general loss of the ancient cultural traits in the zone.

We also know that these antaras arrived from the north from the distant oasis of Atacama desert (Fig. 12) or through the Andes, from the distant lands of northwest Argentina. In these regions fine wooden and stone antaras were used.[32] We know of the use of wood for constructing these instruments in the south only for one particular flute that was conserved in special conditions;[33] the others have disappeared because of the humidity. We can suppose that the distribution of wooden and stone instruments was, at least, equal in all the territory. *Pifilca* was not known to Atacameños, but only four, sometimes three tube *antaras*. To prevent wood from cracking from the desert dryness they secured the body of the instruments with leather strips.

We have no evidence of the use of antaras in pairs, only isolated ones have been recovered all over the territory from southern Chile to northwest Argentina and the Bolivian plateau. The exterior carvings on the Bolivian instruments have a resemblance to the typical Andean siku made of several canes (Fig. 13).[34]

We also know of the representation of the instrument on some of the precious sacred objects used to sniff a psychoactive powder from the *vilca* tree (Fig. 14).[35] These representations are linked with mythical personages central to their sacred knowledge, and they show the antara as the central iconic object. These objects were used only by important shamans, and so it is not difficult to relate the mind altering properties of *sonido rajado* with the ritual states of consciousness produced by the use of *vilca*.[36]

We have found this type of representation in the region where wooden artefacts have been recovered, but as we have said, for the south we do not know if wooden artefacts existed in the past.

The instrument appears in this region as a result of the great cultural influence of the altiplanic Tiwanaku culture, from the years 400 to 1100 A. D. From the Tiwanaku great Andean sanctuary the *antaras* – capable of giving the *sonido rajado* – expanded to distant zones through the llama caravan traffic, appearing in the desert oasis where intense market activity occurred. They were carried among rituals where the sacred vilca powder was used to access the *sacrificador* and the jaguar deities. From there they travelled to the Diaguita zone, most probably among the dignitaries, owners of sophisticated vilca sniffing equipment, great men linked with the political and shamanic roles.

From the Diaguita zone to the south there appeared a variation of the *antara* reduced to one single tube, and this is the instrument that survives until today.

27 The kechua name antara is widely accepted to name the ceramic instrument (Gruszczyńska-Ziołkowska 2000, note 6). I extended it to designate a whole organological family whose original names have disappeared.

28 Lindberg 1959; Pérez de Arce 1988 ; Pérez de Arce 2000.

29 Museo nacional de Historia Natural de Santiago (not yet catalogued), excavated at the Bellavista cemetery; San Felipe.

30 Flutes can be tested with the botella or bombeo sounds, and indeed this was the first attempt made on them by me and other scholars: See Pérez de Arce et al. 1994.

31 Until now we have had access to a limited number of instruments in playing condition, however covering different cultures (Aconcagua, Diaguita, Nazca). There is a need for a comprehensive survey of the whole universe of composite tube flutes in the search for possible different types of sonido rajado.

32 Marquez 1934; Pérez de Arce 1995a ; Pérez de Arce 2000.

33 Museo Arqueológico de La Serena.

34 Pérez de Arce 2000.

35 Vilca was identified by Torres et al. 1991. See also Arenas 1992 for modern use of vilca.

36 Pérez de Arce 1992b. Music and psychedelic plants are common to south American Indians, who perceive music as made not by the musicians, but by the plants themselves, see Smith 1973; Warren et al. 1972; Wasson et al. 1974; Rouget 1980.

But before Tiawanaku times the history goes farther north and farther back in time, to the Paracas and Nazca cultures from the desert kingdoms of southern Peru. We find the antara made of ceramic, with a different form and a variable number of tubes (Fig. 15). It is a completely different type of instrument from the formal perspective: not only material and form changes, but also there is a definite lack of standards in form, number of tubes and 'ornamentation'.[37] However, the acoustic principle is just the same, based on the composite tube. Sound was achieved through modelling and baking, a more difficult way than drilling and carving, because baking ceramic involves a reduction in size, thus sharpening the tone.[38]

Notwithstanding, Paracas and Nazca people showed an astounding knowledge in controlling the final stage of the scale, matching the delicate skill of producing complex tubes.[39]

According to Bolaños the first complex tubes come from the ceramic *antaras* of paracas period, around 500 B. C. Later on, in Nazca times, they continued to exist, and there also appeared a similar clay panpipe with simple tubes that were produced in different sizes, to be played in orchestras. Also here *antaras* are important shaman objects. Nazca shamanism developed using the San Pedro psychoactive cactus, whose representation sometimes appears on the *antaras*.

Now we have the complete picture: the cane panpipe (siku) was very old in the central Peru area, having existed at least from 5000 B. C.40 Around 900 B. C. in Paracas this *siku* underwent a drastic transformation to ceramic and composite tubes, giving birth to the antara. Near 400 A. D. it irradiated from Tiawanaku to the south, in a new transformation to wood and stone and fixed in the form of four tubes.[41] Later on, between 900 and 1400 A. D., Norte Chico and Central Chilean people produced a new variation with only one tube, creating the *pifilca* type that survives until today.

What has been maintained through all these transformations is the acoustic principle around a special and specific kind of sound.[42] The changes in material and form can not be explained as facilitating craftsmanship or changing its acoustics, nor can its acoustic permanence be explained as a general stylistic conservation, because all formal aspects change: material, form, ornamentation and number of tubes. It is the acoustic secret that is maintained, an acoustic knowledge that was much more developed and sophisticated than it is today.

As with the ethnographic record, the archaeological one also shows that *sonido rajado* was part of a broader acoustic world of vibrating, complex flute sounds capable of triggering special states of consciousness.[43] Small Nazca double ocarina whistles with a shrilling high pitched sound of a piercing quality with a particular hypnotic effect to the player, small double whistles from Arica,[44] some double flutes similar to the ones used by Mataco shamans to help the magic fly (Fig. 16),[45] an Arico wooden flute that has a cane mechanism to produce a vibrating sound,[46] are examples of this world of flutes and whistles associated with the trance states. This trend to the search for trance-flutes and whistles are not only common to the great Andean prehispanic world (Fig. 17), but also to the Mesoamerican one, as shown in the investigations of Adje Both and Susan Rawcliffe (see their papers in this volume).

Recent investigation in the prehispanic world is revealing a deep understanding of music subtleties around the quality of the sound itself, its colour, its texture. This is expressed in many ways: the several names for tuning of voices among Aymaras,[47] the final knowledge of the harmonics as shown in the Nazca world,[48] the search for special voices in flutes, etc. This is not strange, since we know that musical learning and practice was immersed in a ritual knowledge where the use of psychoactive substances was essential.

Dispersed evidence shows that prehispanic music practice also had aspects common to present day traditions, such as paired playing (Fig. 18),[49] aleatory, polyphony and movement,[50] spatiality of the sound,[51] the 'dense' and slightly dissonant voice of the orchestra of flutes.[52]

37 Gruszczyńska-Ziołkowska 2000, 193.
38 Dawson 1964 supposes that Nazca invented slip casting to produce these flutes; but Gruszczyńska-Ziołkowska 2000, 19 has reached a more detailed hypothesis; about baking ceramics see also S. Rawcliffe, this publication.
39 Bolaños 1988; Gruszczyńska-Ziołkowska 1999; Haeberli 1979; Sas 1938; Stevenson 1976; Izkowitz 1935.
40 Bolaños 1988.
41 Pérez de Arce 1989 ; Pérez de Arce 1993b ; Pérez de Arce 1995b.
42 Pérez de Arce 1987 ; Pérez de Arce1988 ; Pérez de Arce 1989.
43 Statnekow 1987.
44 Nazca whistles are in several museums, many flutes from Quiani period (1500-950 B. C.) are in the Museo Arqueológico San Migue de Azapa.
45 Several whistles from between 900 and 200 B. C. are in the Museo Arqueológico San Migue de Azapa, see Izkowitz 1935, 336; Novati 1984, 25.
46 From around 300 B. C.
47 Bertonio 1984 (1612), 13; 192; 194; 218; 259.
48 Bolaños 1988.
49 In Moche (Valencia 1982, 13-27), in Arica y Pica (Pérez de Arce 1982), in Inca (many early chronicles).
50 Personal observation also in Moche and Nazca, see Valencia 1982.
51 Stevenson 1976, 159; 166; 265.
52 Personal observation, see Bolaños 1988.

Summing up, we conclude that the knowledge of the acoustic structure related to *sonido rajado* and *catarra* sounds have been passed through generations, from Paracas, in 900 B. C. to the present day, as part of the ritual. It is worth noting that it endured the great changes introduced by the Spaniards that included the prohibition of ancient rituals. Although totally immersed in a European-catholic tradition, the actual flute playing of the chinos shows no contamination of the dominant culture (Tab. 1). The remarkable preservation of this musical practice may be explained because it was neglected by the dominant culture as a 'non-musical' object, with no intrinsic value or interest, thus no pressure existed over it to modify or change it in any way.[53] This preservation does not mean that present day chinos play exactly like their prehispanic ancestors: we know of many minor changes in their interpretation even during the last fifty years or so. They are a living culture, and thus changing all the time. This preservation means that, whatever the differences between prehispanic and present day tradition on the acoustic level, they follow an intrinsic indigenous direction, uncontaminated by the dominant culture thus showing a definite and clear link with the prehispanic past.

III. CONCLUSIONS AND METHODOLOGICAL IMPLICATIONS

Studying the present day chinos is a valuable model for interpreting their prehispanic ancestors' music. Through the utilisation of chinos knowledge of how to play ancient instruments we have found valuable information that would have been impossible to find otherwise. The chinos teach us a different way to consider the sound and the music of their ancestors, to approach ancient music with a broader Andean-style perspective as part of a sonic-social-ritual event.

Study of prehispanic music based on the material evidence of musical instruments is scarce and fragmented. The ethnographic studies permit us to discover how these instruments or similar ones were played, what their acoustic context was, and how people managed to design and create acoustics through them.

We observe the great permanence of the most stable components of culture, those aspects less vulnerable to intellectual manipulation, such as sonido rajado, aesthetics linked with special stares of consciousness. These components, common to all the region, are more stable than those that differ from place to place, such as the assignation of material support for the sound producing instruments, the number of tubes or the shape style. Rituality changes with the new influences; the Catholic one was imposed. As our understanding of living Indian cultures goes on, we recognize more and more aspects of their sonic world that have been continued, sometimes preserved, sometimes mixed or changed to adapt to new situation, but always directed in a specific and unique American perspective.

Now it seems that it is not sufficient (and even an erroneous approach sometimes) to make measurements of pitches in a scientific manner when studying prehispanic musical instruments, as proposed by Olsen;[54] we must consider other aspects as part of a unity with the sound, such as the colour, the spatial dimension, the movement. Ethnography teaches us that here we have found the main clues of ancient American music. Of course, we cannot have the specific prehispanic evidence of such subtle cultural attitudes, but we are beginning to understand a world that includes not only sound, but other cultural elements, especially textiles, that speak in a special American way, using the more subtle and not well defined elements as best suited to express their identity.

At the methodological level, we encounter problems when dealing with acoustic attributes that are more or less undetermined, or difficult with respect to precision, even poorly understood by our musical knowledge. But, on the other side, to continue to ignore them leads to continue the misinterpretation of the prehispanic music essence. To be open-minded in this direction seems to be the basic requirement for future investigations.

53 This is contrasted by the way the rituals have been forced to change in the conceptual religious way, in the idiom, in the visual imagery and so on. See Mercado 1993c.

54 Olsen 1990, 176.

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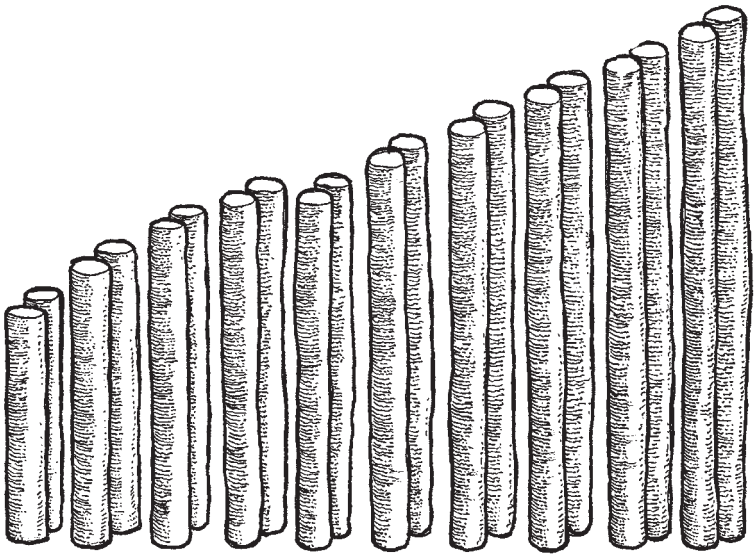
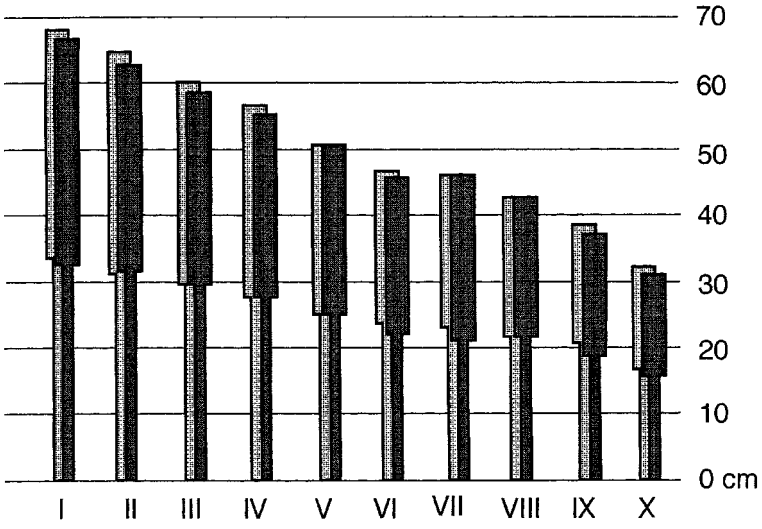
Fig. 1 The set of pitches.



A. The ten pair of sticks as originally cut, thus determining the series of pitches to be included in the chord.



B. The measurements made on the ten pairs of composite tubes after the flutes were finished.

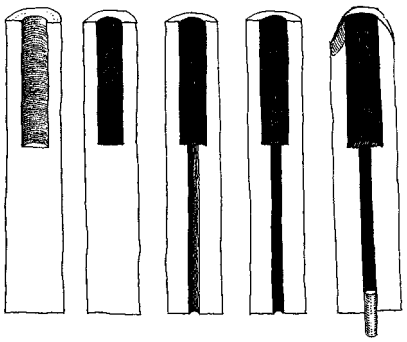


Fig. 2. The six stages of making a flute's sound. First, the 5/8 inch drill bores the upper section of the tube. Second, the burning red 5/8 inch rod hardens and softens the walls. Third, the ? inch rod burns the way through the bottom. Fourth, the 8 mm rod smoothes this section, and fifth, the plug is inserted and the embouchure is carved. A later stage, not shown, happens when the baile paints the flutes and puts mirrors on it in the finishing process.

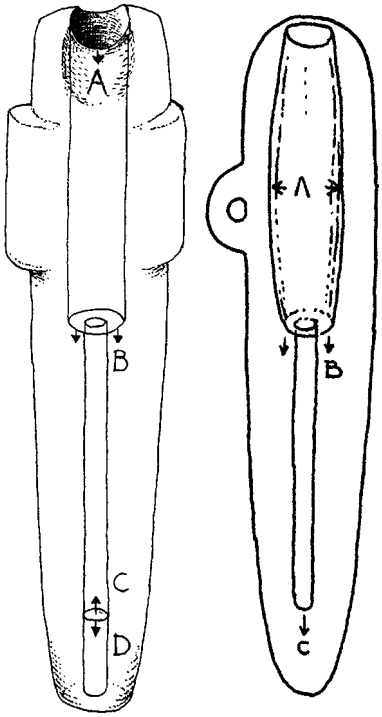


Fig. 3. Tuning. A. The three ways to tune composite tubes in present day flutes: (A) carving of the mouthpiece, (B) deepening the broad section, (C) moving the plug. Sometimes a liquid (water or spirits) is poured to rinse the bottom. B. In comparison, prehispanic flutes of wood or stone were worked to broaden the upper section and had resin plugs, save in the southern instruments that lack the plug, making more difficult the decision of the tuning process.

Fig. 4. Pair of finished flutes. (Photography by the author.)

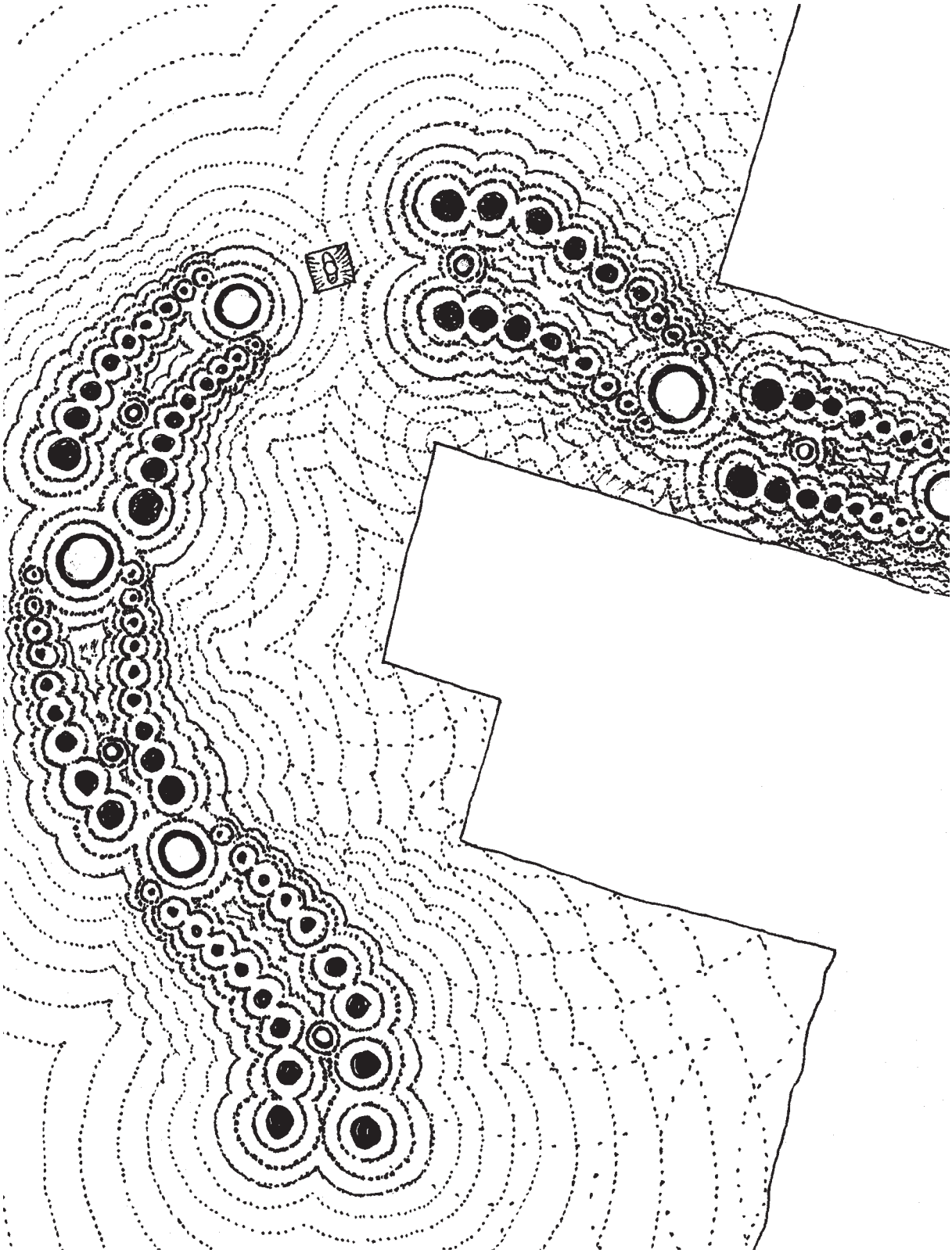


Fig. 5 The importance of space. In the schema, as viewed from above, the processional movement of the bailes, each one represented by 20 flutes (black dots) distributed in two rows from big to small, plus 2 drums (hollow circles) one big, one small. The bailes form a moving serpent whose sound takes the shapes of the narrow streets, the open space of the beach, etc. as it moves.

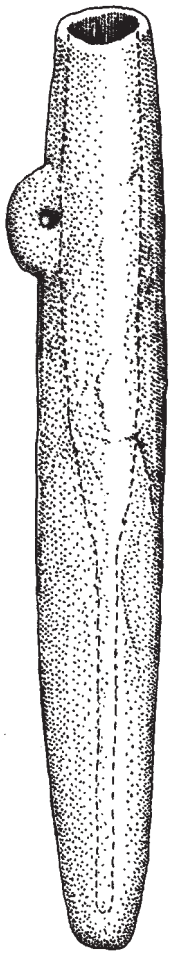


Fig. 6 Pifilca. Aconcagua (900–1470 BC.): Grey stone, 280 mm height, from Vichquén. Dotted lines represent the composite tubes inside. Museo Nacional de Historia Natural de Santiago 3806.

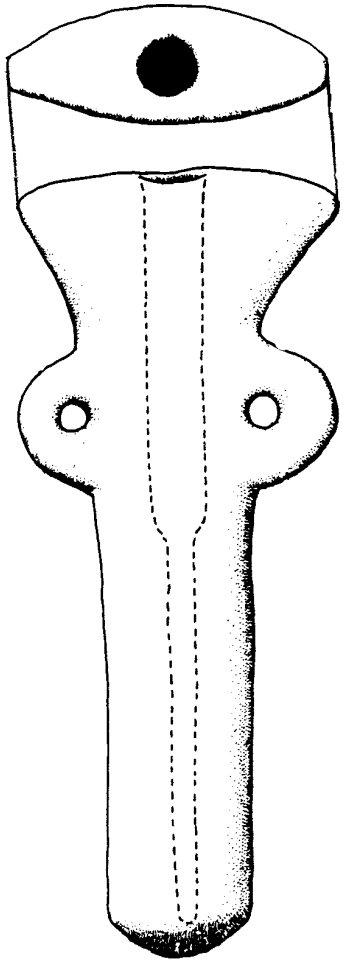


Fig. 7 Pre-Mapuche (1540 BC.). White stone. From San Juan, La Union. 165 mm. Museo Nacional de Historia Natural de Santiago 3817.

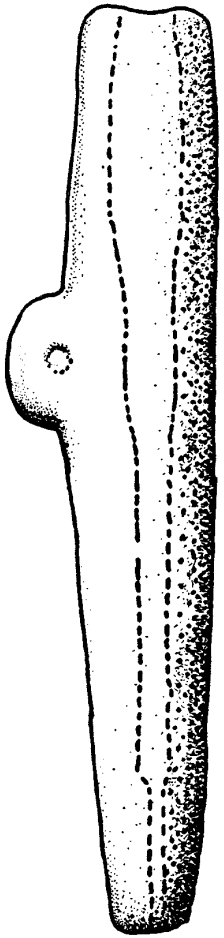


Fig. 8 Pifilca. Diaguita (1470–1536 BC.). Black stone. Probably the narrower section at the bottom of the tube was filled with resin. 210 mm. Museo Arqueológico de La Serena 1529.

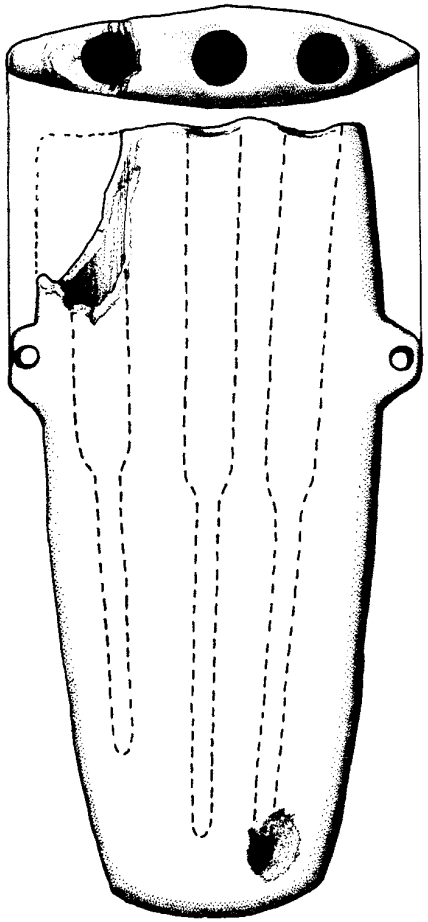


Fig. 9 Antara. Pre-Mapuche (-1540 BC.). Stone. The small hole at the bottom of one of the tubes seems to be intentional to 'kill' the instrument to be put into the grave. 173 mm height, Museo Dillmann Bullock, Angol 88 1 426.

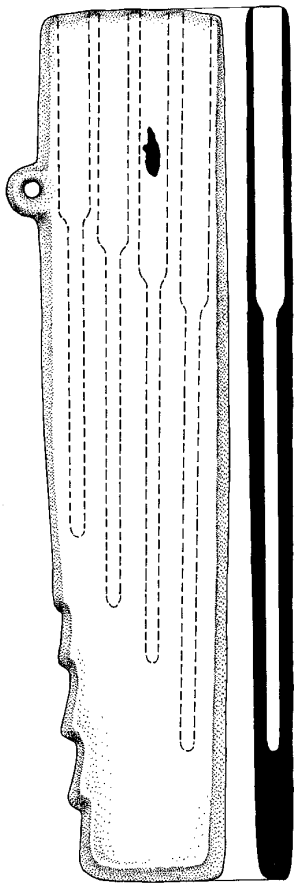


Fig. 10 Antara. Aconcagua (900–1536 BC.). Reddish marble-like stone 'combarbarita', the cross-section shows the exquisite stone craftsmanship reached in its manufacture. At the centre of the instrument is a hole made probably as a means to silence it symbolically. 327 mm height. Museo Arqueológico de Santiago 0132.

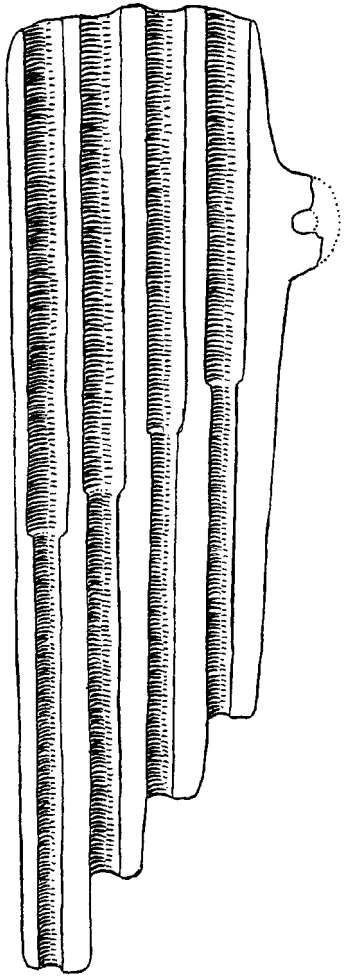


Fig. 11 Antara. Diaguita III (1470–1536 BC.). Dark brown stone. Section showing the disposition of the four composite tubes. The plugs are lost. 228 mm height. Museo Arqueológico de La Serena 1531.

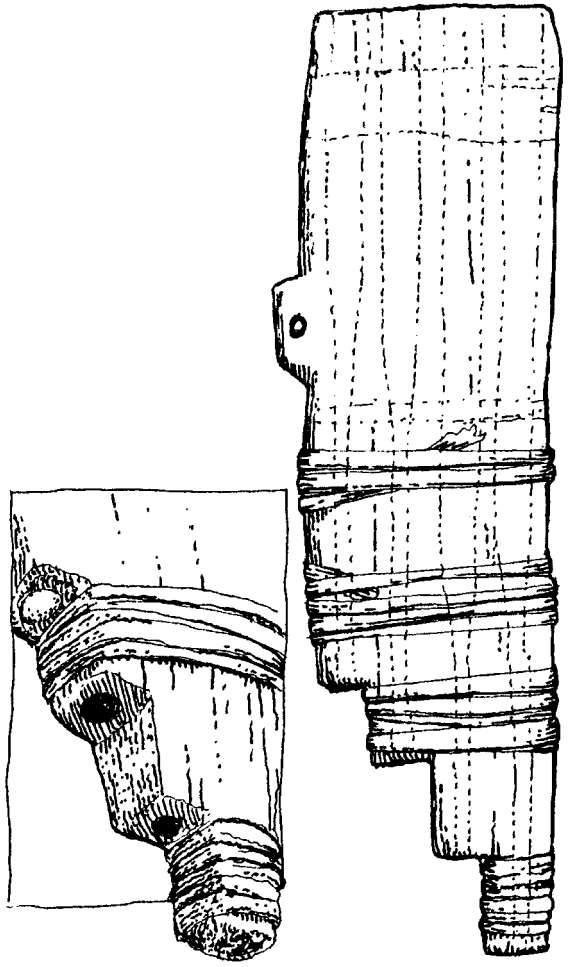


Fig. 12 Antara. Probably San Pedro (1000-1470 B. C.): Wood, secured with leather strips. Some of the resin plugs are present (detail). 274 mm height. Museo Nacional de Historia Natural de Santiago s/n.

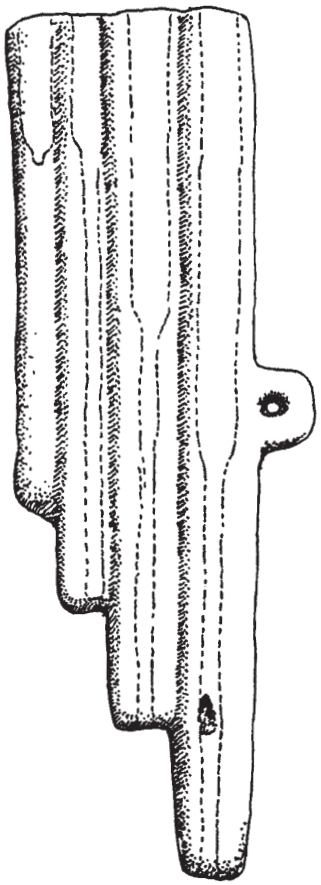


Fig. 13 Antara Yura (1400 BC.). Green stone. From Potosí, Bolivia. It shows the characteristic aspect of the cane panflutes outside, with complex tubes at the inside. Intentional breaking of the largest tube. 200 mm. Museo Universario de Sucre 318.02.679/2805.

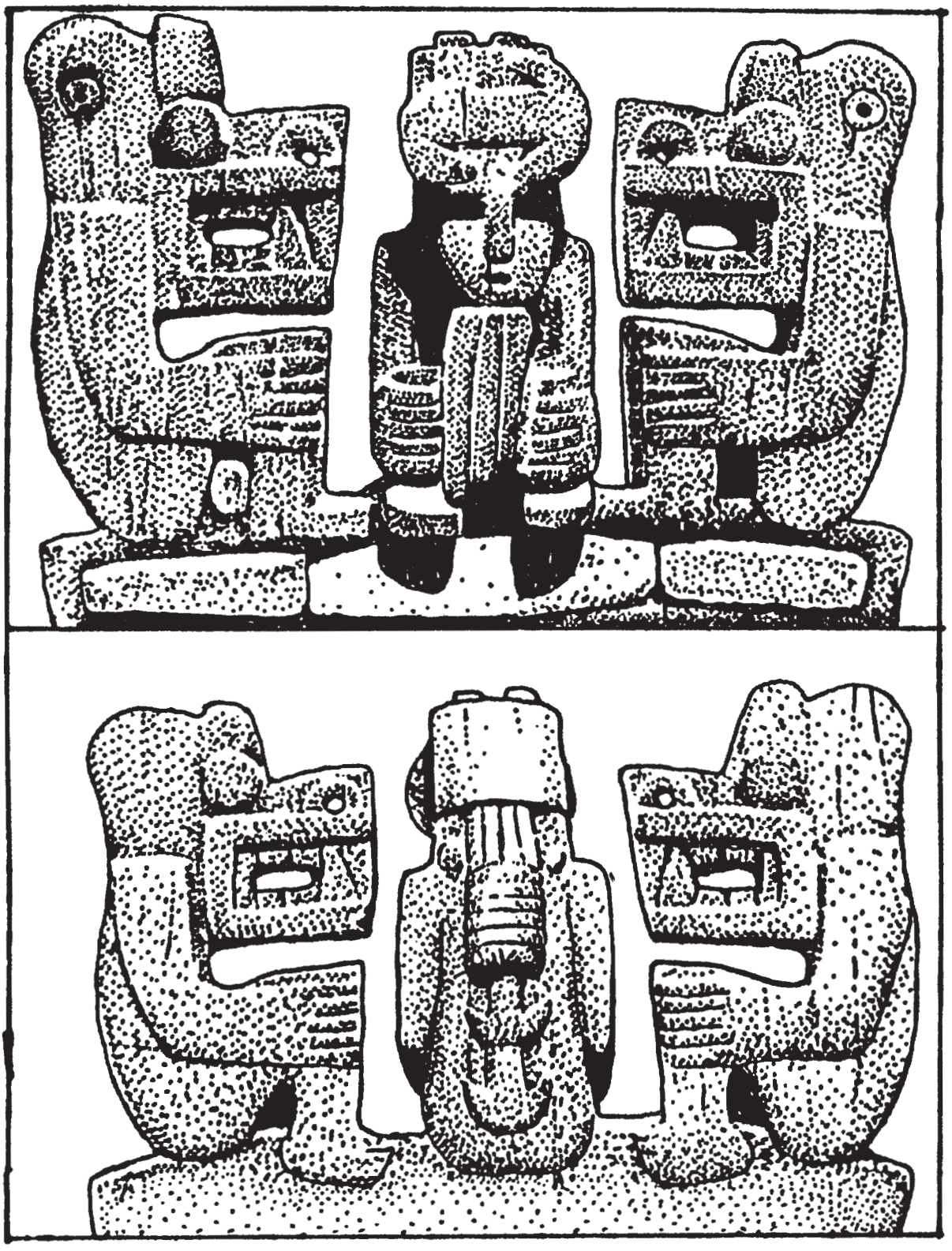


Fig. 14 Antara represented on a 'tableta de rape' (detail). San Pedro (1100-1470 B. C.). Wood, with stone inlaid. The central personage, with a complex headdress, has a 3 tube antara. 150 mm (the complete object). Museo Arqueológico San Pedro de Atacama 9160.

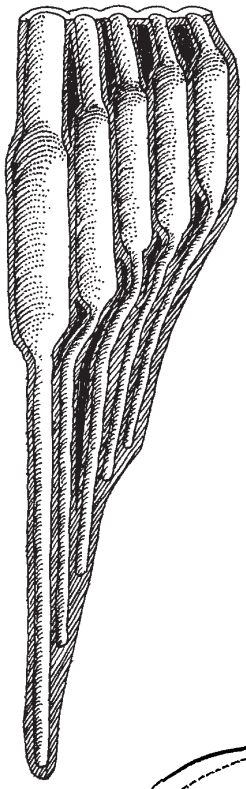


Fig. 15 Antara. Paracas. The tubes have three diameters, and are shaped to avoid spaces between them. From Bolaños 1988:34.

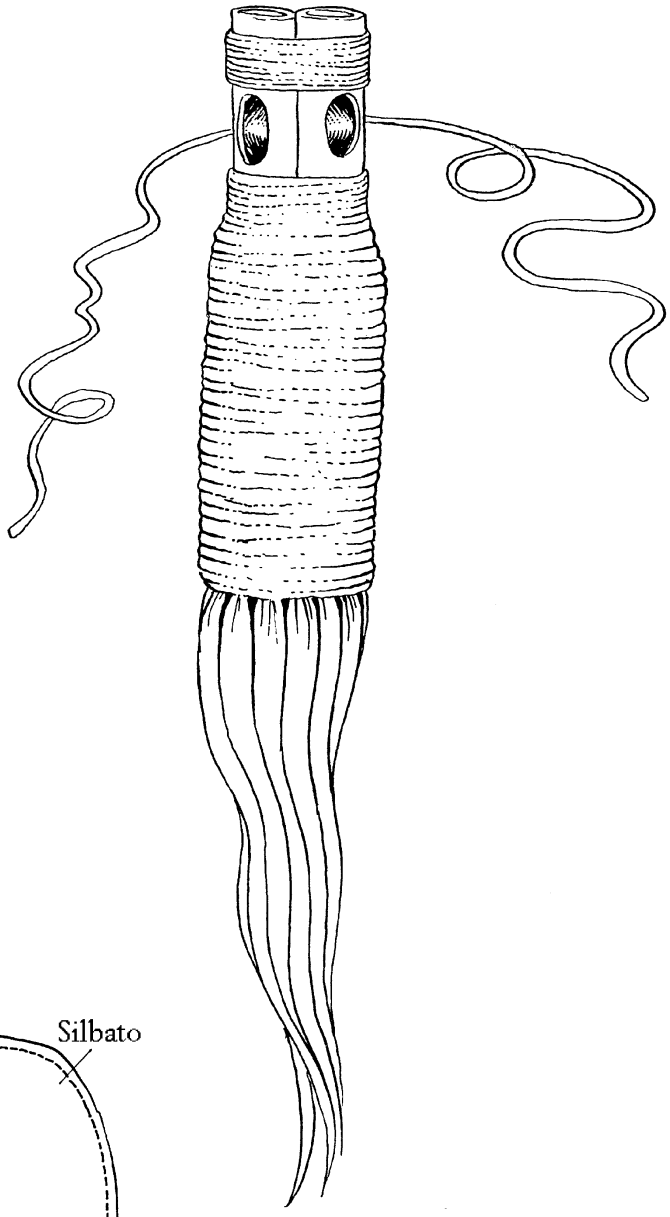


Fig. 16 Double flute. Faldas de morro (500 A.D.–200 B.C.). The two tiny finger holes can produce a delicatevibrated sound at will. 285 mm.Museo Chileno de Arte Precolombiano 0513.

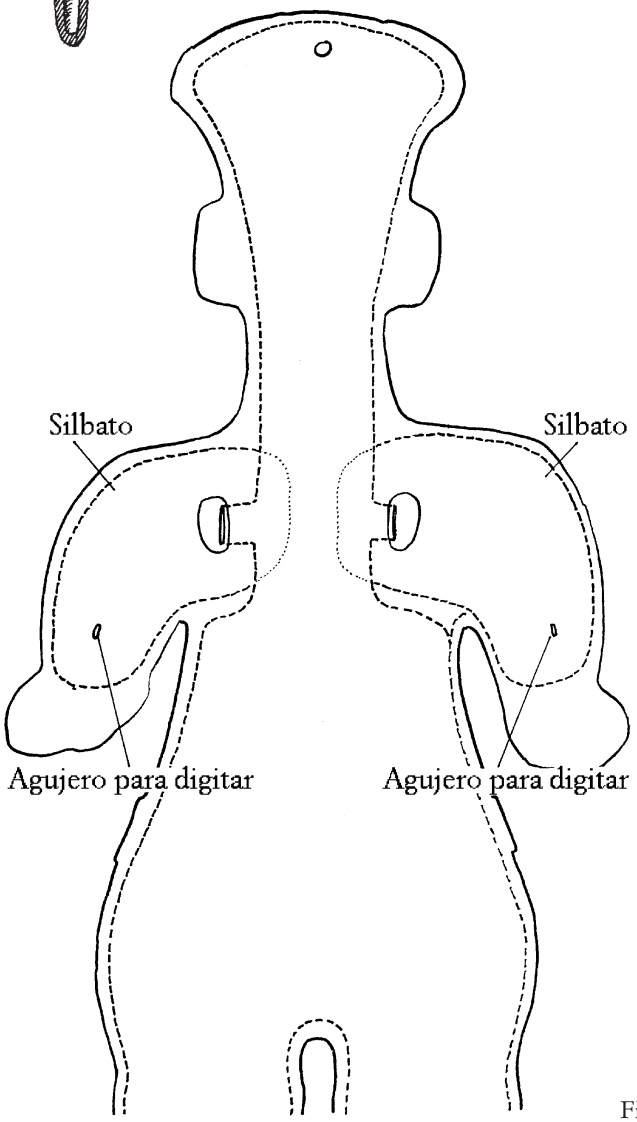


Fig. 17 Double flute, Jama Coaque, 500 B.C.–500 A.D.

Fig. 18 Paired Playing. Nazca (200-600 B. C.). Painted on pottery, shows two men playing ceramic antaras. Dispersed evidence such as this tells us al lot about traditional manners of making music compared to current ways. From Bolaños 1988.