74-19,488

TEKINER, Roselle Martin, 1921-
THE PANPIPE AS INDICATOR OF CULTURE CONTACT: A TEST OF TOLSTOY'S METHOD IN LONG RANGE COMPARISON.

The City University of New York, Ph.D., 1974
Anthropology

University Microfilms, A XEROX Company, Ann Arbor, Michigan

THE PANPIPE AS INDICATOR OF CULTURE CONTACT: A TEST OF TOLSTOY'S METHOD IN LONG RANGE COMPARISON

by

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A dissertation submitted to the Graduate Faculty in Anthropology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1974

This manuscript has been read and accepted for the Graduate Faculty in Anthropology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

THE PANPIPE AS INDICATOR OF CULTURE CULTURE CONTACT:
A TEST OF TOLSTOY'S METHOD IN LONG RANGE COMPARISON

by

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Adviser: Professor Paul Tolstoy

Trait similarities that occur both in Old World and in native American cultures have been cited as evidence of prehistoric trans-Pacific contact. Some of these are features of the panpipe, a simple wind instrument played today by natives of South America and Melanesia, which was present in China and in the Andean area during the third century B.C.

A survey of panpipes was undertaken, based on museum collections and published information, from which a worldwide inventory of panpipe traits was compiled. Panpipe types of South America and the Pacific Islands are defined on the basis of similarities and dissimilarities in trait content. The Andean and Melanesian types resemble each other in musical features to a greater extent than any two other types. Parallels between them were analyzed according to Tolstoy's method of evaluating the probability of diffusion of cultural parallels between distantly separated areas (Tolstoy 1966, 1972).

An application of the recommended procedures did not result in a successful demonstration of the probability of

a relationship between panpipes of the Andean area and Melanesia. The results are not taken to indicate the lack of a relationship, but rather of the unsuitability of available panpipe data to test the method. Asiatic panpipe data were inadequate to evaluate trait similarities, known to exist between Asiatic and New World panpipes, by comparing the total constituent elements of appropriate regional groups. Data outside the circum-Pacific area were inadequate to learn whether the known parallels, or any others, also occur outside areas of postulated diffusion. Furthermore, there were problems in defining the "logical structure" of the panpipe, a procedure that is basic to Tolstoy's method.

A demonstration of the likelihood of a relationship between panpipes of the Pacific and of South America was made by separate comparisons of the traits that determine musical characteristics and those that do not. Similarity coefficients were derived for each of all possible pairs of types and sub-types and they were arranged in a linear order of similarity from which clusters of types were constructed. A relationship between types and sub-types that cluster strongly together on the basis of musical traits is supported by distribution patterns and also by shared morphological features that are rare or non-existent elsewhere. This is true within South America, within the Pacific and also between these two areas. However, a relationship between groups that cluster strongly together on the basis of morphological traits that are unrelated to the music making of the instrument is not supported by other evidence.

The results suggest that musical traits are the more reliable indicators of cultural affiliations. Inasmuch as evidence of musical features is present in a wider range of culture than is represented by the panpipe further research into its diffusion needs to go beyond information that can be derived from the instrument alone.

ACKNOWLEDGEMENTS

Research for my dissertation was done at twenty three museums in the United States and Europe in 1971. There were so many persons involved in one way or another that I cannot mention all to whom I owe thanks for providing me with materials, information and other assistance I required. I am particularly grateful to Dr. Gerhard Baer and Fred Imhof of the Museum für Völkerkunde, Basel, to Dr. Günther Hartmann, of the Museum für Völkerkunde, Berlin, and Mme. Dournon-Taurelle of the Musee de l'Homme, Paris. Because of the large size of the panpipe collections I spent more time at these museums than at others. Every effort was made to furnish me with all of the many specimens in the collections.

Dr. Alan Sawyer of Washington, D.C. generously allowed me to inspect his private collection of panpipes, figurines and photographs. I profited from his knowledge of variations in Peruvian art styles and added a piece of new information to the history of panpipes in the New World. A double row clay panpipe in his collection is the only prehistoric example of a panpipe that is otherwise known only from recent panpipes of the Central Andean highlands.

Dr. Junius Bird of the American Museum of Natural History, New York City gave me access to the collection of Nazca and Paracas panpipes stored in his department. Dr. Gerard van Wengen of the Rijksmuseum, Leiden helped me survey the Dutch literature to ascertain panpipe distribution in Indonesia. The introductions of Dr. Annemarie Malefijt of

Hunter College in New York City to museum directors in the Netherlands saved me much time and trouble in obtaining the information I sought. Correspondence with Dr. Karl Izikowitz of the University of Göteborg, helped direct me to collections of European panpipes. Dr. Wolfgang Marschall of the University of Tübingen provided me with useful reference material. Dr. Dieter Christenson of the Museum für Völkerkunde in Berlin and Dr. Ernst Heins of the Tropenmuseum in Amsterdam gave me useful ethnomusicological information to help orient my analysis of panpipe scales.

I am especially indebted to Dr. William Siler of the Department of Biomathematics of the University of Alabama. His assistance went far beyond his expert direction of the organization and analysis of the data. His insights into many problems other than statistical ones, and his continued enthusiasm for the project were invaluable in guiding me to its completion.

Dr. Paul Tolstoy, Dr. Mervyn Meggitt and Dr. Judith Treistman of the City University of New York and Dr. Phyllis Cahn of Long Island University made helpful substantive and editorial comments. Sami Tekiner and Deniz Tekiner contributed their technical and artistic skills. To all I have mentioned by name, and many others who patiently listened and contribued to the pros and cons of panpipe diffusion, I express my appreciation and sincere thanks.

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INTRODUCTION

The origin of the American Indian and his culture has been a topic of speculation and controversy since the New World was discovered. Over the centuries, numerous attempts have been made to explain the presence of a strange group of people in a distant and apparently inaccessible land. A rich folklore of New World origins has resulted, containing stories of mythical migrations, vanished continents and sub-human races.[1]

For a long time, fantasy substituted for knowledge in the formulation of most origin theories. It was not known that a land bridge once connected the Old and New Worlds and it was apparently incomprehensible to early theorists that the ancestors of the American Indians possessed the necessary skills to cross the oceans. According to religious dogma, the ancestral home of native Americans was the Garden of Eden if, indeed, they were human. One way out of the dilemma was to disclaim their biological relationship with the rest of mankind. This suggestion was seriously proposed and justified by attributing to the natives of the New World characteristics too loathesome to allow membership in the human race (Morton 1844).

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[1] See Wauchope, 1962 for an account of metaphysical speculations about Indian origins.

Some suggestions and observations that were made proved surprisingly accurate, considering limitations of scientific knowledge at the time. As early as the sixteenth century Acosta predicted the discovery of a land bridge uniting the New and Old Worlds. Brerewood, in the seventeenth century, suggested that the New World was once connected with Asia, as evidenced by the physical resemblance of American Indians to Asiatics.[1] Such sensible suggestions of these early scholars, however, failed to influence some later theories of Indian origins. As recently as the mid-nineteenth century, statements were published about the lack of similarity between Indians and the other races of man (Nott and Gliddon 1854). At that time, Humboldt was almost alone in suggesting an Asiatic origin for native Americans (Humboldt 1816:v.1,368).

When it was learned that a prehistoric land bridge once connected Asia with the Americas, it became unnecessary to concoct imaginary access routes. Today no one seriously questions that man first entered America when lower sea levels exposed a land bridge of more than a thousand miles width across the Bering Straits. It is also generally accepted that man may have begun his eastward migrations twenty thousand years ago, but resistance to the idea of so great an age for man in the New World was slow to break down. Scientists, as well as people who were influenced mainly by religious teachings, retarded research into the antiquity of man in America. An outspoken

[1]The most comprehensive account of the status of scholarly thought on the subject of Indian relationships to the latter part of the 19th century is contained in volumes 1 and 5 of Bancroft, 1875-76.

authority on the subject was the leading American physical anthropologists of the early part of this century, Alex Hrdlicka. He long insisted on an age of no more than three to four thousand years for man in America, arguing that older skeletal remains should exhibit easily recognized paleanthropic features, which none of the American discoveries did (Hrdlicka 1932). His assertion was later proved wrong, but for a long time it discouraged other anthropologists from seriously investigating those American skeletal remains which were found in circumstances that suggested they were more than a few thousand years old.

In the mid-twentieth century there was another kind of resistance to investigations of the possibility of outside influences in native American cultures. When Europeans arrived on the scene, they found a variety of cultures, which ranged from simple adaptations to the natural environment to civilizations rivaling in some respects those of the Old World. There is evidence suggesting that some aspects of the New World cultures may not have developed entirely from the Upper Paleolithic cultural equipment that was carried by early migrants from Asia during the Pleistocene. Many cultural traits in America have parallels in Asia or the Pacific Islands. Some of these may have been imported to the New World across the Pacific Ocean. Nordenskiöld (1933:262-3), Dixon (1928) and Gladwin (1937:137-48) compiled impressive lists of such traits and all three considered the possibility that the parallels result from diffusion. However, they held the opinion that pre-Columbian men possessed neither the maritime equipment nor the skills required to cross the Pacific Ocean. Nordenskiold and Dixon therefore favored a theory of independent invention. Gladwin argued for diffusion, not across the Pacific Ocean, but along the route of the Bering Straits.

The question of possible outside influences in native American cultures has been argued by "diffusionists" and "anti-diffusionists", and extreme positions have sometimes been taken by spokesmen for both sides. For a number of reasons, the predominant tendency in American anthropology has been a resistance to hypotheses of diffusion. Some New World archaeologists have assumed the ethnocentric attitude that all achievements that have been discovered in the Americas are purely American inventions. Such an opinion gains credence from the widely held assumption that prehistoric transoceanic passage was impossible, except for perhaps a few accidental voyages. The relative popularity of the anti-diffusionist position may also be a reaction to the extravagant and irresponsible assertions which once characterized discussions of Indian origins and which are still sometimes made today. In addition, a hypothesis of independent invention has the appearance of being a less onerous one than diffusion. Because independent invention is not susceptible to demonstration, the burden of proof is passed to supporters of diffusion. Diffusion studies, however, are plagued with methodological problems that are not easily solved, particularly those that are based on the distribution of discontinuous traits. It is difficult, in methodological terms, to build a convincing case for prehistoric trans-Pacific contact.

Despite the factors which favor an anti-diffusionist position, a strictly isolationist view of New World cultural development has been losing ground. Two books have appeared recently which add considerable strength to an argument for early outside influences in the Americas. The papers presented in Man across the sea (Riley et al 1971), the outcome of a symposium on problems of pre-Columbian contact, show that the topic has attracted a good deal of scholarly attention. Diverse themes covered during the symposium included the theoretical issues and related methodological problems, as well as the evidence of botany, geography, navigation, material culture and mythology for trans-Atlantic as well as trans-Pacific contacts. In Transpazifische Kulturbeziehungen, Marschall applied the criteria of form, number, distribution and chronology to four cultural complexes that have been published as evidence of trans-Pacific diffusion: the blow gun, house models, wheeled animal figurines and techniques of weaving and dyeing. In each case, he concluded that the evidence favored a theory of diffusion rather than independent development (Marschall 1972:111-233). In addition, Tolstoy has gathered and analyzed an impressive amount of evidence which indicates an Asiatic origin of Mesoamerican paper-making technology and bark beaters (Tolstoy 1963,1966,1972).

These and other studies show that it can no longer be considered appropriate simply to appeal to independent development to account for Old World-New World parallels or to favor such an interpretation because it is more expedient to do so.

What is called for is specific and objective scrutiny of each parallel, and very many have been suggested since Tylor wrote about the probable Asiatic origin of the ancient Mexican game of patolli (1879). Most parallels that have been suggested are in the form of impressionist statements of similarities, which are vulnerable to attack. Only a few anthropologists have contributed to a solution of the methodological problems involved and there are no agreed upon standards to evaluate a hypothesis of diffusion.

Anthropological interest in the subject of prehistoric trans-Pacific contact has goals that are more far reaching that merely determining the skills of pre-Columbian navigators. A major problem in anthropology is whether the similar stages of cultural development through which man passed in different parts of the world were independent of each other. There could be at least one important consequence of a demonstration that alien influences might have been sufficient to alter the course of native American cultural development. The hypothesis of an independent attainment of civilization by man in the New World could be weakened, and a revision of some existing theories of the nature of the rise of civilization might be required.

In an attempt to add to the growing body of evidence bearing on the problem of Old World cultural influences in the New World, I examined the characteristics and distribution of the panpipe, one of the items of material culture that has been cited as evidence of prehistoric trans-Pacific contact.

The works of two German musicologists, Hornbostel and Sachs, are primarily responsible for statements that recur in the anthropological literature regarding the diffusion of the panpipe across the Pacific Ocean. However, the premises on which Hornbostel's and Sachs' conclusions are based are not usually pointed out. The value of some of Hornbostel's data is dependent upon his theory that the source of the musical scales in use in many indigenous cultures throughout the world is to be found in China (Hornbostel 1919). The value of Sachs' data depends upon his assumption that certain New World features of panpipe morphology derive from a philosophical concept unique to the Chinese (Sachs 1940). Neither premise has ever been verified, both are questionable, and data to test them are not very likely to appear.

The data that were collected in the worldwide survey of the panpipe presented herein are analyzed according to the methodology for long range comparisons devised by Tolstoy (1963, 1966, 1972). The study has several objectives. The geographical and chronological distribution of individual panpipe traits is plotted in order to define regional panpipe groups. In an attempt to distinguish panpipe groups that are historically related, they are analyzed for similarities in trait content. The procedures are expected to provide a basis for an application of the method Tolstoy used to demonstrate successfully a historical relationship between the bark cloth industries of southeast Asia and Mesoamerica. The results bear on the extent to which his methodology is able to evaluate the probability of a relationship between Old World and New World panpipes.

CHAPTER I

Problems and Background of the Study

Definition of a panpipe

The panpipe is a musical wind instrument whose sounding elements are hollow cylindrical tubes that are closed at one end. Like other simple instruments in the woodwind class, such as the flute, sound is generated by air that is blown into the tube opening. Unlike a flute, which is made of a single tube with lateral holes that can be opened or closed to vary the tones, a panpipe has a number of tubes. Each one is capable of producing only a single tone when the air in the tube vibrates, for there are no stops by means of which the length of the air column can be changed. The pitch of each tube is thus dependent upon its internal length and diameter. Usually the tubes are fastened together in a single row in order of progressively increasing lengths. This results in a panpipe that produces a series of progressively decreasing pitches, for the longer the tube, the lower the note it is capable of sounding.

The usual way of playing a panpipe is to hold it vertically in front of the mouth and to blow across the proximal opening, directing the air stream so that it strikes the opposite inner edge. If, instead, the instrument is held obliquely against the mouth so that the air is directed diagonally into the tube, the tone will be lowered. This effect is due to a slight lengthening of the sound wave because of the increased angle at which the air stream strikes the inner surface of the tube.

A panpipe is simple to make. Most are composed of hollow grasses, the toughest of which is bamboo. A number of stalks are cut through the growth nodes, which provide the distal stops for the pipes. Tuning each tube to the desired pitch is done by trimming the open ends, after which the tubes are fastened together. The musical quality of a panpipe cannot be judged from external appearances. Some crudely fashioned panpipes are carefully tuned to a musical standard apparently common to a group of people. Other panpipe groups exhibit high standards of craftmanship in the way they are cut, trimmed and fastened, whereas an ideal musical pattern appears not to have been a primary objective.

Panpipes do not serve exclusively as instruments for music making. Their use as a love charm and for purposes of herding animals has been reported for several societies and, like whistles, they are sometimes used for signaling and communication (Bell 1937:412; Snethlage 1921:412; Simpson 1954: 171). These uses may co-occur with the primary purpose of furnishing music for ceremonies or for secular entertainment (Wiener 1880:625).

Both Chinese and Greek mythology claim the invention of the panpipe. According to Greek mythology, the panpipe originated from a misadventure of Pan, the ugly shepherd god with the horns and hooves of a goat. During his amorous pursuit of the reluctant nymph, Syrinx, her prayer for escape was answered by the gods who transformed her into a bundle of river reeds. As Pan reached out for her, he grasped only the reeds which the wind blew upon to sound a plaintive love call. Pan is often portrayed in Greek and Roman art with his pipes, which were given the name "syrinx". They are arranged in a row according to increasing length so that the instrument has an even horizontal upper end and a stepped lower end. Most panpipes throughout the world are of this shape. It is not necessary for proper musical performance, however, for the notes of the scale to follow in spatial sequence and some panpipes are arranged in a different manner.

Legend states that the first panpipe was made of twelve bamboo pitch pipes by order of the legendary emperor of China, Shun. Every second note of the pitch series was believed to represent a note of the female bird, the alternate notes representing those of the male bird. In accordance with the Chinese belief that inharmonious elements be separated in order to achieve a balance of the universe, alternate notes were placed on opposite sides of the instrument. The long pipes were located on the extreme ends with progressively shorter ones toward the middle, creating an instrument that is shaped somewhat like a pair of wings.

Historic panpipes of the western world have a single row of tubes of graduated lengths of the kind usually associated with Pan. Some Chinese panpipes are also of this type, but wing-shaped panpipes have been common since Han times and persisted in the musical culture into the Ch'ing dynasty. Except for Rumania, native South American and Melanesia, the panpipe has almost disappeared from the inventory of musical instruments in both the eastern and western worlds during the last century.

There are instruments referred to in the literature as panpipes which look like panpipes except that the tubes are not stopped at the distal ends. The so-called "bundle panpipes" of Melanesia are of this kind and some are played in a quite different manner than described for panpipes with closed tubes. Instead of systematically directing his breath stream across the opening of each tube he wishes to sound, the player passes the pipes slowly back and forth in a random fashion in front of his mouth while blowing directly into the tubes. The resulting sounds are reportedly so faint that they can scarcely be heard by anyone but the player himself (Durrad 1940:199). It is reported that the Tinguian of northern Luzon in the Phillipines also blow open tubes in this fashion. However, unlike bundle panpipes, they are fastened together in a row (Cole 1922:441). If the piper places a finger over the distal opening when sounding a tube, a practice which is apparent in pictures I have seen of Melanesian panpipers, the instrument would be played and sound like a conventional panpipe. I have included such instruments in my study.

Musicological problem in the study of panpipes

The origin and development of musical scales were topics of intellectual interest during the late nineteenth and early twentieth centuries. Wallaschek, in his now classic study of primitive music, attributed the development of scales to practical aspects of manufacturing and playing musical instruments rather than to musical theory (1893:158). Wead elaborated the same premise, i.e. that instruments came first and scales later developed from attempts to make music on them. In his examinations of simple musical instruments from various parts of the world, he found that the principle often applied in their manufacture was that of equal proportions in the lengths of strings and tubes and the location of holes at equal distances. He pointed out how practices unrelated to musical theory can influence the construction of simple musical instruments. Practical limitations, such as the five fingers of the human hand and the extent of the span of each are a primary consideration in the number and placement of the features of a musical instrument which must be manipulated to produce variable tones. The limited range of human variation in anatomical dimensions thus restricts variation in such features as the locations of the holes of a flute, which in turn restricts variation in the interval relationships of the tones that are produced. He hypothesized that such practices result in the independent development of similar musical scales (Wead 1902:417, 437).

Ellis, a mathematician, studied a number of non-western musical scales and found that it was not possible to describe them by means of the familiar notation used in western music. He therefore devised an arithmetic system which divides the octave into twelve equal intervals of one hundred cents each, a method which is used today to describe non-western musical scales. He reported that all of the scales in his study divided the octave into approximately equal intervals. The intervals were not of an exact equal distance on the instruments tested, but they were within a range which Ellis believed represented an attempt by the makers to produce scales of equal intervals (Ellis et al 1885).

Hornbostel also approached the problem of the origin of musical scales through comparative studies of the music and the musical instruments of people at a simple level of cultural development. He used cents units to record the scales and confirmed Ellis' discovery of a propensity toward those of equal intervals in so-called "primitive" music. He reported that the panpipes from the Solomon Islands and those from the western Amazon both had scales of approximately equal intervals. Reasoning that it is highly unlikely for two distantly separated people to have independently arrived at similar results in their attempts to make music, Hornbostel postulated that a relationship existed between them (1912).

Ellis' and Hornbostel's results stimulated further comparative musical research of a similar kind, much of which was said to show a widespread distribution of equitonal scales.

(Bose 1934; Ellis et al 1922; Kunst 1925:29; 1936:57; Lachmann 1929; Rosenberg 1938; Schneider 1937; Schünemann 1936). Hornbostel attempted to find an explanation for the similarities, particularly through the formulation of his "Blasquintenzirkeltheorie", which has been translated as the "theory of the cycle of blown fifths" (1919:27, 28). In it, he postulated that a system of tuning panpipes by overblowing them was the way in which equal interval scales had originally developed and that they later diffused widely from a source which he suggested was China.

The first major criticism of Hornbostel's research was made by Bukofzer, a physicist, who found that the results of his own tests of the pitch of the musical instruments of the Solomon Islanders did not agree with Hornbostel's. He used an electrical tone generator to determine the vibration frequencies, whereas Hornbostel relied on his own blowing of the pipes. Bukofzer attributed some of Hornbostel's errors to a faulty method of blowing (1936, 1937).

Schlesinger, a musicologist, discussed Hornbostel's work in meticulous detail, pointing out a number of errors and false assumptions which caused her to reject unequivocally his theory that overblown panpipes were the source of the scales that he and other investigators had found in widespread use (Schlesinger 1939:320-342). There is no longer serious consideration of Hornbostel's theory of the cycle of blown fifths (Lloyd 1946a, 1946b). Kunst, a Dutch musicologist who had conducted research into relationships between African and Indonesian music, was one of its last adherents but he, too, eventually expressed doubt of its validity (Kunst 1948).

Of the many criticisms of Hornbostel's theory one, in particular, is significant for evaluation of his hypothesis of a relationship between Melanesian and Brazilian panpipes. Schlesinger pointed out that the scales on which Hornbostel based his hypothesis of culture contact are not actually scales of equal intervals but that the intervals increase proportionally in size as pitch values decrease. She arrived at this conclusion by examining the vibration frequencies Hornbostel had reported for his Brazilian pipes (332-3). She hypothesized that Ellis made the original mistake in attributing his scales to those of equal intervals by allowing too great a margin of error for intervals he described as equal. She believed that in doing so he was influenced by an Aristotelian statement to the effect that Greek musical scales were based on a principle of number and equal measure. According to Schlesinger, however, this is not a reference to equal acoustic intervals but to proportional lengths of the sounding elements of musical instruments. She believes that Hornbostel and later researchers repeated Ellis' error. Expecting also to discover equitonal scales, they attributed deviations from equality in the interval relationships to an inability of the instrument makers to achieve exactly the results intended (Schlesinger 1939).

Only a few of the scales said to support a hypothesis of culture contact were later re-examined. Even the data on the panpipes Hornbostel presented as evidence of contact between the Solomon Islands and the western Amazon could not be properly evaluated because Hornbostel reported only the vibration frequencies resulting from his own blowing of the pipes. It is not always possible to make positive distinctions between panpipes that are constructed on the theory of equal acoustic intervals and panpipes whose construction is based on a rule of equal length proportions between adjacent tubes. If a panpipe is built on the metric principle, its scale will have approximately equal intervals in the medium frequency range. In the higher frequencies, however, acoustic intervals are greater when length distances between adjacent tubes remain proportional and in the lower frequencies the acoustic intervals become smaller. However, when length distances between adjacent tubes remain proportional throughout the entire range, the acoustic intervals are greater in the higher and lesser in the lower frequency range. It is clearly demonstrable that a visual rather than an acoustic standard was applied on when a panpipe covers a wide range.[1]

It is certainly possible thatsome of the scales indeed were intended to be equitonal and that, if there were deviations from the ideal pattern, they actually were the result of makers' errors. Musicologists say, however, that this makes little difference as concerns theories of diffusion. When

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[1]A description of the method I used to determine whether panpipes were constructed according to equal length or equal acoustic distances is given on pages 46-49.

earlier musicologists hailed the discovery of scale similarities in distantly separated musical instruments as a basis for tracing historical relationship they assumed that an equitonal system was too complex to have been arrived at independently by the unsophisticated musicians among whom the similar scales were found. At the present time, it is generally agreed that a scale of equal intervals is a simple one. There are a number of reasons they can arise independently, including the possibility that scales of equal intervals may have sometimes developed from attempts of musicians to make music on panpipes that were constructed according to equal length proportions. Therefore, both instruments of equal length proportions and those based on a theory of equal acoustic intervals are considered by musicologists to be irrelevant in discussions of culture contact (Heins 1966; Roberts 1932; Tracey 1961).

Anthropological problems in the study of panpipes

The hypothesis of trans-Pacific panpipe diffusion is based solely on observations and opinions of musicologists. In addition to the musical evidence they once offered and later rejected, musicologists have also suggested Old World-New World morphological parallels as evidence of panpipe diffusion. Horbostel pointed out that the tubes of some panpipes of the Solomon Islands and of the Andean area were arranged in two rows instead of the usual one (1909:385) and that the panpipes in both the New and Old Worlds frequently combine a stick and a string to fasten the peipes together (1911:612). Sachs called attention to the fact that, instead of following in the usual manner in order of increasing pitch, an alternation of notes between two sides of the panpipe occurs in China, Burma and the Andean area (1940:178). An additional similarity is the separation of the panpipe into two parts which are connected by a loose cord (Sachs 1940:198). Sachs observed such panpipes being played by the Karen of Burma (Sachs 1917: figs 46-7) and the Indians of Panama play them today. That they were also played by the Inca is demonstrated by a representation on a vase. Two men are depicted, each holding panpipe which is connected to the other by a cord (MVBe VA 4676).

Judging by comments in the anthropological literature the similarities suggested by musicologists are widely construed to constitute acceptable evidence of prehistoric diffusion. Steward and Faron, for example, in defense of trans-Pacific diffusion, state the Hornbostel showed the scales of certain panpipes from Oceania and South America to be identical and that panpipes were played in joined complementary pairs in southeast Asia and in South America (1959:42). McGowan and Hester support their assertion of trans-Pacific contact with the evidence of similar scales in the Solomon Islands and western Brazil and occurrences of double row panpipes in Burma, the Solomon Islands, Panama and the Andean highlands (1962:235).[1] Estrada and Meggers base a statement of prehistoric trans-Pacific contact on "symmetrically graduated" tube arrangements of panpipes found on both sides of

[1]In fact, double row panpipes exist only in the Solomon Islands and the Andean highlands, not in Panama or in Burma.

the Pacific Ocean (1961:919-20).[1] There has been no anthropological evaluation of the material culture evidence, thus it has never been questioned whether the morphological parallels constitute any better evidence of diffusion than the musical parallels.

Anthropologists have long been concerned with problems of diffusion. Tylor was one of the first to address himself to the problem of determining whether cultural parallels resulted from natural causes or from contact (1865:5). He advocated that, for purposes of analysis, the phenomena under comparison should be broken down into constituent elements having no connection with each other. He reasoned that the more numerous were the independent elements making up a trait, the less likely it was that their recombination would recur (1896:66). Using this method to compare the Indian game of pachisi with the Mexican game of patolli, he concluded that there was a historical relationship between them, for recurrence was "far outside any probability on which reasonable men could count" (Tylor 1896:66). The concepts of Tylor were elaborated and designated by Graebner as the criteria of form and number (Graebner 1911:98, 108) and by Schmidt as the criteria of quality and quantity (Schmidt 1937:136). The criterion of form specifies that traits used to support a historical relationship should not arise from the nature of

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[1] India is stated as one of the areas where panpipes occur but they have, in fact, never been reported there. The reference cited in Marcel-Dubois 1937:38, Pl XIV-4 is a picture of musicians playing instruments connected with a cord, but they are not identifiable as panpipes.

the material nor should they be essential to the function of the trait. The criterion of number states that the more numerous the parallels are, the more likely it is that a historical relationship exists between the cultures within which they are found.

These criteria retain their validity today and whether they are specifically stated or not constitute the theoretical foundation for any diffusion study. However, problems arise in attempting to apply them, for there are no agreed upon standards regarding the amount of similarity required to constitute proof of diffusion, nor the weight to be given to particular parallels as evidence of diffusion. We cannot always recognize the function of a trait. If it is based on unknown metaphysical concept, for example, function cannot be discerned from the morphological properties of the artifact. We cannot always be certain whether a trait arose from the material used, although in many cases this is obvious. Neither is it always a simple matter to determine whether the constituent elements of a trait are truly independent of each other, for they may be linked in a way that is not readily detectable. Thus, after counting similarities between two items we must often, like Tylor, appeal to reason that independent invention is improbable, for a dividing line has not been established between the degree of similarity that constitutes probability or improbability that a trait diffused.

Tolstoy's Methodology

Tolstoy has developed a methodology which he believes can test more objectively the probability of a set of parallels having arisen by diffusion or independent invention (1963, 1966). He followed several procedures in order to demonstrate the likelihood of a historical relationship between Mesoamerican and Southeast Asian bark cloth industries. These procedures, their aims and their results are described by Tolstoy as follows:

> "In an effort to go somewhat beyond impressionistic assessments, the evidence has been subjected to several kinds of examination. The parallels themselves have been itemized by being broken down into minimal discrete units or traits. Such a breakdown provides a crude arithmetic measure of the similarities between the two technologies under comparison but its main purpose is to make possible other operations. The latter have included the use of world-wide information on bark-cloth manufacture to examine the mutual interdependence of some of these traits, viewed as steps in an overall manufacturing process aimed at a specific result. The alternatives available at each of the steps have been inventoried to provide a possible theoretical basis for estimating whether the parallels observed are, in a probabilistic sense, expectable. Other searches of the world ethnographic picture have aimed at: (a) determining whether the discovered parallels are, in fact, rare or frequent the world over; (b) determining whether known instances of diffusion and differentiation among bark-cloth industries have produced degrees of similarity comparable to those observed between Mesoamerica and parts of Southeast Asia; and (c) establishing whether distributions in space, time, and context are compatible (where known) with the hypothesis of trans-oceanic diffusions between Southeast Asia and Mexico. Of these three concerns, the last two imply, of course, an attempted reconstruction of the history of bark-cloth technology wherever it occurs, and an examination of the world evidence not merely in cross-cultural but also in historical perspective. Immediate results include the classification and mapping of industry types within all major areas of bark-cloth use."
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> * * *
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> "I feel the true significance of the parallels between bark-cloth technologies in Mesoamerica and Southeast Asia emerges in the light of the following tests or criteria:
>
> 1. Number: They form the vast majority of all descriptive features of the Mesoamerican complex (92 out of 119).

2. Distribution: They cluster (88 out of 92) in Southeast Asia in a specific group of closely related industries, apparently of suitable age. They are inadequately represented in Central and South America (34, of which only 9 are common).
3. Exhaustiveness: They include almost all (except for 4) of the features found in Mesoamerica that also occur anywhere else outside of it.
4. Degree of similarity resulting: They make for greater likeness between the industries of Celebes and of Mesoamerica than between either group and any other. This means, in particular, that these two industry types are more similar to each other than the Celebean is to the contiguous, obviously related Javanese and Mainland industries, or to the tapa complex of Polynesia.
5. Local relationships: The parallels seem to appear gradually in Southeast Asia at one end of an extended developmental continuum. No such continuum is apparent in the New World, where the parallels that do occur outside of Mesoamerica are scattered, both geographically and as to context.
6. World infrequency: Most (67 out of 92) of the parallels are very rare traits in the world as a whole, some (31) being found nowhere but in the industries under comparison.
7. Non-essentialness: Many (44 out of 92) are optional, not required by any of the other steps in the procedure of which they are part or by the goal itself of making bark-cloth.
8. Plurality of alternatives: Even when essential, many of these traits are still but one of several known alternatives for solving a particular problem of bark-cloth manufacture.
9. Redundancy: A number (37 out of 92) are redundant, i.e. they co-occur with their alternatives, thus casting doubt on their competitive advantage or determination by function.
10. Convergence of evidence: Inherently, there is no reason that optional (test 7) or redundant (test 9) traits that also satisfy criteria of distribution (test 2) or local relationships (test 5) should be relatively frequent; or that, on the contrary, optional or redundant traits should be rare among the Mesoamerican/Southeast Asia parallels also shared with Central and South America; or that traits rare in the world as a whole (test 6) should be more frequent in the first group than in the second. The degree to which various of the criteria considered tend to be satisfied by the same traits is thus in itself significant, though it remains

> to be tested by appropriate statistical means. Yet it is apparent already that the degree of coincidence between the various lines of evidence strongly suggests in itself the need for some other explanation than chance, derivation from presently conceivable New World antecedents, or even functional imperatives." (Tolstoy 1972:833-6)

Tolstoy has suggested a wider applicability of his tests for dealing with problems of diffusion. Proposals have been made by Ekholm (1964), Estrada and Meggers (1961), Meggers, Evans and Estrada (1965), Heine-Geldern (1959a,b,c) and Kelley (1960). Tolstoy believes that the reasoning underlying these proposals are similar to those imbodied in the criteria he has listed as tests of diffusion (1972:838). One of the traits that has been suggested as evidence of trans-Pacific diffusion is the panpipe (Estrada and Meggers 1961:919-920). In this paper, the procedures as outlined by Tolstoy (above) are applied to the panpipe data that were accumulated in the course of my research. My main objective is to go beyond impressionistic assessments of diffusion. The results are expected to indicate whether a methodology, which convincingly demonstrated the trans-Pacific diffusion of bark cloth making, can be applied as successfully to panpipe making.

World distribution of the panpipe

The panpipe has a scattered distribution throughout a large part of the world. Many of the large spatial and temporal gaps are probably due to loss of the evidence, for most panpipes are merely a few stalks of fragile plant material. In many places we cannot expect to find prehistoric panpipes but graphic representations in art objects may have survived.

The reconstruction of a historic distribution pattern cannot be complete, because all traces of the panpipe's presence quickly disappear in many places shortly after the instrument falls into disuse. Our knowledge of the material culture of many native American and Pacific Islands populations before the impact of foreign influence depends on reports of early travelers and explorers. If the panpipe escaped their notice, its history is lost.

Only in the Andean area and in China is there some continuity in panpipe history from prehistoric times to the present. In the dry western coastal areas of South America, where much fragile material has been preserved, the panpipe record goes back to the third century B.C. The panpipe has as long a history in China--from Han times to the present, a history which is known from art objects and written records. In western Asia, Europe and northern Africa the panpipe is known mainly from art and literature of classic Greek culture. In the Pacific and throughout most of South America the panpipe is known only from the time of European discovery and in Africa from recent reports. Elsewhere, information is fragmentary.

There are five major panpipe areas in the world: 1) South and Middle America; 2) the Pacific; 3) East Asia; 4) West Asia and Europe; and 5) Africa. In this chapter a chronological and geographical distribution is presented for each area based on a compilation of all published information of panpipe distribution and distribution data that were obtained from panpipe collections and obscure sources. In the appendix are detailed descriptions of regional groups within those major areas for which adequate information is available. They are based on my own observations of museum specimens plus published descriptions of individual attributes that did not occur in the panpipes I observed.

A fairly complete compilation of regional panpipe traits could be obtained only for South America and some Pacific Islands. Each is based mainly on the ethnographic record, for, as has been pointed out, no prehistoric data exists for Melanesia. For South America, prehistoric data exist only for the Andean area. Descriptions of many attributes of East Asian panpipes are missing because no actual specimens are included in the survey. The main sources of information are Panpipes of Ancient China (Chuang 1963) and Die Musikinstrumente Birmas und Assams (Sachs 1917), which report only some of the attributes in my list of panpipe traits. Early West Asian and European panpipe attributes are known primarily from art objects particularly sculpture from which little else than outline shape can be discerned. A few archaeological specimens have been published but these, too, provide little information about specific attributes. A few recent European panpipes are also included in the survey. Recent African panpipe specimens come from scattered areas. They furnish information of all traits listed in Table 1, but there are insufficient specimens to furnish information on regional style.

Panpipe distribution in South and Middle America

Pottery figurines of panpipe players were excavated from Bahia I levels of the Regional Developmental Period in the province of Esmeraldas on the coast of Ecuador (D'Harcourt 1942). There are two radiocrabon dates for the early part of the Bahia sequence, 2200 and 2150 BP, both with a margin of error of 240 years (Estrada and Meggers 1961). About a thousand miles further south on the Peruvian coast, a number of reed panpipes attributed to the Early Horizon Period (900-200 B.C.) were excavated from prehistoric graves at Ocucaje and Ancon (MVBe VA44743-4, VA12138, VA45322-6). These Ecuadorian and Andean specimens are the earliest known panpipes in the New World.

By the Early Intermediate Period (200 B.C.-A.D. 600) the panpipe had diffused widely throughout the Andean area. A large number have been recovered from grave sites. Recuay, Mochica and Nazca pottery figurines show that it was played by the common folk. The panpipe was in widespread use throughout the Inca empire and its popularity has continued in the Central Andean highlands to the present time.

Historic distribution of the panpipe is widespread throughout South America (Izikowitz 1935:405-408; Nordenskiöld 1933, 1920-Table 14). It is a popular musical instrument among many Indian and Mestizo groups along the western South American coast from the Isthmus of Panama south through Colombia, Ecuador and Peru to central Chile. East of the Andes, panpipes are used by native tribes of Bolivia, Paraguay and northern Argentina. The known southern limit in Argentina is in the Calchaquí area of Santa Fe. There, the now extinct Calchaquí Indians, who lived on the eastern slopes of the Andes, are said to have used the panpipe (Ambrosetti 1899:160). Many tropical forest tribes throughout the Amazonian area play the panpipe, and it occurs also in the Guianas and in Venezuela. It has not been reported anywhere along the entire eastern coast of Brazil. As far as is known, the southernmost limit of the panpipe in the New World is in the area of the Toltén River in central Chile (lat. 38 degrees S.). It is no longer played there (Orrega Salas 1966:56), but natives in the area are said to recall panpipes made of cane (Amberga 1921).

The panpipe has not been reported among native Americans north of Panama during historic times, but its prehistoric presence in Middle and North America has been archaeologically established. A panpipe and the fragments of several others were excavated from the upper Tres Zapotes phase (250 to 750 A.D.) in Vera Cruz on the Gulf Coast of Mexico (Weiant 1943: 110, fig. 13; Drucker 1943:88). An undated prehistoric panpipe from western Mexico is in the National Museum of Anthropology and a panpipe figurine in the Museum of Guadalajara (Marti 1968:99-102).

Joined copper tubes that were presumably used as panpipes have been recovered from graves of the Hopewell culture (Willoughby 1922:50; Moorehead 1922:129, fig. 22). Hopewell is a widespread complex extending from the Gulf Coast to the Great Lakes but is best known from burial mounds in southern Ohio. The Ohio earthworks are estimated to have begun at approximately 100 B.C. and the last great construction was about A.D. 500 (Prufer 1964:90). One of the mounds from which tubes were recovered has three radiocarbon dates ranging from 335 B.C. to 1 B.C., the earlier date having a margin of error of 210 years (Griffin 1958:5-6). Three copper tubes of equal lengths, each containing a cane tube of the same length as its copper enclosure were found at a Hopewell site near Helena, Arkansas. The cane had been preserved by copper oxide. Two of the cane tubes have plugs in them which created air columns of differential lengths, in the manner of a panpipe (Ford 1963: 16-17). There are three radiocarbon dates for the mound in which the joined tubes were found, 140 B.C., A.D. 30 and A.D. 335, all with an estimated margin of error of 150 years (Ford 1963:46).

Joined copper tubes have also been found in Hopewellian sites in Illinois (Wray 1952:154). Another was found in a Florida site of St. Johns I period, a time when Hopewellian traits were introduced into the area (Griffin 1952:331, fig. 184-H). Griffin includes copper tubes among items he considers to be good time markers for the Hopewellian culture, to which he gives an antiquity of 2100 years in Ohio and 2300 years in Illinois by radiocarbon dating (Griffin 1952:369). Panpipes are not known in native North America outside of the Hopewell culture.[1]

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[1]Gladwin attributed panpipes to prehistoric California (Gladwin 1937). The excavator of the site had identified objects of bone as panpipes (Rogers 1929:416, pl.22, 74): they are not panpipes but Mataco whistles, which are named after an Indian tribe in the Gran Chaco. Distribution extends northward east of the Andes through Central America into North America. A group of these whistles, usually made of bone, are often combined. They then resemble a panpipe and, except for the lateral holes, may easily be misidentified as such.

Panpipe distribution in the Pacific Islands

The panpipe is a popular musical instrument throughout the Melanesian Island chain from the easternmost Island of Fiji westward to the Admiralty Islands. In New Guinea it is present east of the Sepik River and southward in the Islands of Torres Straits. It has not been reported west of the highlands of central New Guinea. In Polynesia, the panpipe is known only in Samoa and in Tonga. There is no evidence of it in the Pacific, north or south of Samoa and Tonga, nor is it known in Micronesia or in aboriginal Australia. In all of Indonesia, the panpipe has been reported only in the easternmost Islands of Flores and Timor and in the Sunda district of Java (Bastian 1886:fig. 4; Sachs 1923:145-6; Kunst 1927:1; 1936; 1942:fig. 152). The panpipe is unknown in any of the islands north of Java,[1] although the Tinguian of Luzon in the northern Phillipines play an instrument that is like a panpipe. (Schadenberg 1886:550; Cole 1922).

The distribution pattern furnishes little evidence to indicate direction of diffusion in the Pacific, and the lack of time depth makes it impossible to reconstruct a regional history for any of the islands. The data only suggest that the present distribution in Melanesia and adjacent areas predates the eighteenth century. Panpipes were present in Samoa

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[1]A Borneo musical instrument that has been called a panpipe is an oval hollow gourd into which reeds of various sizes are inserted. Each reed has two openings for tuning purposes. Kunst (1942) reported a panpipe in Central Borneo. The report stems from Breitenstein (1899:153) who referred to a "kind of panpipe".

and Tonga in the latter part of that century (Ellis 1842; Wilkes 1845; v.2, 142; Stair 1897:135); and it appears that they arrived there through Fiji, the eastern outpost of Melanesia, for the three islands form a triangle within which frequent inter-island communication and trade took place. Although the total absence of panpipes between western Polynesia and the American shores may be due to their disappearance, the lack of evidence weakens a case for westward diffusion.

The panpipes of Indonesia might be taken as an indication of eastward diffusion from Southeast Asia, except for two pieces of evidence that suggest they were late introductions into the area. A Dutch physician who sailed to the islands of eastern Indonesia in the mid nineteenth century tells of teaching some of the natives to make panpipes, which they eagerly learned to play (Vollmer 1863-5, p.162). Those that have been reported by Sachs and Kunst may possibly be related to these recent introductions from Europe.[1] Supporting a hypothesis that the panpipe is not an indigenous Indonesian instrument is its absence in New Guinea east of the Central Highlands. If the panpipe had been brought to Melanesia through Indonesia, we would expect to find some evidence of it in western New Guinea. However, panpipes are not found elsewhere than

[1]Reports of panpipes in New Zealand evidently refer to recent introductions also. Edge Partington illustrated a typical New Hebrides bamboo panpipe from the British Museum which was said to originate in New Zealand (1890, v.1, pl.386, fig.4). Wilkes (1845) states that the panpipe is unknown in New Zealand.

Indonesia in the Pacific west of New Guinea except for the pseudo-panpipes in the Phillipines.[1]

Panpipe distribution in East Asia

According to Chinese legend, the first panpipes were made of cut pieces of bamboo over 4200 years ago by the hero emperor, Shun, but this early date has no support from the archaeological record. Information about early Chinese panpipes comes from stone carvings, frescoes and historical sources. The earliest is from the Han dynasty (206 B.C. to A.D. 200). There are two representations of panpipes in stone carvings from this period. One is on a tomb in the Shiaotang Mountains of Shantung, which depicts four persons sitting in a coach, each of them playing a panpipe (Chuang 1963:pl.1). Another is on a tomb on Tienhui Mountain near Ch'engtu Szechuan (Chuang 1963:7,fig.2). Still another source of information is the book, San-li-tu, which shows two Han panpipes (Chuang 1963:8, figs. 3,4). As far as can be discerned from the photographs, simple reed panpipes are represented.

Chuang, in his history of Chinese panpipes, has described the many varieties in use from Han to recent times. According to the material he collected, the panpipe in China developed from simple unconnected tubes to a variety of forms. For each period there were different traditional styles of construction and decoration, many of which were elaborate. The story of

[1]On the island of Taliabu, east of Celebes, single bamboo pipes are blown, but the panpipe is unknown either there or in Celebes (Kaudern 1927:203).

panpipe beginnings from unconnected tubes to pitch pipes is derived from ancient legends. By Han times, three methods of arranging tubes are known to have been in use: 1) a row of graduated lengths; 2) a row of two series of graduated lengths with the shortest tubes in the enter; and 3) a row of graduated lengths followed by several longer tubes of equal length. Later, during the Northern Wei dynasty, Chuang reports that rectangular panpipes appeared, and still later, during the Ming dynasty, panpipes combining two symmetrically graduated rows with longest tubes in the center.

The earliest panpipes were fastened with string. Later, they were glued together, then a wooden frame encased the entire panpipe and, finally, a frame was made with openings into which the tubes were individually inserted.

Ancient Chinese writings and representations of people playing panpipes on frescoes and stone carvings show the panpipe to have been used in folk music, religious ceremonies and in court rituals, both as an orchestral instrument and for solo playing. According to Chuang, the panpipe is rarely used in China today (1963:75).

In Northeast Asia, the panpipe is known in the modern musical cultures of Japan and Korea and in southeast Asia in Thailand, Cambodia, Laos and Vietnam (Malm 1959; Piggott 1909; Courant 1912; Lee 1962:206; Chuang 1963:110-11). Similarities in the form of the instruments, the music played and the names by which they are designated indicate a relationship with each other and with recent panpipes of China. There is no evidence presently available to indicate the time when diffusion might have taken place between any of these areas. The panpipe is not used by modern Indian and Burmese musicians and the only tribal groups reported using it are the Karen and the Padaun of Burma (Sachs 1917:31, pl. 15, figs. 46-47). Karen panpipes are in two parts connected with a cord and the notes of the scale alternate between the two parts. Sachs saw this feature as indicating a relationship between Asiatic and American panpipes, for similar instruments are depicted in Inca art and are in use by modern Panamanian Indians (Sachs 1940:198).

Okladnikov has suggested that pieces of bone tubes discovered in eastern Siberia are panpipes (1950:397, fig. 126). If this is so, they represent the earliest evidence of the panpipe in the world. They are from the Kitoi period of the Neolithic, which is known from the contents of forty one graves in eight localities. Groups of bone tubes were found in three of these localities. The estimated time range for this period is the second half of the third millenium to the beginning of the second millenium. Others, however, have questioned Okladnikov's identification of the material as panpipes. The ends of the tubes are not stopped, which suggested to Michael that they might have been used for drinking water through the ice (1958:69-70). This suggestion is not convincing, because the tubes are not long enough to reach water through ice that is usually several feet thick. Marschall pointed out that there are no remains of a ligature, nor any indication that the tubes had been arranged in the form of a panpipe (1965:127). This is also not a convincing argument against the possibility of their use as panpipes. Ligatures and stops are perishable parts of a panpipe and it is not likely that they would be recovered. The main obstacle to identification of the tubes as panpipes is their spatial and temporal isolation from panpipes elsewhere in the world. Panpipes of Neolithic age are unknown and none has been positively identified for any period in the area between east Asia and the Russian Caucasus.

Panpipe distribution in Europe and western Asia

The following literary references and art objects suggest that the panpipe existed in Europe and western Asia earlier than the archaeologically established date for its presence in China and in Ecuador.

There are two references to the syrinx in Homer's Iliad where it is said to have been used by the Trojans (X 13:XVIII 526). The Iliad is believed to have been composed before the fifth century B.C.

Herodotus says of Alyattes, the father of Croesus and king of Lydia, who fought against the ancient city of Miletus on the Ionian Sea in Asia Minor, that he marched to the sound of the syrinx (Schlesinger 1910). The battle referred to took place in the sixth century B.C.

A bas-relief on a bronze urn in the municipal museum in Bologna, said to date to the fifth century B.C. portrays two men whose hats indicate they are princes. They sit facing each other, one with a panpipe and one with a lyre. Campana reports a bas-relief in the Volterra Museum in Italy depicting Ulysses' adventures with the Syrens, one of whom is playing a syrinx. In the same museum, on an alabaster funeral urn, musicians are portrayed playing a syrinx at a funeral procession (Campana 1909). Dates are not given for these last two art objects, but they serve to indicate that the panpipe in the Mediterranean area was used for purposes other than as a shepherd's instrument, as is usually suggested.

The earliest record of a panpipe in central Europe is from the Iron Age Hallstatt culture. On a bronze pail found in Austria a man is shown holding a five tube panpipe (Déchelette 1913:766). Toward the end of the Hallstatt culture, at about 500 B.C., Greek influences entered via the Danube, which may account for the presence of the panpipe in Europe at that time.

A fragment of a panpipe was discovered in a grave of the La Tène Period at Klein Kühnau in Dessau (Seelman 1907). La Tène is an art style dating to the last quarter of the fifth century B.C. in western Switzerland, and many of its elements are related to classic Greek motifs.

The possibility that the panpipe is a pre-Hellenic invention is suggested by its apparent representation on two Hittite stonestelae (Perrot and Chipiez 1887, figs. 281, 283). In both cases, the instrument depicted is of rectangular form, the external lengths of the pipes being equal. However, it is not known whether the instrument represented had internal stops at different heights in the manner of a panpipe. The rectangular syrinx is, however, one of several forms used by the ancient Greeks. In the museum of archaeology in Florence, one is represented on a statue of Calliope. If the Hittite instruments are true panpipes, then the tradition is earliest in

Anatolia. The main centers of Hittite power there were destroyed in the twelfth century B.C.

Little can be said about any of these early panpipes except their outline shape. The following are represented in various art objects: 1) simply graduated; 2) partially graduated; 3) rectangular; 4) quadrangular with a square cut out; 5) quadrangular with a triangle cut out.

Panpipes survived in several places in Europe into historical times. Traill tells of a panpipe called an "organetto" which was played in Italy and in Switzerland. He says that "from time immemorial" it has been used by inhabitants of the Alps and that panpipers who travel through Europe procure their instruments from Italian cantons in the vicinity of Lake Como (Traill 1853:127). At the end of the last century the panpipe was played in Italy by the Abruzzo shepherds in the Bergamasco district, in the Mugello district of Tuscany, in the Scarperia and by goat herders in the Pyrenees (Campana 1909). The panpipe was popular in England at the beginning of the nineteenth century when itinerant parties of musicians, terming themselves Pandeans, went about the country giving performances (Grove: 1961:v.6, 539). Panpipes are played by the peasants of Georgia in the Russian Caucasus (Steshenko-Kouftina 1936). They are doubly graduated, the notes of the scale alternating between the two sides of the instrument in such a way that the longest tubes are in the center and the shortest at the sides. It is a tube arrangement that is known otherwise only in China, Melanesia and South America. All panpipes known to have survived in Europe and western Asia to recent times are graduated according to progressive lengths.

Since the middle of the nineteenth century, the popularity of the panpipe in Europe has largely disappeared. Rumanian gypsies still play it today, and in the last several years there has been a minor revival of interest in it in Europe. Panpipes can be purchased in many music stores and several recordings of panpipe music have become popular.

Panpipe distribution in Africa

The panpipe is played in North and Central Africa. Those of North Africa apparently stem from the time of Greek-Roman influences. The earliest known are two that were discovered at the sites of Tebtynis and Batn Herit in the Fayum. They are rectangular in shape and, according to Hickman, date to the third century B.C. Hickman also reports that there are representations of panpipes on Greek statues of the same approximate date as the archaeological specimens. Hickman believes that panpipes may predate the third century B.C. in Egypt because there is a word for the instrument in the ancient hieroglyphics (Hickman 1955:218).

The distribution of the panpipe in Africa appears to be limited. Besides the Congo (Ankermann 1901), panpipes have been reliably reported from South Ethiopia (Jensen 1959:102, 232, 310, 358) and Uganda (Trowell 1953:34; Czekanowski 1911: 383; Lawrance 1957:157, fig. 1).

The Bushmen and Hottentots blow simple closed tubes that might be called panpipes, although they are not connected to each other. Each of a number of players blows one tube, chiming in with his tone at the proper time to produce a melody (Nettl 1956:99). The Pedi of South Africa blow a wind instrument, which in principle is like a panpipe. Porcupine quills of different lengths are bundled together and it is reported that the player sounds the notes at random, appearing to aim at no particular melody (Kirby 1937:101). According to Kirby, panpipes other than these are not found in South Africa.

CHAPTER II

Techniques Used in Cross Cultural Comparison of Panpipes

Tolstoy has suggested three operations which should precede an appraisal of parallels between distant cultures. The first is a precise definition of the aspect of culture under consideration (1966:71). The panpipe was defined in Chapter I. As I pointed out, there are instruments that have been called panpipes in the literature but that are not, strictly speaking, panpipes because the distal ends are not stopped. Inasmuch as such instruments, theoretically, can be played as panpipes by closing the openings with the fingers, they are included in the survey, although there are no reports that any have actually been used in this way. Flutes and whistles are not included, even though they are sometimes wrongly identified as panpipes, especially when several are combined.[1]

A definition of the panpipe should include a statement of its purpose which, for most panpipes, is to make music. There are others, however, that are said to be used as signaling devices or as toys. It may be difficult to distinguish panpipes whose function is to make music from those that may be used only for communication. If a panpipe has two, three or

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[1]A collection of South American Mataco whistles in the Museum für Völkerkunde, Berlin are identified as panpipes.

four irregularly spaced notes and the arrangement of the notes is not consistent within a panpipe population, it suggests that it is not a musical instrument. Such a judgment, however, reflects our own musical concepts, which do not necessarily apply to musical cultures everywhere. It is possible for such instruments to be combined in ways that conform to a group standard of tonal sequences. Unless we are familiar with the music and observe the methods of playing, it cannot be stated with certainty that the purpose of any particular panpipe is to make music.

The second and third operations suggested by Tolstoy are: a cross-cultural analysis of the segment of culture under consideration and a classification of local ethnographic and archaeological evidence pertaining to it (1966:71).

Data collection

I undertook a survey to gather information about the varieties of panpipes and their distribution throughout the world. The data collected are based on panpipes and art objects with representations of panpipes that were examined in museum and private collections, and supplemented by published descriptions, photographs and illustrations of archaeological and ethnographic panpipes.[1]

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[1]The following institutions in the United States and in Europe allowed me access to their collections: New York City: American Museum of Natural History, Heye Foundations, Museum of Primitive Art, Metropolitan Museum of Art; Chicago: Field Museum of Natural History; Washington, D.C.: Smithsonian Institution, Library of Congress; the Peabody Museums of Harvard and Yale University; San Diego, California Museum of Man; University of Indiana; Switzerland: Museum für Völkerkunde, Basel and Musée

Observations made of 919 panpipes were recorded on prepared mimeographed sheets to provide uniform descriptions of the following features: 1) material; 2) construction; 3) tube joining; 4) proximal openings; 5) tube closure; 6) sectioning of distal end; 7) tube tiering; 8) outline shape; 9) register of individual instruments; 10) spread of individual instruments; 11) mean register of collection; 12) spread of collection; 13) length pattern; 14) completeness of pattern; 15) decorations; 16) reported uses.[2]

For some specimens, information about specific attributes was either not applicable or not available. Descriptions of attributes I through N in my list of panpipe traits (Table 1) are based on measurements of internal depth of the tubes, which were obtainable only from actual panpipe specimens. Many of the attributes apply only to panpipes made of reed. For example, one piece instruments of clay, stone or wood, do not require the separate step of tube joining in the manufacturing process. Therefore, the panpipe manufacturer need not make decisions regarding materials and methods of fastening individual pipes together. Also, methods of sectioning the

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d'Ethnographie, Geneva; Germany: Museum für Völkerkunde, Berlin; Linden Museum, Stuttgart; Museum für Volkerkunde, Frankfurt; France: Musée de lhomme, Paris; Austria: Museum für Volkerkunde, Vienna; Netherlands: Rijksmuseum, Leiden; Gemeente Museum, the Hague; Tropenmuseum, Amsterdam. Dr. Alan Sawyer of Washington, D.C. also made his private collection available. The code used to identify each of the museums is given in the appendix preceding the list of museum specimens.

[2]These features and defined and discussed on pages 54 to 67.

stalks do not apply to instruments other than those made of reed. Pictures and descriptions do not yield the information necessary for the identification of all attributes, especially those relating to musical features. Prehistoric art objects provided valuable chronological data, for which there is a paucity in this study, but they permitted the indentification of few attributes. The best source of all information is the panpipes themselves, but for some important areas they could not be found. All sources were therefore helpful in filling in distribution gaps for some features because a number of attributes did not occur in the specimens actually observed. Some statements in the literature only mentioned the presence of the panpipe without furnishing details of construction. Such reports serve only to extend the known distribution of the panpipe. They do not provide the important information that is required to build evidence of the probability of historical relationship.

In addition to a catalogue number of the item, museum records usually included the provenience and the date the object was collected or acquired. If a date was not given, the museum catalogue number provided a clue to time of acquisition. Infrequently, the collector commented on manner of use. Provenience information varied in quality. Most panpipes were identified by country of origin, and frequently more specific geographical information was furnished. Linguistic designations were sometimes used or the tribal name by which a group was known. When place of origin of a panpipe was identified by a large geographic unit as Melanesia, Oceania, Brazil or South America, it was a less useful speciman than those more precisely indicated provenience.

Museums are intended as storehouses of authentic records of past and present cultures, but when items are mistakenly identified their potential value can be destroyed. It is necessary to be highly critical of catalogue information. An object acquired through a museum expedition is likely to have a correct identification of provenience, for this is usually a routine procedure with uniform labels applied to all items in the lot. However, when an object comes to a museum as a gift, exchange or purchase, the labeled information may not be as precise or the documentation as reliable. There were cases where a particular panpipe might have been a crucial piece of evidence but was rendered useless because of an inadequate description of its origin. Because a single specimen that provides new information can upset or complete a provisional reconstruction, I made every effort to find data to corroborate its presence at the time and place that was indicated. Unlike the field archaeologist, who may be able directly to evaluate a discovery, the investigator using museum specimens for purposes of reconstruction relies solely on records that cannot be directly verified. Fortunately, most museum curators now emphasize the importance of full documentation of each item, but this was not always so in the past. Without the aid of careful records, the value of any object in a study of material culture is limited, especially in a study of a diachronic nature. In particular, collections of a class of objects, such as musical instruments, may be of dubious value as evidence of culture contact or change. Artistic considerations often predominate, with historical and geographic identifications being of lesser concern. The varying quality of curatorial care that permanently affects a collection must be recognized if a study that relies on museum specimens is to be soundly based.

Organization of data

Tolstoy analyzed his world wide inventory of bark beater traits according to a logical structure which made it possible for him to "establish a pattern of relationship or blueprint for any given set of traits, situating each one of these as one of a finite number of obligatory, optional redundant and/or contingent alternatives, linked to one another by a series of interlocking decisions" (1966:73). Each trait was identified by a symbol which furnished information on the "logical relationship of the trait to the remainder of the industry of which it is a part" (1966:77). This list indicated the total number of alternatives to any set of parallels. Besides laying the basis of a statement of probabilities, logical structure describes the complexity of a set of resemblances (1966:73).

Following Tolstoy's example, I attempted an analysis of the structure of the panpipe complex to provide a numerical expression of the relative complexity of the trans-Pacific parallels that would later be evaluated as evidence of diffusion. The preparation of this list presented a number of difficulties unique to the panpipe and also points to problems that apply to the long range comparison of other musical instruments.

The initial task was to make a concrete statement of the purpose or goal of a panpipe, a necessary step in the formulation of the "series of interlocking decisions" responsible for its construction. Although the preliminary analysis of my tube measurements, which will be described, suggested that some panpipes might not have been used as musical instruments, it was decided that, for the purpose of structural analysis, the goal of a panpipe can be stated as the performance of music. Music making is a highly codified activity, of which an important element is preserved in the form of a series of measurable lengths.

The greatest difficulties were encountered in attempts to describe "scales" or pitch patterns as attribute states. In the case of non-musical features, such as joining methods and some tube arrangements, etc. all occurrences were listed as alternative attribute states, even those occurring but a single time. However, a pitch pattern cannot be regarded a significant contribution to a statement of the probability of diffusion unless it is established that the pattern represents the sequence of notes which is the basis for musical performance. Music making, as has been stated, is a highly codified activity and therefore each length pattern that has relevance for this study must represent a culturally standardized series of pitches which stand in definite interval relationships to each other.

The first task was to group the panpipes according to specific tribe or locality in order to organize samples to be tested for homogeneity in pitch series. A few such groups were made to order in that a number of panpipes in a collection carried identical date, tribe and collector. Other groups were assembled by selecting panpipes from the various collections with similar identifications of provenience.

It was next necessary to establish the pitch series exhibited by each panpipe group. An established method of doing so is to convert the measurements of internal length and diameter of each tube into the number of vibrations per second that results when the tube is sounded, using the appropriate formula. Then, following a table devised by Hornbostel to eliminate the arithmetic calculations, the differences between the pitches of each succeeding pipe in the graduated series is determined. Because of the large amount of data used in this study, a graphic method was devised to simplify the task. The results, although not as precise as those achieved by Hornbostel's method, are sufficiently accurate to indicate the homogeneity or lack of it in a panpipe population.[1] Measurements in millimeters of the lengths of the tubes of each panpipe of a particular tribe or geographic area were plotted on semi-logarithmic graph paper in order of progressively decreasing length, which represents progressively increasing pitch. The purpose of using semi-log paper is that it is designed to convert proportional distances into equal distances, making it possible to use the metric data directly without first converting them in-

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[1] I thank Dr. William Siler, Chairman, Department of Biomathematics, University of Alabama for his valuable assistance in suggesting this method of ordering my panpipe measurements and interpreting the results.

to pitch intervals. The vertical distances between the plotted points represent the pitch intervals between the pipes. If a line is drawn connecting the plotted points, its slope will indicate the number of intervals contained in one octave (fig. 5).

When a collection of panpipes is homogeneous in length pattern, the lines representing each panpipe will tend to have the same slope, i.e. the musical scale followed contains the same number of intervals in an octave. If the lines are not of the same slope, the panpipes do not adhere to a uniform musical standard. The possibility exists, then, that they were not made by the same group of people or that they represent more than one musical standard.

The use of semi-log paper that is transparent further simplifies comparison. By placing each of the papers with plotted panpipe populations over the others, the differences in slopes of the line patterns is easily noted. The relative popularity of particular lengths can also be seen, facilitating intra-group comparisons of preferred pitch series.

Further musical information can be derived directly from the graphs by following a simple procedure. A specific distance on semi-log paper represents one octave. If a measure is made which equals this distance, it can be used easily to check whether the octave is recognized in the pitch series of the particular panpipe. This is the case if the measure exactly spans the distance between any two plotted points. In addition, the number of intervals contained in an octave can be determined by counting the number of plotted points falling within the measure. The size of the distances demonstrates whether the intervals are of equal or of unequal lengths.

Ordering the metric data by this graphic method revealed two distinct patterns: 1) Some panpipe populations are represented by straight lines (fig. 5). A straight line on a logarithmic scale means that the pitch intervals between the pipes are approximately equal. If an appreciable number of the straight lines representing a culturally homogeneous group of panpipes have the same slope, it suggests that the panpipes were constructed according to a standard of equal pitch intervals. Some of the panpipes have the octave represented in the pitch series, while others do not. 2) Some panpipe populations are represented by lines with a smooth downward curvature (fig. 6). This may mean that the tubes were arranged according to increments of equal metric length. To check whether this is the case, tube lengths should be plotted on linear graph paper. A line connecting the plotted points will then be a straight one. The octave is rarely represented in the pitch series of these panpipes. Panpipe populations that follow such a pattern suggest that visual considerations predominated over musical ones in their manufacture. They were evidently constructed according to a rule of uniform length increments between adjacent tubes.

These graphs, however, will not clearly distinguish panpipes constructed according to equal pitch increments from those constructed according to equal metric increments unless the pitch series cover a wide frequency range. The reason is that, in the medium frequency range, equal metric proportions have approximately equivalent distances as equal pitch proportions. As the progression of tube lengths decreases, however, i.e. as pitch rises, the pitch intervals increase in size, although metric proportions remain uniform. For panpipes encompassing a narrow range, the distinction is not readily apparent.

The plotting of some panpipe populations resulted in a series of line segments of varying slope, indicating that the sequence of tones is based on intervals of various sizes. If these line segments followed a similar pattern, it would suggest that the panpipes were probably constructed according to a sophisticated musical standard. None of the panpipe populations plotted exhibited such homogeneity. In all cases, the pattern of line segments was a random one, suggesting three possibilities: 1) the panpipes originated from diverse populations; 2) several scales were in use by the particular population; or 3) the pattern is not made apparent by the method used, but may nonetheless be present.

Although the method described succeeded in identifying some homogeneous panpipe populations, it did not provide the list of alternative length patterns needed for the application of Tolstoy's criteria to all individual attributes and to the total body of evidence of the panpipe. In an attempt to formulate such a list, I reorganized the internal measurements of tube lengths as follows. Again, with the use of semi-logarithmic graph paper, I converted the measurements of the tubes of all panpipes in the survey to acoustic distances. The resulting pitch series of each panpipe was then recorded on individual index cards (fig. 7). Furthermore, a vertical line was drawn on each card at a point, arbitrarily chosen, of a 20 centimeter tube length, which represents a tone at the lower end of the medium frequency range. Each card thus furnished the following information: 1) the number of notes that could be sounded on the panpipe; 2) the approximate acoustic distances between the notes; 3) the pitch value of each note; 4) the distance in terms of the octave that each panpipe encompassed; 5) whether the divisions of the octave are equal or unequal; 6) whether the octave is represented by notes marking the beginning and the end of the octave; and 7) in cases where the panpipe spanned more than a single octave, whether the pattern exhibited in any octave is repeated in octaves of a different range.

Appropriate information was thus provided for the descriptions of the following attributes: 1) register of individual instrument as mean pipe length; 2) spread of individual instrument; 3) mean register of collection; 4) spread of collection; 5) pitch pattern; 6) representation of octave; and 7) completeness of pattern. Pitch pattern was substituted for musical scale because complete information to describe a scale, in the musical sense of the term, is lacking. In order to do so, it would be necessary to know the exact sizes of pitch intervals between adjacent notes. For reasons discussed on page 46 , I relied on tube measurements, rather than on methods of testing the sound directly, which is the usual musicological approach to determining the pitch series of an instrument. Furthermore, tube diameter, which exerts a small influence on pitch, was not included in the conversion of metric distances to acoustic distances. This omission, however, does not significantly affect relative distance proportions because tube diameter tends to decrease with decrease in tube lengths. Considering the large amount of data required for this study, the metric approach was the only practical way to obtain information needed to fully describe the panpipe complex. What I wanted to find out was not exact musical scale in vibration frequencies, but rather an approximate musical pattern of each panpipe and whether the pattern was in approximate agreement with that of other panpipes of the same population.[1] Because "pitch pattern" is a term I coined in order to distinguish it as an attribute from a conventional musical scale, it should be pointed out that the terms "acoustic distances" or "pitch interval" used in connection with "pitch pattern" are not intended to suggest the precise differences in vibration frequencies that these terms imply in musicological terminology. They differentiate between metric distances obtained directly from differences in tube length dimensions and distances that result from the plotting of length dimensions on semi-logarithmic graph paper.

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[1]The possibility of errors would not be eliminated even if tubes were blown to test pitch because we do not know whether we are repeating the method actually used by the piper. As was pointed out earlier, different methods of blowing a tube influence the sound that is generated.

Thirty-one pitch patterns in the world wide inventory of panpipe traits empirically established "the logical possibilities for variation and combination," which is basic to Tolstoy's methodology. However, unlike the number of other attributes which make up the "logical structure" of the panpipe complex, the number of length patterns cannot be taken to indicate the probability of the diffusion of any one of them. The reason is that we do not know whether each one actually represents a culturally standardized series of pitches or, in other words, the musical theory on which the melodies are based. In an attempt to determine which of the individual pitch patterns might represent a group norm, I used the cards with sketches of individual length patterns to make direct comparisons between individual panpipes within each population. In many panpipes encompassing more than a single octave, the pattern was not consistent throughout the entire span. Moreover, the pattern appearing in a certain range of one panpipe might appear in a different range of another. Because the cards could be shifted back and forth to find the best fit with each other, some correspondences in patterns were revealed that would otherwise not be apparent.

Very few of the 31 pitch patterns were shown by this method to represent a pattern that was adhered to by a culturally homogeneous group of panpipes. It became apparent that another solution had to be found for enumerating the possibilities for variation. The solution I chose is explained in Chapter IV, in which attributes shared by South America and Oceania are evaluated as evidence of diffusion.

Each trait in Tolstoy's bark beater trait list is coded to "furnish information on the logical relationship of the trait to the remainder of the industry of which it is a part." The symbols he used indicate, among other things, whether a particular attribute state is an obligatory, optional redundant and/or contingent alternative (1966:77). An attempt to designate panpipe traits in a similar manner presented some problems. It is difficult to state the manner in which some panpipe traits, particularly musical ones, are linked to others. It might be possible, if a total musical system were considered, to devise a method for determining whether features such as register, spread, or number of notes in the octave are obligatory or optional or contingent or redundant. When dealing with a single instrument, however, especially with one whose pitch series in many populations is based on rules unknown to us, the "series of interlocking decisions" which link the traits is too elusive to permit specification. The manner of coding the panpipe traits is therefore a modification of the method used for bark beater traits.

Each panpipe attribute is identified by a letter of the alphabet from A through P. Each of these attributes has two or more attribute states which are numbered in sequence. A number in parentheses indicates a state of the attribute to which the numbered attributes following it are related. The symbol "O" before a letter or number indicates that the trait is an optional one. (In the case of some morphological features, unlike musical ones, it is obvious whether a trait is obligatory or optional in panpipe manufacture.) The numbers in the left hand margin are my serial numbers.

In the following descriptions, the number in parentheses following each attribute is the serial number of the attribute state in my list of panpipe traits (Table 1).

A description of panpipe attributes used in analysis of panpipe groups.

The following descriptions refer to the list of panpipe traits on pages 68 to 71.

A. Material (traits 1-8)

A panpipe maker can choose from a number of materials to construct his instrument. Reed is by far the most popular choice, but panpipes of stone, clay, wood, glass, metal, bone and quills are included in the worldwide sample. Reed is a plant category which includes several genera of grasses with cylindrical stems that are hollow except at the joints or growth nodes. The stems vary in sturdiness and rigidity, ranging from the tough culms of plants in the bamboo subfamily, which may reach over ten meters in height, to relatively small and fragile grasses that grow along sandy beaches, such as those of the genus *Ammophila*, which grow no taller than ten to twenty centimeters. All of the hollow grasses are perennial, but those growing in temperate climates, such as the genus *Arundo*, lose their stems each winter. They are renewed annually and may attain heights of six meters and more during each growing season. The distribution of the hollow grasses covers most of the world, except for arctic regions. The most widely distributed genus is the common reed, *Phragmites*, with shiny stems, that grows in marshy areas of every continent.

The choice of clay, glass and metal is contingent upon knowledge of these materials. Many panpipes of clay, stone and silver have been recovered from prehistoric Andean graves, suggesting that they were perhaps made specifically as burial offerings rather than as instruments to be played. For example, some elaborately carved stone "panpipes" found in graves lack the openings that are required to sound a tune. Panpipes of reed apparently were the kind mainly used for prehistoric musical performances. This is suggested by their co-occurrence with panpipes of other materials and also by pottery panpiper figurines holding instruments of reed, which can often be identified as such because of the ties that are represented.

Panpipes of quills and bone are of rare occurrence although these materials are often used throughout the world to make other simple wind instruments, such as whistles and flutes. Archaeological bone panpipes are of uncertain occurrence because materials to hold the tubes together have not been found. Therefore it is problematical whether bone tubes that have been said to be panpipes were actually used as such. Panpipes of glass have only been reported for ancient China.

B. <u>Construction</u> (traits 9 and 10)

The construction of a panpipe is either one piece or composite. Panpipes of stone, clay, wood or metal are usually made of a single piece of material. Those of reed, bone or quills are composite instruments, for they are composed of as many pieces as there are tubes, plus the material used to fasten the tubes together.

There is a greater range of variation in the morphological attributes of composite panpipes than in those of one piece. Panpipes that are shaped from a single piece of material do not require ligatures, and the closure of the tubes is dictated by the nature of the material used. A variety of methods are used to join tubes of composite panpipes and there are several kinds of tube closures and proximal openings. Therefore, panpipes of composite construction have greater potential value in a comparative study of attributes. The composite panpipes surveyed in the present study, are almost exclusively made of reed.

C. Tube joining (traits 11-40)

All attributes related to tube joining are contingent upon construction and apply only to composite panpipes. There are five basic methods of joining tubes: 1) they may be encased in a sheath of clay, wood or metal; 2) they may be inserted into perforations in a wooden holder of slightly larger diameter than the tubes; 3) a cloth may be bound around the tubes; 4) an adhesive substance such as tar, wax or plant resin may be used; or 5) the tubes may be tied together with raw plant fibers, cord or, rarely, with strands of hair. Whatever material is chosen for tying purposes, the same number and kind of tying patterns are possible.

C(2). Tying pattern (traits 20-29)

Of the five methods of tube joining, tying offers most opportunities for variation. Ten patterns were distinguished among panpipes in the survey, ranging from simple and crudely executed ligatures that are merely functional to those which are finely made. All serve the purpose, with varying degrees of efficiency, of joining panpipe tubes. The first six in the list (20-25) are simple and obvious methods of fastening a row of tubes together. The last four (26-29) are intricate ligatures. A chain ligature (26) is formed by winding a fiber around each tube in succession, drawing the fiber back each time to be inserted under the loop around the preceding tube. It resembles a chain. The procedure may be repeated a number of times, each new row that is made placed directly below the preceding one (figs. 8, 9). In some cases, the rows extend from the proximal to the distal end of the panpipe, completely covering all tubes. The areas where the loops are joined form linear patterns extending vertically, either down the middle of each tube or between each tube. These patterns may be emphasized by using fibers of different colors (fig. 10). It is an efficient, although relatively time consuming method, of fastening tubes firmly together in a row and it may also be decorative.

The step tie (27) fastens two pipes together at a time so that a step-like pattern is formed across the width of the panpipe. The tying material is first wound several times around the first two longest tubes and then the second and third tubes are bound together. This is followed by joining the third and fourth tubes and continuing in the same manner until all are joined. Each separate binding starts directly above the foregoing one so that the stepped arrangement of the lower end of the panpipe is imitated in the ligature (figs. 11, 12). In many cases, the step tie is placed on the distal end of the panpipe with one of another pattern at the proximal end.

An efficient and decorative tying pattern is one I have called "herringbone" because it resembles a herringbone weave. Either narrow or wide strips of raw fiber are woven through the tubes (28) (figs. 13, 14).

The circular pattern (29) is basically a simple ligature, the fiber merely wrapped around each tube, and the ends of the fiber are twisted into several circles. Unlike the step, chain and herringbone patterns, the design is not a functional element of the ligature.

C(3). Number of elements in tie (30 and 31)

Most tying patterns may be executed a few or many times. The greater the number of elements in a tie, the more firmly the tubes are fastened into place. An advantage of fewer elements is the shorter time needed to make a panpipe.

C(4). Number of ties (32-34)

There is usually one tie in each panpipe but there may be two and, less often, three or more.

C(5). Rigid support (35-40)

A rigid support is often used to reinforce a tie. It may be either a flexible splint wrapped around the panpipe (fig. 15) or a stick (36). If a stick is chosen, there are four ways of positioning it: 1) placed horizontally across the width of the instrument (37); 2) one stick placed horizontally and another diagonally across the instrument (38) (fig. 16); 3) a single stick inserted through a string tie (39); 4) in a double row panpipe, a stick may be inserted between the two rows and fastened with a string to the tubes (40).

D. Proximal openings of tubes (41-46)

The proximal openings of most panpipe tubes are formed by cutting the reed crosswise through a hollow portion without making further modifications. These are round and completely open (41). Panpipes of other materials also usually have circular openings, except for some Nazca panpipes of clay which have oval shaped openings (42). Some proximal openings are partially closed by either of two techniques. One is to cut the stalk through its growth node and then to pierce the node through its center (43). Another is to insert a reed of slightly smaller diameter into the opening (44). Proximal openings may be indented by cutting a curvilinear notch into one (45) or both sides (46). If two notches are made, one is usually deeper than the other (fig. 17).

E. Tube closure (47-53)

Tubes are not always closed (47), but when they are, three methods are used. One is to section the reed directly through the node, utilizing the solid portion of the node as a stop (48). Another is to make the cut below the node so that a portion of the reed projects beyond the stop (49). The reed may also be sectioned through a hollow portion so that the tube is open throughout its length. A plug is then inserted, which may be a well fitting piece of gourd (50) or wood (51) or a wad of fiber (52) or a piece of wax (53). An advantage of a removable plug is that its position can be changed if a pipe requires tuning. When a closure is permanent, tuning can be done by trimming the proximal ends or inserting material (water, seeds or wax) into the tube. These practices can raise the tone of a pipe but cannot lower it.

F. Sectioning of distal end (54-58)

A crosswise cut (54) means that the stalk was sectioned through the node or hollow portion and no further modifications were made. If a reed is sectioned below the node, the hollow part distal to the node may be cut on a bias (58). A rectangular piece is sometimes cut out at the extreme distal end (55) (fig. 10). This usually occurs on tubes that are hollow throughout. The ends of the tubes may be carved into a rounded (56) or pointed shape (57).

G. Tube tiering (59-66)

Most panpipes throughout the world have one row of tubes (60). In some cases, however, the tubes are not arranged in a row, but left loose or simply bundled together (59). Panpipes may also have two (61, 62, 63, 64), three (65) or four rows (66) of tubes. When there are two rows, the following relationships of the rows occur: 1) the tubes of one row are approximately of the same lengths as the tubes of the other row (61) (fig. 18); 2) the tubes of one row are one-half the length of the tubes of the other row (62) (fig. 15); 3) progressive lengths alternate between the two rows (63). The apparent function of 1) and 2) is to enable the piper to blow two notes simultaneously that are an octave's distance apart.[1] When the two rows of tubes are the same lengths, the distal ends of one row of tubes is open and the other is closed. When the tubes of one row are one-half the lengths of the tubes in the other row, the distal ends of all the tubes are closed. Although both serve the same function, there appears to be some advantage in closing all the tubes of the panpipe. Inasmuch as an open tube is not blown in the same manner as a closed one, the position of the instrument must be manipulated when attempting to sound the open and closed tubes simultaneously.[2] It is easier to do so when both the adjacent tubes are closed.

When the sequence of lengths alternates between the two rows (63), the tubes of one row are not directly adjacent to those of the other, making it impossible to sound two notes simultaneously. A possible interpretation of this method of tube tiering is discussed in the attribute category "outline shape", for it appears to be an expression of the same principle as other doubly graduated forms.

Three and four rows of tubes are rare (65, 66).

H. <u>Outline shape</u> (67-77)

The majority of panpipes in most panpipe areas throughout the world arrange the tubes in a row according to progressively graduated lengths so that the notes of the scale follow in

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[1]The next higher octave of a closed tube can be sounded either by a closed tube one-half its length or by an open tube equal to its length.

[2]A closed tube is sounded by blowing across the opening, whereas an open tube is sounded by blowing directly into it.

order of increasing or decreasing pitches (70). This results in a panpipe with a step-like lower edge and an even horizontal upper edge. There are other, less frequently occurring alternatives. The arrangement may be completely irregular (67) (fig. 9). The irregularity may be partial, some tubes either ordered in a graduated manner (68) or equally (69). An unusual method of arranging panpipe tubes is in two graduated series, so that the notes of the scale alternate between the two sides of the instrument. Any of the following five forms can result from this procedure: 1) the longest tubes in the center with progressively shorter ones proceeding toward the two ends (71) (figs. 3, 19, 20); 2) the shortest tubes in the center with progressively longer ones proceeding toward the two ends (72) (fig. 2); 3) the shortest of the one graduated series of tubes is placed next to the longest tube of the other series, so that the instrument resembles two singly graduated panpipes that are attached side by side (73) (figs. 4, 21, 22); 4) a panpipe in two parts, each part containing the notes of the scale that are missing in the other (74) (fig. 1); 5) one series of tubes placed adjacent to the other in two rows (63).

The tubes may be of equal external lengths, resulting in a quadrangular outline shape. Functionally, quadrangular panpipes are like simply graduated ones, i.e. the successive notes of the scale follow in sequence. The graduated length sequence, however, does not appear in the outline shape of the panpipe, for the stops are located internally at different heights within the tubes instead of at their distal ends. These are either rectangular (75) or there are several shorter tubes at one end. The addition of these shorter tubes changes the outline shape, making it appear that a square (76) or triangle (77) has been cut out of it.

I. Register of individual instrument as mean pipe length (78-82)

The register of each panpipe tube is determined by its dimensions. The five registers distinguished in the present study are: very high (78), high (79), medium (80), low (81) and very low (82). The register of an individual panpipe is the average of its total tube lengths. The length which define each register are indicated in parentheses. Diameter, which has a slight effect on pitch, has been omitted from the calculation of register.

J. Spread of individual instrument (83-86)

The spread of a single panpipe may vary from less than an octave to four octaves. They are defined as narrow (83), medium (84), wide (85) and very wide (86). The difference in length between the shortest and the longest tube is a measure of spread of the instrument.

K. Mean register of collection (87-91)

The mean register of a collection is determined by averaging the registers of all panpipes in a collection. Because the sample size of the collections is highly variable (ranging from 2 to 36), the significance of the mean is also highly variable. Registers are indicated as very high (87), high (88), medium (89), low (90) and very low (91).

L. Spread of collection (92-95)

The spread of a collection, like the spread of an individual panpipe, may vary from less than an octave to four octaves. The spread is a measurement of the length difference between the shortest and the longest tube in a collection. They are indicated as narrow (92), medium (93), wide (94) and very wide (95).

M. Pitch pattern (96-126)

The precise methods of testing that are required to describe a scale in musicological terms were not undertaken (see pages 43-44). Measurements of tube lengths and conversion of the measurements to approximate acoustic intervals, which I have called "pitch pattern", gives only a crude expression of a musical scale. The results, however, provide information for the identification of attribute states to which the tests are applicable. A total of 31 pitch patterns were distinguished among the panpipes in the survey, each of which permits the description of the following features: 1) the pitch intervals between successive notes, i.e. whether the octave is divided into equal or unequal intervals; 2) representation of the octave in the pitch series, i.e. whether the beginning and end of the octave are marked by a note in the pitch series; 3) the number of notes in the distance of one octave (or approximately one octave in cases where the octave is not represented in the pitch series). The 31 length patterns that are described in this manner represent only a portion of those that are theoretically possible.

Frequently, more than one pitch pattern is represented in a single panpipe population. This may be due to any one or more of a number of possible causes:

More than one scale may have been in use, which would not be detected in a small sample. If, for example, three musical scales were recognized by a particular group of people, a large sample would be required in order for each to be identified. If the sample size is as small as five or six panpipes, which is common in the survey, and if by chance all three scales are included in the sample, the impression would be given of greater heterogeneity than actually exists.

The sample may not represent a culturally homogeneous population. Museum catalogue information sometimes fails to include specific locality. Furthermore, the nomenclature applied to native peoples, particularly those of South America, lacks uniformity. The provenience of a panpipe may be designated by locality, language or tribe, which makes it difficult to order the specimens into culturally homogeneous groups. Differences in time of collection may also affect the homogeneity of a sample. It is possible for two panpipes made at different times to represent different musical systems, although they originate in the same area.

Tuning errors may be responsible for deviations from an apparent group norm. Undoubtedly, there are variations in degree of musical sophistication among panpipe makers, which would result in variations in tuning precision. In actual playing, mistakes could be compensated for by the insertion of loose material into the tube or by variations in manner of blowing.

A panpipe may have been damaged or removeable stops may have fallen out and been wrongly reinserted. It is also possible for imperfections to exist in the inner tube, such as growth nodes that were incompletely removed. These would be ignored by the panpipe maker tuning his instrument by ear, but would affect the pitch results obtained from measurements.

Although care was taken to measure precisely, it is possible for errors to have been made in recording tube dimensions. There was no opportunity to return to a collection to check whether this may have been the case.

A panpipe may have been used for communication purposes rather than as a musical instrument, in which case the instrument would not likely follow a musical scale.

A rule of equal length increments between adjacent tubes may have been applied to panpipe construction. See page 48 for a discussion of the method I used to determine whether this might have been the case.

Some instruments have been designed for the performance of particular pieces, and thus might have only the tubes needed for that purpose. Such a series of notes might, depending on the overall musical conventions and practice of the group, be considered one of several "scales" or as a portion of a "scale" used by the group (see pages

N. <u>Completeness of pattern</u> (127-131)

The completeness of the pattern is not apparent unless it is possible to establish the pitch pattern of a population with certainty. Therefore, the extent to which the group standard is represented in any single panpipe is assumed on the basis of the data from which the pitch pattern of the populations has been constructed.

O. Decorations (132-138)

The majority of panpipes are undecorated, but occasionally decorative materials are attached. Some panpipes are painted or have simple patterns incised or dots burned onto their surfaces.

P. Reported uses (139-145)

Little information has been found regarding specific uses of panpipes. In addition to music making, panpipes have been reported as signaling instruments (139), love charms (140) and for the herding of animals (142).

Q. Tube number (146-148)

Panpipes having one to seven tubes are designated as having a few number (146); eight to fifteen tubes are a moderate number (147); fifteen or more tubes are many (148).

TABLE 1

List of Panpipe Traits

A. Material
1 1. stone
2 2. clay
3 3. wood
4 4. metal
5 5. glass
6 6. reed
7 7. bones
8 8. quills

B. Construction
9 1. one-piece (only possible for A 1. through 5.)
10 2. composite

C. Tube joining
1. encasement in sheath (1) material
11 1. clay
12 2. wood
13 3. metal
14 2. perforated wood holder
15 3. cloth
16 4. adhesive
5. tying (1) material
17 1. hair
18 2. raw fiber, plant
19 3. cord
(2) tying pattern
20 1. around and between each
21 2. around all and between each
22 3. criss-cross
23 4. back and forth
24 5. around each tube in turn
25 6. wrapped around all
26 7. chain
27 8. step
28 9. herringbone
29 10. circular pattern
(3) number of elements in tie
30 1. few windings
31 2. many windings
(4) number of ties
32 1. one
33 2. two
34 3. three or more
(5) rigid support
35 1. none
36 2. splint around
3. stick(s) (1) position
37 1. horizontal
38 2. horizontal and diagonal
39 3. through string ligature
40 4. between two rows

D. Proximal openings of tubes

41 1. round

42 2. oval

3. narrowed (1) technique

43 1. by piercing node

44 2. by insertion of reed

4. indented (1) how many sides

45 1. one

46 2. two

E. Tube closure

47 1. none

2. node plug (1) how reed sectioned

48 1. through node

49 2. below node

3. inserted plug (1) material

50 1. gourd

51 2. wood

52 3. fiber

53 4. wax

F. Sectioning of distal end

54 1. crosswise

55 2. rectangular piece cut out

56 3. rounded

57 4. pointed

58 5. cut on bias

G. Tube tiering

59 1. none (loose tubes, bundle)

60 2. one row

3. two rows (1) relation of rows

61 1. same length

62 2. 1/2 length

63 3. alternating lengths

64 4. one row grad., one row irregular

65 4. three rows

66 5. four rows

H. Outline shape

1. irregular (1) how completely

67 1. completely

68 2. graduated in part

69 3. equal length in part

2. graduated (1) how elaborately

70 1. simply

2. doubly (1) location of extreme tubes

71 1. longest in middle

72 2. shortest in middle

73 3. one short, one long in middle

74 4. interchangeable

3. quadrangular (1) how elaborate
75 1. rectangular
76 2. with square cut out
77 3. with triangle cut out

I. Register of indiv. instrument as mean pipe length
78 1. very high (2.5 to 5 cm)
79 2. high (5 to 10 cm)
80 3. medium (10 to 20 cm)
81 4. low (20 to 40 cm)
82 5. very low (40 to 80 cm)

J. Spread of individual instrument
83 1. narrow (under one octave)
84 2. medium (one to two octaves)
85 3. wide (two to three octaves)
86 4. very wide (over three octaves)

K. Mean register of collection
87 1. very high (2.5 to 5 cm)
88 2. high (5 to 10 cm)
89 3. medium (10 to 20 cm)
90 4. low (20 to 40 cm)
91 5. very low (40 to 80 cm)

L. Spread of collection
92 1. narrow (under one octave)
93 2. medium (one to two octaves)
94 3. wide (two to three octaves)
95 4. very wide (over three octaves)

M. Pitch pattern of individual instrument
1. spread under one octave; irregular divisions
(1) number of tubes
96 1. two
97 2. three
98 3. four
99 4. five
100 5. six
101 6. seven
2. spread one octave or more; octave not represented; irreg. divisions
(1) number of notes in octave's distance
102 1. one
103 2. two
104 3. three
105 4. four
106 5. five
107 6. six
108 7. seven
109 8. eight
110 9. nine
111 10. ten
112 11. eleven

3. spread one octave or more; octave not repres. approx. = divisions
(1) number of notes in octave's distance
113 1. four
114 2. five
115 3. six
4. octave represented; approximately = intervals
(1) number of intervals in octave
116 1. four
117 2. five
118 3. six
119 4. seven
120 5. eight
121 6. nine
122 7. ten
5. octave represented; unequal intervals
(1) number of intervals in octave
123 1. four
124 2. five
125 3. six
126 4. seven

N. Completeness of pattern in single panpipe
127 1. complete pattern
2. 1/2 pattern (1) connection
128 1. linked by cord
129 2. unlinked
130 3. incomplete pattern (but not 1/2)
131 4. unknown

O. Decorations
132 1. incised
133 2. painted
134 3. burned
135 4. fabirc added
136 5. feathers added
137 6. shells added
138 7. none

P. Reported uses
139 1. signaling
140 2. love charm
141 3. in orchestra
142 4. pastoral (use by shepherd, etc.)
143 5. dance accompaniment
144 6. solo music
145 7. duet music

Q. Tube number
146 1. few (1-7)
147 2. moderate(8-15)
148 3. many (15+)

CHAPTER III

Results of Study

After establishing the existing number and kind of variations in all attribute categories (Table 1), the collections were organized into groups according to geographic area. The aim of these procedures is to permit the description of panpipe groups in both the New and Old Worlds and to identify those that are sufficiently similar in trait content to suggest a culture historical relationship.

The origin of most South American panpipe collections is identified by present national boundaries. Because frequent migrations have caused a great deal of shifting of ethnic and linguistic groups, the name alone of the country from which a panpipe was collected is of little help in identifying a native culture. However, when an approximate area within a country is specified, either by direction, position on a river or village name or when the name of the collector is given, it is possible to place the source of a panpipe more precisely. Linguistic and tribal names by which native groups have been recognized are frequently used for identification, but these designations are not always consistently applied. In an attempt to form regional groups from the diversely identified South American specimens, the collections were divided into the following major geographic areas:

1) Panama; 2) North Central Amazon; 3) Northern Colombia; 4) Northwest Amazon; 5) Western Amazon; 6) Central Amazon; 7) Montana; 8) Central Andean Highlands; and 9) Archaeological Andean area.

The origin of most Pacific panpipe collections is identified by island or locality within an island. There are few ethnic identifications, and the collectors specified the geographic locations of these. The raw data of the Pacific, therefore, lent itself well to the organization of regional panpipe groups. There are sufficient reliable specimens to describe panpipes of the following regions: 1) New Guinea; 2) Admiralty Islands; 3) New Ireland; 4) New Britain; 5) Solomon Islands; and 6) New Hebrides. The easternmost Melanesian Island of Fiji, the westernmost Polynesian Islands of Samoa and Tonga and the eastern Indonesian Islands of Timor and West Java are represented by a few specimens each.

A description of all regional groups, including a few collections outside of South America and Oceania, is contained in Appendix 1. From the regional descriptions, major panpipe types and sub-types were distinguished for South America and Oceania based on variations in the following features, each of which was separately discussed in Chapter II: material, construction, joining method, tying pattern, elements in tie, number of ties, support, proximal openings, tube closure, distal end, tube tiering, outline shape, register of instrument, spread of instrument, pitch pattern, representation of octave, pattern completeness, connection, decorations and tube number. The register and spread of the collections were not used for the definition of panpipe types either in South America or Oceania because many of the regional groups contain insufficient specimens to derive a realistic average figure. Uses that have been reported in the literature were also not included in the typology because of lack of information for most of the collections. Elsewhere in the world, there were insufficient data for the identification of panpipe types.

Panpipe types of South America

Five major panpipe types were distinguished in South America, which are designated as Types I-1 (76 specimens), I-2 (23 specimens), I-3 (18 specimens), I-4 (9 specimens), I-5 (29 specimens), II (15 specimens), III (33 specimens), IV (37 specimens) and V (22 specimens) (see Table 2). I am calling Type I the "Andean type", inasmuch as it includes the majority of specimens known to me from the Andean area, both recent and prehistoric. However, some sub-groups within it have distributions which lie entirely or in part outside of the Andean culture area. Major types are distinguished primarily by musical features, whereas sub-types within Type I are distinguished by morphological features. With the exception of Type V, which includes only panpipes of one piece construction, to which many of the attributes are not applicable, the following attribute states are common to all types: the use of reed as a construction material (6); composite construction (10); tying with cord as a method of tube joining (19); round proximal openings (41); one row of tubes (60); medium register and medium spread (84).[1] The following musical features are common to all five sub-types of Type I panpipes: seven approximately equal intervals with the octave represented (119) and one-half pattern in a single panpipe, either linked with cord (128) or unlinked (129).

Sub-type I-1 panpipes are geographically restricted to the Central Andean highlands. They differ from all other South American types except I-5 (archaeological Andean) by the presence of double row panpipes, of which there are two varieties. The earlier panpipes, i.e. those that were collected prior to the 1930's, have two rows of tubes of equal lengths, one row open and one row closed. The more recent panpipes have one row which is one-half the length of the other and both rows are closed at the distal ends.

Sub-type I-2 panpipes are restricted to Panama. They are distinguished from all other South American panpipe populations by the separation of the panpipe into two parts which are linked with a cord (128), one part having three tubes and the other four. Other features, except the step tie, are shared with other South American populations.

Sub-types I-3 and I-4 are primarily Amazonian in geographic distribution. Type I-3 is characteristic of the Tucano and of the natives of the Uaupés region of the North-

[1]Numbers in parentheses are serial numbers of traits listed in Table 1.

west Amazon. Type I-4 has a wider distribution in the Amazon basin. They differ primarily in that Type I-3 uses sticks as a rigid support (38) which are fastened with a criss cross tie (22), whereas Type I-4 has a simple back and forth tie (23) with no support.

Sub-type I-5 is composed mainly of archaeological Andean specimens, but a number were collected in the late nineteenth and early twentieth centuries in the western Amazonian area. The following features distinguish I-5 from all other sub-types of Type I: The proximal openings are narrowed by piercing the node (43) or by the insertion of a reed (44). The distal ends of the tubes are closed by the insertion of a plug made of a piece of gourd (50), wood (51), fiber (52) or wax (53). A rectangular piece is cut out of the distal ends of the open tubes of double row panpipes (55). It shares the feature of a double row of tubes (61) only with the panpipes of the Central Andean highlands (I-1). These features make Type I-5 panpipes sufficiently distinctive morphologically from other sub-types of Type I to justify assignment to a separate major type. Nonetheless, they are designated a sub-type of Type I because of similarity in musical features.

Type II panpipes, which are northwest Amazonian and northern Andean in origin, are characterized by a pitch pattern with small irregular divisions of the octave. The interval relationships are inconsistent, not only within the collection, but within a single panpipe and the same note is often repeated. The octave is represented throughout the pitch series of each panpipe. Most panpipes span three octaves and more. A strikingly distinctive morphological feature is the complete irregularity of outline shape (67).

Type III panpipes have large, irregular divisions of the octave, sometimes as much as an entire octave, although there may be as few as two or three tubes in a single instrument. It is possible that some of these panpipes may not be musical instruments, but instead served as signaling devices. Type III panpipes exhibit the greatest variation in tying pattern and in outline shape. All the ties are simple ones and are crudely executed. Their distribution is characteristically peripheral to the main area of occurrence of the panpipe in South America. They tend to occur on the northern, eastern and southern margins of the Amazon basin (Guianas, eastern Brazil and Bolivia).

Type IV panpipes have a pitch pattern that results from constructing the instrument according to a rule of equal metric proportions between adjacent tubes. Included in this group are panpipes with a few number of tubes (146) that are fastened with a chain tie (26) and those with a large number of tubes (148) that have sticks for support (38). Although these morphological differences are great enough to justify sub-typing, they are included in the same major type because both the large and small varieties are the contemporaneous products of the Machiguengua of the Peruvian montana. Distribution of Type IV panpipes extends into the western Amazon basin.

Panpipe types of the Pacific

Four major panpipe types were distinguished in the Pacific, which are designated as Types I (20 specimens), II (13 specimens), III (10 specimens), IV-1 (109 specimens), IV-2 (24 specimens), IV-3 (35 specimens), IV-4 (28 specimens) and IV-5 (73 specimens). As in South America, major types are distinguished primarily by musical features, whereas sub-types are distinguished by morphological features. The following attribute states are common to all types: the use of reed as a construction material (6); composite construction (10); tying with fiber as a joining method (18); round proximal openings (41); crosswise sectioning of distal ends (54); register of individual instrument in the medium range (80); lack of decorations (138). The following musical features are common to all five sub-types of Type IV: register of individual instrument in the medium range (80); seven approximately equal intervals with octave represented (119); incomplete pattern in single panpipe (130).

Type I is restricted to the Admiralty Islands, the most northwesterly of the Melanesian Island chain. It differs from all other Pacific types in the following attribute states: 1) The tubes are joined by encasing them in a sheath of clay (11), a feature which occurs in the majority of the panpipes of the Admiralty Islands. 2) The length differences between tubes are the smallest of any Pacific panpipe types and, in several cases, two tubes of a single panpipe are of equal dimensions. As a result, there are very fine tonal distinctions between notes and the same note may be repeated in a single instrument. No panpipe spans a full octave and there is no apparent consistency in the interval relationships, making it impossible to ascertain a group musical standard. 3) Simple linear designs are incised into the clay sheath (134). Decorations do not occur in other Pacific types. The following features of Type I panpipes occur rarely in other Pacific panpipes: 1) Many of the tube arrangements are irregular (67). 2) The spread of each instrument is very narrow (83), the entire span of each panpipe encompassing less than half an octave. 3) The number of tubes in each panpipe is consistently small, having either four (113), five (114) or six (115) tubes.

Type II panpipes are restricted to a collection of thirteen specimens from the Piago of Papua in southern New Guinea. 1) The pitch pattern appears to be one of nine approximately equal intervals in an octave (121). 2) The tubes are joined with a criss cross tying pattern without the addition of a rigid support (22). Although the criss cross ligature commonly occurs elsewhere, it is always in conjunction with a stick or a splint.

Type III is represented by ten panpipes of the Tinguian of northern Luzon in the Phillipine Islands. It is distinguished by the following features: 1) The tubes are arranged in a doubly graduated manner with the longest tube in the center of the instrument (71). 2) There are either three (97), four (98) or five (99) intervals in the distance of an octave with the octave not represented in the pitch series. These are greater distances than occur in other Pacific types.

3) The tubes are not stopped at the distal ends, but are open throughout (47). Elsewhere in the Pacific, only bundle panpipes (Type IV-5 of the Solomon Islands, New Britain, New Hebrides and New Guinea) have open tubes.

Type IV panpipes occur in northern New Guinea, New Ireland, New Britain, Solomon Islands and New Hebrides and may be referred to as the "Melanesian type." The features that distinguish panpipes of Type IV from the other three major types are as follows: 1) A pitch pattern of seven approximately equal intervals in an octave with the octave represented (119) and 2) an incomplete pattern in a single panpipe (132). Many panpipes contain only a portion of a seven interval scale, the notes apparently selected for the performance of particular melodies. These musical features occur in all sub-types of Type IV panpipes.

Sub-type IV-1 predominates in New Ireland, but also occurs elsewhere in Melanesia and New Guinea. It is distinguished from other sub-types of Type IV by its tying pattern. The tubes are joined by a step ligature (27) at the distal end of the instrument and, in the majority of cases, a chain ligature at the proximal end (26).

Sub-type IV-2, which is restricted to New Hebrides, is distinguished by the herringbone ligature (28).

Sub-type IV-3, which predominates in the Solomon Islands but occurs also in New Britain and New Guinea, is distinguished by the use of a rigid stick support (37) in conjunction with a criss cross ligature (22). Many Sub-type IV-3 panpipes have two rows of tubes (61), a feature it shares with Sub-type IV-4.

The panpipes of Sub-type IV-4 have two rows of tubes (61). It shares this feature with some panpipes of IV-3. However, each panpipe of Sub-type IV-4 has a fewer number of tubes than those of IV-3. A second feature which distinguishes IV-4 from IV-3 is the tying pattern. The tubes are joined either with a step ligature (27) or a fiber is wrapped around all the tubes to hold them in place (25).

Several features distinguish Sub-type IV-5 from the others. 1) The tubes are not arranged in a row, but are bundled together (59). 2) Many of the proximal openings are narrowed by cutting the stalk through the natural node and piercing it in the center (43) or by inserting a piece of reed of narrower diameter into the opening (44). 3) A rectangular piece is cut out of the distal end of many of the tubes (55). Sub-types IV-3, IV-4 and IV-5 have similar Melanesian and New Guinea distributions and are represented abundantly in the Solomon Islands. However, IV-4 is not found in New Britain, where Sub-type IV-5 predominates.

Computer Analysis of Types and Sub-types

In order to substantiate the typology which was established empirically and to permit analyses of the similarities among the seventeen Pacific and South American types and sub-types, the list of traits was divided into two groups. One group contained five musical traits, and the other fifteen morphological traits. The establishment of musical and morphological similarity indices between all possible pairs of types was then begun, so that each type could be compared to all other types.

First, a count was made of the number of traits held in common for each of all possible pairs of types. Often, for the two types being compared, some but not all of the categories found under a given trait were shared; for example, one type might include panpipes of both medium and low register, while another type might include both medium and high registers. In such cases, the score for that trait was the number of shared categories (one: medium register) divided by the total number of categories for that trait found in both collections (three: low, medium and high registers), yielding for this example a score of 1/3 trait shared. Tables 4 and 5 list the scores for numbers of shared musical or morphological traits between all possible pairs of types.

The similarity coefficients of Tables 6 and 7 were derived from Tables 4 and 5 by dividing all the values by the total number of musical or morphological traits. These similarity coefficients have a maximum possible value of 1.00 (all traits identical) and a minimum possible value of 0.00 (no traits in common). Values for the mean, variance and standard deviation of the off-diagonal similarity coefficients are given in these tables.

The clustering procedure was begun by arranging the types in a linear order of similarity. This was accomplished by using a computer algorithm and program under the direction of Dr. William Siler of the Department of Biomathematics, University of Alabama in Birmingham. The program re-orders the sequence of types given in Tables 6 and 7 until the matrix of similarity coefficients resembles most closely the form to be expected when the types are arranged in linear order of similarity; i.e. if three groups A, B and C are truly arranged in a linear similarity order, then the similarity coefficient between A and C will be less than that between A and B or that between B and C. Results of this re-ordering are shown in Tables 8 and 9. In these tables, the similarity coefficient between any two types can be found at the intersection of two diagonal lines, one drawn downwards to the right from the left-hand type, and one drawn downward to the left from the right-hand type.

From Tables 7 and 8 of re-ordered types, clusters of types can be constructed. Two levels of clusters are given: strong clusters, in which the similarity coefficients between all types in a cluster are at least one standard deviation above the mean; and weak clusters, in which the similarity coefficients between types in a cluster are at least equal to the mean. (Coefficients within one standard error of the cluster inclusion criterion were interpreted so as to yield the simplest structure.) The resulting clusters are shown in Figures 25, 26, 27 and 28 for musical (strong and weak) and morphological (strong and weak) traits.

In musical traits, all sub-types of Pacific Type IV cluster strongly by themselves and also all sub-types of South American Type I cluster strongly by themselves. Pacific Types I, II and III do not cluster strongly with Pacific Type IV nor with each other. South American Types

II, III, IV and V do not cluster strongly with South American Type I nor with each other.

In morphological traits, strong clustering does not occur among sub-types of Pacific Type IV nor among sub-types of South American Type I. The strong clusters overlap South American and Pacific types.

These results substantiate the selection of panpipe types in South America and in the Pacific. They suggest that musical traditions are more persistent than morphological ones in panpipe manufacture. Therefore, similarities in musical features are more likely to indicate historical relationships.

TABLE 2

Panpipe Types of South America

	I-1	I-2
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	tied w. cord(19)	tied w. cord(19)
C(2) Tying pattern	back & forth(23)	around and btw.(20); step(27)
C(3) Elem. in tie	few(30)	few(30); many(31)
C(4) No. of ties	one(32); two(33)	one(32); three(34)
C(5) Support	splint(36)	none(35)
D Prox. openings	round(41)	round(41)
E Tube closure	thru node(48); below node(49)	below node(49)
F Distal end	crosswise(54); rounded(56); cut on bias(58)	cut on bias (58)
G Tube tiering	1 row(60; 2 rows same length(61); 2 rows ½ length(62)	one row(60)
H Outline shape	simply grad.(70)	doubly grad.(74)
I Register (instr.)	v. hi(78); hi(79); med(80); low(81); very low(82)	hi(79); med(80); low(81); very low(82)
J Spread (instr)	med(93); wide(94); v. wide(95)	med(93); wide(94)
M Pitch pattern	7 approx. = intervals	7 approx. = intervals
(M)Octave rep	yes	yes
N Pattern compl.	½ pattern(129)	½ pattern(129)
(N)Connection	none(129)	linked w. cord(128)
O Decorations	none	none
Q Tube number	few	few

	I-3	I-4
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	tied w. cord(19)	tied w. cord(19)
C(2) Tying Pattern	criss cross(22)	back & forth(23)
C(3) Elem. in tie	few(30)	few(30)
C(4) No. of ties	one(32); two(33)	one(32)
C(5) Support	horiz. & diag. sticks(38)	none(35)
D Prox. openings	round(41)	round(41)
E Tube closure	thru node(48)	thru node(48); below node(49)
F Distal end	crosswise(54)	crosswise(54)
G Tube tiering	one row(60)	one row(60)
H Outline shape	simply grad(70)	simply grad(70)
I Register (instr)	hi(79); med(80); low(81); v. low(82)	med(80); low(81)
J Spread (instr)	med(93); wide(94); v. wide(95)	narrow(92); medium (93)
M Pitch pattern	7 approx. = intervals	7 approx. = intervals
(M)Octave rep	yes	yes
N Pattern compl.	½ pattern(129)	½ pattern(129)
(N)Connection	none(129)	none(129)
O Decorations	none	none
Q Tube number	few; med.; many	few

	I-5	II
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	tied w. cord(19)	tied w. cord(19)
C(2) Tying pattern	chain(26)	criss cross(22); back & forth(23)
C(3) Elem. in tie	many(31)	few(30)
C(4) No. of ties	one(32)	two(33)
C(5) Support	none(35)	horiz. diag. sticks(38)
D Prox. openings	round(41); node pierced(43); reed inserted(44)	round(41)
E Tube closure	wood inserted(52); gourd inserted(51)	below node(49)
F Distal end	crosswise(54); rect. piece out(55)	crosswise(54)
G Tube tiering	one row(60); two rows same length(61)	one row(60)
H Outline shape	simply grad.(70)	irregular(67)
I Register (instr)	high(79); med(80)	v. hi(78); hi(79); med(80)
J Spread (instr)	narrow(92); med (93)	med(93); wide(94)
M Pitch pattern	7 approx. = intervals	small irreg. divisions; medium irregular divisions
(M)Octave rep.	yes	yes
N Pattern compl.	½ pattern(129)	complete(127)
(N)Connection	none(129)	none(129)
Q Tube number	few(146); mod(147)	mod(147); many(148)

	III	IV
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	cloth(15); adhesive(16); tied w. cord(19); tied w. fiber(18)	tied w. cord(19)
C(2) Tying pattern	around & btw.(20); back & forth(23)	criss cross(22); back & forth(23); chain(26)
C(3) Elem. in tie	few(30)	few(30)
C(4) No. of ties	one(32)	one(32); two(33)
C(5) Support	none(35)	none(35); horiz. diag. sticks(38)
D Prox. openings	round(41)	round(41)
E Tube closure	thru node(48); below node(49)	thru node(48); below node(49)
F Distal end	crosswise(54)	crosswise(54); cut on bias(58)
G Tube tiering	one row(60)	one row(60)
H Outline shape	none(59); irreg. (67); simply grad. (70)	simply grad.(70)
I Register (instr)	hi(79); med(80); low(81)	hi(79); med(80); low(81)
J Spread (instr)	narrow(92); med.(93)	narrow(92); med (93); wide(94)
M Pitch pattern	large irreg. divisions	= metric proportions
(M)Octave rep.	no	no
N Pattern compl.	unknown	complete(127)
(N)Connection	none(129)	none(129)
Q Tube number	few(146)	few(146); mod.(147); many(148)

	V
A Material	clay(2)
B Construction	one piece(9)
C Joining	not applicable
C(2) Tying pattern	not applicable
C(3) Elem. in tie	not applicable
C(4) No. of ties	not applicable
C(5) Support	not applicable
D Prox. openings	round(41); oval(42)
E Tube closure	not applicable
F Distal end	crosswise(54); rounded(56)
G Tube tiering	one row(60)
H Outline shape	simply grad.(70)
I Register (instr)	v. hi(78); hi(79); med(80); low(81)
J Spread (instr)	narrow(83); med(84); wide(85); v. wide(86)
M Pitch pattern	medium irregular divisions
(M)Octave rep.	no
N Pattern compl.	unknown
(N)Connection	none(129)
O Decorations	none(138); painted(133)
Q Tube number	few(146); moderate(147); many(148)

Distribution of Panpipe Types

Type I-1	Central Andean highlands: Aymara (ling.), Quechua (ling.), La Paz (loc.), Chuicuito (loc.), Puno (loc.). 71 panpipes
Type I-2	Panama: Cuna (eth.), Tupi (ling.), San Blas (loc.), Darien (loc.). 23 panpipes
Type I-3	Northwest Brazil: Uaupés (loc.); Western Brazil: Tucano (eth.). 18 panpipes
Type I-4	Colombia: Piapoco (eth.); Venezuela: Makiritaré (eth.); Central Brazil: Huanyam (eth.), Amniape (eth.). 9 panpipes
Type I-5	Archaeological Andean area: Huacho (loc.), Ocucaje (loc.), Ica (loc.), Pachacamac (loc.), Nazca (loc.); Montaña: Rio Ucayali (loc.), Iquitos (loc.); Central Brazil: Paressí (eth.), Cayabí (eth.); Upper Amazon: Brazil-Peru border (loc.), Omagua (eth.). 29 panpipes
Type II	Ecuador: Jivaro (eth.), Cayapa (eth.), Esmeraldas (loc.), Rio Putumayo (loc.), Payamino (loc.). 15 panpipes
Type III	North Central Amazon: Wayana (eth.); Western Amazon: Bora (eth.); Central Amazon: Nambicuara (eth.); Colombia coast: Noaname (eth.); Brazil: Xingu River (loc.), Trumaí (eth.), Tupari (eth.); Bolivia: Beni province (loc.), Chacobo (eth.), Chiquito (eth.). 39 panpipes
Type IV	Peruvian montaña: Machiguenga (eth.), Campa (eth.); Eastern Bolivia: Moré; (eth) Brazil: Rio Guaporé (loc.). 67 panpipes
Type V	Archaeological Andean area: Nazca (loc.), Paracas (loc.). 22 panpipes

TABLE 3

Panpipe Types of the Pacific

	I	II
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	encased w. clay (11); tied w. fiber(17)	tied w. fiber(17)
C(2) Tying pattern	back & forth(23)	criss cross(22)
C(3) Elem. in tie	many(31)	few(30)
C(4) No. of ties	one(32)	one(32)
C(5) Support	none(35)	none(35)
D Prox. openings	round (41)	round(41)
E Tube closure	through node(48)	below node(49)
F Distal end	crosswise(54)	crosswise(54)
G Tube tiering	one row(60)	one row(60)
H Outline shape	irregular(67); simply grad.(70)	simply grad.(70)
I Register (instr)	medium(80)	high(79); medium(80)
J Spread (instr)	narrow(83)	narrow(83)
M Pitch pattern	small irregular divisions	9 approx. equal intervals
(M) Octave rep.	no	yes
N Pattern compl.	incomplete(130)	incomplete(130);
(N) Connection	none(129)	none(129)
O Decorations	incisions(132); none(138)	none(132)
Q Tube number (in one row)	few(146)	few(146)

	III	IV-1
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	tied w. fiber(17)	tied w. fiber(17)
C(2) Tying pattern	criss cross(22); back & forth(23)	chain(26); step(27)
C(3) Elem. in tie	few(30)	many(31)
C(4) No. of ties	one(32)	two(33); three(34)
C(5) Support	splint(36)	none(35)
D Prox. openings	round(41)	round(41)
E Tube closure	open(47)	through node(48)
F Distal end	crosswise(54)	crosswise(54); pointed(57)
G Tube tiering	one row(60)	one row(60)
H Outline shape	doubly grad.(71)	simply grad.(70)
I Register (instr)	medium(80)	very high(78); high(79); medium(80)
J Spread (instr)	narrow(83)	narrow(83); medium (84); wide(85)
M Pitch pattern	medium irregular divisions	7 approx. equal intervals
(M)Octave rep.	no	yes
N Pattern compl.	unknown	incomplete(130)
(N)Connection	none(129)	none(129)
O Decorations	none(132)	none(132)
Q Tube number (in one row)	few(146)	few(146); moderate (147); many(148)

	IV-2	IV-3
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	tied w. fiber(17)	tied w. fiber(17); tied w. cord(18)
C(2) Tying pattern	herringbone(28)	criss cross(22)
C(3) Elem. in tie	few(30)	few(30)
C(4) No. of ties	one(32); two(33); three(34)	two(33)
C(5) Support	none(35)	horiz. sticks(37)
D Prox. openings	round(41)	round(41)
E Tube closure	through node(48)	through node(48)
F Distal end	crosswise(54); pointed(57)	crosswise(54)
G Tube tiering	one row(60)	one row(60); two rows(61)
H Outline shape	irregular(67); simply grad.(70)	simply grad.(70)
I Register (instr)	very high(78); high(79); medium (80)	very high(78); high(79); medium(80); low(81); very low(82)
J Spread (instr)	medium(84); wide(85)	medium(84); wide(85)
M Pitch pattern	7 approx. equal intervals	7 approx. equal intervals
(M)Octave rep.	yes	yes
N Pattern Compl.	incomplete(130)	incomplete(130)
(N)Connection	none(129)	none(129)
O Decorations	none(132)	none(132)
Q Tube number (in one row)	moderate(147)	moderate(147); many(148)

	IV-4	IV-5
A Material	reed(6)	reed(6)
B Construction	composite(10)	composite(10)
C Joining	tied w. fiber(17) tied w. cord(18)	tied w. fiber(17)
C(2) Tying pattern	wrapped around all (25); step(27)	wrapped around all(25)
C(3) Elem. in tie	few(30); many(31)	few(30)
C(4) No. of ties	one(32); two(33)	one(32); two(33); three(34)
C(5) Support	none(35	none(35)
D Prox. openings	round(41)	round(41); node pierced(43); reed inserted(44)
E Tube closure	through node(48)	through node(48)
F Distal end	crosswise(54); cut on bias(58)	crosswise(54); rect. piece out(55)
G Tube tiering	two rows(61)	none (bundle) (59)
H Outline shape	simply grad.(70)	irregular(67)
I Register (instr)	medium(80); low (81); very low(82)	high(79); medium(80); low(81); very low(82)
J Spread (instr)	narrow(83)	narrow(83); medium(84)
M Pitch pattern	7 approx. equal intervals	7 approx. equal intervals
(M)Octave rep.	yes	yes
N Pattern compl.	incomplete(130)	incomplete(130)
(N)Connection	none(129)	none(129)
O Decorations	none(132)	none(132)
Q Tube number (in one row)	few(146)	few(146); moderate(147)

Distribution of Panpipe Types

Type I	Admiralty Islands (20)*
Type II	The Piago of South Papua, New Guinea (13)
Type III	The Tinguian of northern Luzon, Philippines (10)
Type IV-1	New Ireland (63); New Britain (33); Solomon Islands (7); New Hanover (6); New Guinea (6)
Type IV-2	New Hebrides (24)
Type IV-3	Solomon Islands (29); New Britain (4); New Guinea (2)
Type IV-4	Solomon Islands (23); New Guinea (5)
Type IV-5	Solomon Islands (18); New Britain (22); New Hebrides (12); New Guinea (21)

*Number of specimens in sample in parentheses

Evaluation of Andean-Melanesian panpipe parallels

The Melanesian (IV) and Andean (I) types share 59 of 127 panpipe traits.[1] The evaluation of the 59 parallels follow the tests discussed on pages 21 to 23, which rate the significance of parallels between distant cultures. The following five are tests to rate individual traits: 1) distribution; 2) world infrequency; 3) non-essentialness; 4) plurality of alternatives and 5) redundancy. In Table 10, a rating of parallels between Melanesian and Andean panpipes, distribution elsewhere than within the areas included by the Melanesian (IV) and Andean (I) types is indicated by numbers 1 through 5: 1) South America; 2) Pacific; 3) East Asia; 4) West Asia and Europe; and 5) Africa. Frequency elsewhere is indicated as absent, rare, moderate or common. The number of alternatives indicate the actual number occurring in the survey rather than the theoretical number of possibilities. The tests of non-essentialness and redundancy are not indicated in the table because only a few of the total number of traits are optional ones and also most traits co-occur with their alternatives. These are referred to specifically in the text. The ratings as evidence of a historical relationship are: rejected, poor, satisfactory or good. They are based primarily on the extent of the distribution and frequency outside of the areas under com-

[1]The list of panpipe traits includes 148 traits. 31 are pitch patterns, many of which are not suitable for a proper application of the tests. The number of pitch patterns considered in the comparison was reduced to 10, making a total of 127 traits. The reasons are discussed on pages 109 to 115.

parison. The numbers preceding the traits are the serial numbers of the list of panpipe traits (Table 1).

A Material (6)

Reed is the most common material wherever panpipes occur, undoubtedly because of its ready availability and the ease with which a few stalks can be converted into a panpipe. It is characteristic of all types except Type V of South America. The use of reed (trait 6) is rejected as evidence of diffusion.

B Construction (10)

A panpipe is either a one piece or a composite instrument. All reed panpipes are necessarily composite because of the natural form of the material. Panpipes of composite construction (trait 10) are rejected as evidence of diffusion because of their high frequency and wide distribution.

C Tube joining (18, 19)

Of the five methods of tube joining, that of tying has the widest distribution and highest frequency. In the Andean area cord is the favored material while in Melanesia the material most commonly used is raw plant fiber. Fiber (trait 18) and cord (trait 19) as tying material are rejected as evidence of diffusion on the basis of wide distribution and high frequency.

C(2) Tying pattern (20, 22, 23, 26, 27, 28)

Ten distinctive tying patterns were identified among the panpipes surveyed. All are contingent upon the use of tying as a method of tube joining. Five are shared by the

Melanesian and Andean panpipe areas. Those that are designated as around and between each (trait 20), criss-cross (trait 22) and back and forth (23) are simple utilitarian ways of tube joining. All three have a wide and sporadic distribution, occurring in many parts of South America, in Polynesia, Europe and in Africa and in most areas they co-occur with alternatives. All three are rated poor evidence of diffusion. The chain tie (trait 26) and the herringbone tie (trait 28) are more complex methods of tube joining and therefore appear less likely than the other three to have arisen independently.

The chain tie commonly occurs on prehistoric Andean panpipes (Sub-type I-5) and is usually carefully made with a design created through the use of different colors of cord. The rows of cord often continue throughout the entire length of the panpipe. A number of panpipes from various parts of the Amazonian area which were collected late in the last century have ligatures that are very similar to those on panpipes from ancient Peruvian graves. The chain ligature does not occur on historic panpipes of the Andean area but are a common ligature on the smaller panpipes of the Machiguengua of the Peruvian montana. In Melanesia the chain tie occurs in the Solomon Islands, New Britain, New Ireland, New Hanover and New Guinea. There, it is often combined with a second ligature, the chain tie being used at the proximal end and, often, the step tie at the distal end. In all areas of its occurrence, the chain tie co-occurs with at least one of the nine (Figs. 8, 9, 10) alternative methods of tying. It is rated good evidence of diffusion.

In Melanesia the herringbone ligature is restricted almost entirely to the New Hebrides (Sub-type IV-2), where it is the most common method of fastening pipes together, using either narrow or wide strips of plant fiber. It is a distinctive and attractive ligature which has not been reported elsewhere in the world except one illustrated in Izikowitz on a double row panpipe from the Ica Valley (Izikowitz 1935: fig. 23, 281) and two I found in museum collections. One is attributed to Huacho (MVBe VA31351) and the other to Pachacamac (MVBe VA40298) (Sub-type I-5). Because of its restricted distribution, the large number of alternatives and co-occurrences with other more popular tying patterns, the herringbone tie is rated very good evidence of diffusion.

C(3) <u>Number of elements in tie</u> (30, 31)

Ties with few windings (trait 30) and those with many windings (trait 31) both have a high frequency and worldwide distribution and co-occur with each other in most places. They are rejected as evidence of diffusion.

C(4) <u>Number of ties</u> (32, 33, 34)

The choice of one or more ties is dependent to a large extent on the size of the panpipe. The larger it is, the more likely it will have two or more ties for additional support to hold the tubes firmly in place. Panpipes with one, two and three or more ties (traits 32, 33, 34) are widely distributed both within and outside the areas under comparison. All are rejected as evidence of diffusion.

C(5) Rigid support (35, 37, 38)

A stick combined with a tie provides greater support than a tie alone, and is especially practical for joining the tubes of large panpipes. It is possible to make a panpipe rigid by joining the tubes with cord or with fiber alone, but a great deal more time and effort is required. It is simpler to furnish the necessary support by adding a stick. Two particular ties are commonly used to fasten the stick to the tubes. In all areas of occurrence the sticks are fastened either with a criss-cross tie or the fiber is wound back and forth between each tube. Sometimes both methods are combined in one panpipe.

Panpipes having no rigid support (trait 35) have a high frequency and are distributed throughout most panpipe areas. The trait is rejected as evidence of diffusion. Sticks that are placed horizontally, one on each side of the instrument (trait 37) occur not only in the Melanesian and Andean panpipe areas but are distributed sporadically throughout the Amazonian area and occur in Africa. Diagonal and horizontal sticks used together (trait (38) occur, in addition, in Samoa, Egypt, Italy and Burma. In many areas a stick and tie is the only method of tube joining used. Both traits are rated poor evidence of diffusion.

D Proximal openings of tubes (41, 43, 44)

Round proximal openings (trait 41) occur in all areas of panpipe distribution with high frequency. The trait is rejected as evidence of diffusion. The alternatives are of rare occurrence anywhere.

Panpipes with proximal openings that are narrowed by piercing the node (trait 43) and also those with a reed of smaller diameter inserted inside the opening (trait 44) occur only in open tubes of some double row panpipes of the prehistoric Andean (Type I-5) area and in open tubes of some bundle panpipes of Melanesia (Type IV-5). These traits do not occur on open tubes of double row panpipes of the Solomon Islands nor on recent double row panpipes of the Andean area. Both traits are very rare, their distribution cohesive and they co-occur with the more popular and simple trait, i.e. round openings. Traits 43 and 44 are rated very good evidence of diffusion.

<u>E Tube Closure</u> (47, 48, 49)

One row of tubes of many double row panpipes of the Andean area, one row of tubes of all double row panpipes of Melanesia, some tubes of some bundle panpipes of Melanesia and all tubes of single row panpipes of the Philippines are open throughout their lengths (trait 47). In contemporary double row panpipes with open tubes, the open tubes sound the next higher octave of the closed tubes to which they are adjacent. The proximal openings of these tubes are round and completely open.

We do not know how prehistoric double row panpipes were played, It is probable that, in some cases, the row of open tubes served a purpose other than sounding the higher octave, for their openings are narrowed. It would not be possible then to sound both the closed and open tubes with the same puff of air, for the air must be directed across the opening to sound the closed tubes, but into the opening to sound the open tubes. The narrowed openings are similar to those which occur on the open tubes of bundle panpipes which are played by blowing directly into the tube. The Tinguian blow their panpipes like the Melanesians blow some of their bundle panpipes, i.e. into, not across the openings. However, the proximal openings of the Phillipine panpipes are not narrowed, unlike those of the bundle panpipes of the Melanesians.

It is uncertain whether all open tubes can be classified as the same trait. Certainly, those on the modern double row panpipes of the Andean and Solomon Islands are the same, for they serve the same function. Perhaps the open tubes of prehistoric South American panpipes functioned as bundle panpipes of Melanesia do today, but we do not know. The open tubes of Tinguian panpipes, although their form is identical to the open tubes of double row panpipes, cannot serve the same function because there are no closed tubes of the same lengths.

The open tubes that occur on the double row panpipes of the Andean (Sub-type I-5) and Melanesian panpipe (Subtype IV-5) areas are rated very good evidence of diffusion, for their distribution is highly restricted and cohesive and there are alternatives in use in both areas.

In all panpipe areas throughout the world the natural node of the reed is used as a distal stop for the tubes. The reed may be cut through the node (trait 48) which is the most common method or below the node (trait 49), which is less common but has a moderate frequency. Both traits are rejected as evidence of diffusion.

F <u>Sectioning of distal end</u> (54, 55, 56, 58)

Most panpipes throughout the world are cut crosswise (trait 54), which causes this trait to be rejected as evidence of diffusion.

Many prehistoric double row panpipes of the Andean area (Sub-type I-5) and bundle panpipes of Melanesia (Sub-type IV-5) have a rectangular piece cut out of the distal ends of some open tubes (trait 55). The pieces that are removed are of different sizes. This suggests that it may represent a method of tuning the pipes by reducing the length of the air column. The trait has not been reported outside the Andean and Melanesian panpipe areas and it is rare in both areas. It is rated good evidence of diffusion.

Rounding of the distal ends after the stalk of reed is cut through the node (trait 56) occurs in the two areas under comparison. It co-occurs with its alternatives in all areas of occurrence. It is rated satisfactory evidence of diffusion.

When a stalk of reed is cut below the node a part of it projects beyond the distal stop. The additional external tube length does not influence the tone that is sounded. The projecting part is sometimes cut on a bias (trait 58), a trait which is sporadically distributed in South America and in Melanesia and occurs in the African Congo and in The Russian Caucasus. It is rated poor evidence of diffusion.

<u>G Tube tiering</u> (59, 60, 61, 63)

A single row of tubes (trait 60) is rejected as evidence of diffusion because it is of frequent occurrence in all panpipe areas.

The panpipe with open and closed tubes (trait 61) is an ancient form in the New World.[1] Several specimens are known from sites of the Early Horizon (900 B.C.-200 A.D.), the period during which the panpipe, from all evidence, made its initial appearance in the New World. Many are known from the following Early Intermediate Period (200 B.C.-A.D. 600) and they continued into historic times.

Double row panpipes from the Lake Titicaca area of the Peruvian and Bolivian highlands before the early part of this century are like the prehistoric ones, i.e. they have open and closed tubes. Those that were collected since the

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[1]It may have been more popular prehistorically than a single row panpipe. Of 27 prehistoric reed panpipes in this survey, 19 are double row and 8 single row. Most pottery specimens have a single row of tubes, but they may have been used as double row panpipes by placing two together while playing. In several cases, the pitch series of two that were found together are an octave's distance apart (Stevenson 1968:246).

1920's, however, have tubes that are all closed.[1]

The only variety of double row panpipe that has ever been reported in Melanesia is that which was popular prehistorically in the New World. It was present in the Solomon Islands before 1900 (Guppy 1887; Codrington 1891; Hornbostel 1911; Ribbe 1903; Frizzi 1914) and has continued to the present time. Its distribution is restricted primarily to the Solomon Islands with only a few specimens reported elsewhere in Melanesia. Double row panpipes with all closed tubes, as are used in the New World today, are unknown in Melanesia or elsewhere in the world.

The double row panpipe with closed tubes of the same lengths as the open ones is rated very good evidence of diffusion. The double row panpipe is more widely distributed and more varied in South America than in the Solomon Islands. Therefore, diffusion from South America to the Solomon Islands appears more likely than diffusion in the opposite direction.

<u>H Outline Shape</u> (70, 72, 73)

The simply graduated trait (trait 70) is rejected as evidence of diffusion because of its high frequency and world wide distribution.

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[1]The prehistoric existence of the Andean double row panpipe variety that is popular today is known from only one specimen which is in the collection of Dr. Alan Sawyer, Washington, D.C. It is said to come from the Santa Valley in the northern Andean area and was associated with material like Recuay (200 B.C.-400 A.D.). It is made of pottery and there is a simulated binding on it which indicates that it is a representation of a reed panpipe. This feature suggests a greater popularity for this variety than a single recovered specimen might indicate.

According to Chinese legend, it is the panpipe having the shortest tubes in the center, which is somewhat double wing shaped (trait 72), that resulted from the practice of separating the notes of the male bird from those of the female. However, all three forms follow the same practice, differing only in the manner in which the two halves of the panpipe are placed together. It can be reasoned, therefore, that if one pattern is based on the yin-yang principle, then all are.

Presently available evidence suggests that the double wing shaped panpipe (trait 72) appeared earlier than any of the other panpipes which separate sequential notes of the scale. In fact, it appeared as early as the more common panpipe with a single series of graduated tubes. It was present in China at least as early as the Han dynasty (206 B.C.-202 A.D.) and in coastal Peru and Ecuador by the third century B.C. In China there is historic continuity to recent times, but in the New World the only other reported occurrence is in Colombia where it is played by the Motilón Indians (Bolinder 1917:45; Reichel-Dolmatoff 1945:Pl.VI-4; Nordenskiöld 1938:75-6, fig. 11), who also have panpipes with the longest tube in the center (Bolinder 1917:fig. 27). Panpipes with long center tubes (trait 71), which represent the reversed position of the supposedly original Chinese form, have also been reported among the Ica Indians of Colombia (Izikowitz 1935:388). There are no reports of their presence elsewhere in the New World either in recent or prehistoric times. Outside of the New World they have been reported in several widely separated areas. They were used in China from the seventh to thirteenth centuries A.D. (Chuang 1963:25, 102). Cook found them in Tonga when he visited the island at the end of the eighteenth century. The Tinguian of the Philippines, whose panpipes have tubes that are open throughout, place the longest tubes in the center. The panpipes played by the peasants of Georgia in the Russian Caucasus have the longest tube in the center, the notes alternating between two sides of the instrument (Stechenko-Kouftina 1936:211).

The panpipe with the shortest tube of one series and the longest tube of the other series placed next to each other in the center (trait 73) is known only in the Solomon Islands and in Colombia.

In Panama and in the Central Andean highlands, the two series of graduated tubes are not combined in a single instrument, but are kept apart and can be combined in any one of the four different ways while they are being played (trait 74). In Panama, parts that belong together are connected with a cord, as the Inca did many centuries earlier. The panpiper may place two parts alongside each other with the shortest tubes in the center or with the longest tubes in the center, or the two parts may be placed together in two rows. At times there are two players, each blowing one-half of the whole instrument. In the central Andes the two parts are not linked with a cord.

A double row panpipe with the notes alternating between two rows (trait 63) has been reported from the Solomon Islands (Hornbostel 1911:473, 495) and from two prehistoric sites in Peru (D'Harcourt 1925, fig. 50; Stevenson 1968:251).

The frequency of prehistoric use of panpipes which alternate sequential notes of the scale may be greater than a few reported specimens suggest for it is not usually possible to know whether all the notes of the scale are represented in one specimen. Only if the pairs are joined or if the complete scale is known can an instrument be identified as a complete or incomplete one.

All three of the patterns which separate sequential notes of the scale qualify as good evidence of diffusion according to the tests applied (traits 63, 72, 73). Each is a rare trait having a number of alternatives and there is no obvious quality to encourage its independent invention. None has been reported elsewhere than in the circum-Pacific area.

<u>I, J Register and spread of individual instrument</u> (78 to 88)

All traits are rejected as evidence of diffusion because of high frequency and widespread distribution elsewhere.

<u>Mean register and spread of collection</u> (89, 93, 94)

All are rejected as evidence of diffusion because of high frequency and widespread distribution elsewhere.

<u>M Pitch pattern</u> (119)

The 31 pitch patterns were identified in the same manner as were the other attribute states, i.e. by counting the number of choices that panpipe manufacturers throughout the world have made in solving a particular problem of panpipe construction. In this case the problem was assumed to be the proper selection of tube lengths for the production of melodies. The melodies of any people, whether they are aware of it or not, are derived from a culturally prescribed series of notes and usually all the notes can be played on a single musical instrument. It was therefore further assumed that this series of notes, or musical scale, is represented by the pitch pattern of the panpipe. Based on these assumptions, the patterns that occurred in all panpipes in the survey were listed as the attribute states according to the procedure recommended for application of the test.

If it were true that the pitch series of each panpipe constitutes a musical scale, the panpipes belonging to a culturally homogeneous group would exhibit a single pitch pattern (or at most a few) except for deviations resulting from tuning errors or damage. This, however, was rarely the case. Even among panpipes that were unquestionably the product of a single group of people and were contemporaneous, many patterns occurred. It was apparent that something other than a choice of musical scale was influencing selection of tube lengths.

In central Andean panpipe populations, for example, the pitch series of some of the instruments have the octave represented while others do not. Some panpipes have three notes within the distance of an octave; others have four and five. In some the intervals are regular and approximately equal and in others unequal. The characteristic which distinguishes the length patterns of the central Andean populations from most others in the survey is the great width of the intervals, but the sizes are not consistent. The clue to the solution of the problem of heterogeneity of length pattern came from ethnographic reports that panpipes are played in pairs with notes of the scale alternating between two instruments.

Some of the museum specimens were designated as pairs by the collector. When the tube lengths of these were combined and plotted on semilogarithmic paper the results in each case were seven approximately equal intervals to an octave. The pitch series of the combination always had a note marking the beginning and one marking the end of an octave. For individual specimens, tube lengths were plotted as if every second one was missing. When this was done, the degree of slope of the line connecting the plotted points indicated that there were seven approximately equal intervals in an octave.[1]

The method of combining two panpipes to complete a pitch series of seven intervals in an octave is a diagnostic feature of the Andean panpipe type.

[1]The pitch series of seven intervals in an octave is not to be taken as a scale on which all central Andean music is based, for much of the music is pentatonic. Certain tubes may not have been used when the panpipe was played.

In some central South American panpipe populations (those belonging to Type IV) the number of pitch intervals in the distance of an octave ranges from three to 15 with the octave rarely represented in the pitch series of a panpipe. When the tube lengths of the larger panpipes, those covering several octave's range, were plotted on semi-log paper in order of decreasing length, a line connecting the plotted points was not straight, as in panpipes of equal acoustic intervals, but was a smooth downward curve. This indicates that the panpipes were constructed according to equal length proportions between adjacent tubes with the pitch intervals following from the metric standard. In the medium range of these panpipes, the pitch intervals are approximately equal, but in the higher frequency range, as tubes decrease in length, the pitch intervals between successive tubes become increasingly greater. The pitch patterns that occur in such panpipes are not "scales", in the musical sense of the term, for there is no homogeneity either within the group or within a single panpipe. The rule applied in their construction was apparently visual rather than acoustic. When melodies were played, only a few of the many notes may have been selected. Some of the tubes, particularly the short ones which sound the highest notes, are stopped at both ends indicating they were added for appearance rather than to contribute to the performance of music.

There are other populations in South America, mainly on the peripheries of the distribution area, whose panpipes have a small number of tubes which are crudely cut and tied together and which rarely span an octave (Type III). When the tube lengths are plotted on semi-log paper, lines connecting the plotted points are of varying slope which means that the sequence of tones is based on intervals of various sizes. These jagged lines formed by the length patterns of a single population are not similar but form a random pattern. This suggests that neither a musical nor a metric standard was applied to the selection of tube lengths.[1]

Panpipes may be used as signaling devices rather than as musical instruments.[2] If melodies are not played on them, panpipes need not have a standardized series of tones. We do not know how the museum specimens were used, but one explanation of the lack of uniformity in length pattern is that they were instruments of communication rather than musical instruments.[3]

Many panpipes of Melanesia have a pitch pattern of seven equal pitch intervals to an octave. Others, even

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[1]In a previous report of these patterns, I attributed this pattern to Melanesia, particularly New Hebrides. There, however, notes of a scale are selected for the playing of particular melodies, so the pitch pattern of a collection only appears to be a random one. This pattern is primarily characteristic of Type III panpipes of South America (Tekiner 1972).

[2]Snethlage observed that the Chipaya of central Brazil have panpipes that are used in this way (1921:412). Panpipes are also used as signaling devices in Melanesia.

[3]The slight amount of homogeneity exhibited by a panpipe group may result from the genetic pattern of the plant species used. Many hollow grasses have internodes which gradually decrease in length from the bottom to the top of the stalk. If the stalk is divided by cutting through its growth nodes, the pieces will constitute a series of progressive lengths. If these are fastened together in order of size, a series of tones will result that is dictated by the growth pattern of the plant.

within the same populations, have four, five or six notes in an octave and the interval relationships are inconsistent. A typical pattern found in many Melanesian populations is a group of closely spaced notes separated from another group by a wide interval, each group containing either two or three notes. Another, in Bouganville panpipes is four notes with inconsistent interval relationships. The variability in length pattern made it appear that no common pattern exists but that there were a large number of apparent "scales" like the South American populations just described. However, unlike those in the New World which were constructed according to metric proportions, or which combined two panpipes to complete the length pattern, each Melanesian panpipe contained a note which began and another which ended the octave. This feature suggested that each panpipe furnished all the notes that are necessary to play a melody.[1] Therefore it seemed unnecessary to look for a missing member of a pair but rather to find the pattern within a single panpipe.

These diverse length patterns were closely examined to find a common feature, which resulted in the discovery that the notes occurring in each panpipe are extracted from a scale of seven equal intervals to an octave. The gap

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[1]Although it has been reported that panpipes are used in pairs in Melanesia, it is evidently not the method of the Andean area where two panpipes are required to complete a scale.

between adjacent notes that are closely spaced are always equivalent to the distance between the notes of panpipes that have a complete scale of even equal pitch intervals. The gaps between adjacent groups of notes are twice and three times the size of those between closely spaced notes. If all the gaps are filled in by notes that are spaced equidistantly the resulting scale is seven equal pitch intervals to an octave.

It is reported that panpipes are often made for a specific ceremony and discarded after use (Blackwood 1935). It seems likely, therefore, that the notes selected for each panpipe are probably based on the melody the panpipe is intended to play. Inasmuch as it is not intended for general use, there is no need for each panpipe to contain all the notes of the scale.

The discovery of more than one rule governing the selection of tube lengths makes it necessary to reconsider the assumptions that were made regarding the relevance of pitch pattern to a particular problem of panpipe manufacture. It is apparent that pitch patterns are not always complete musical scales and, in some cases, do not even represent a partial scale. Therefore, all patterns cannot be viewed as states of an attribute having the single objective of furnishing a standard series of notes so that the panpiper can play all of the melodies composed by a particular group of people. If we want to compare musical scales, information about them must be obtained from sources other than panpipes.

Although it may be possible to do so, such an attempt is beyond the scope of this project, which is limited to the evidence of the panpipe.

For the two populations under comparison it has been possible to identify a standard series of notes on which many of the diverse length patterns of their panpipes appear to be based. In the Melanesian panpipe area it is seven equal intervals in an octave. In the Andean area the panpipes also have seven intervals in an octave, but the intervals are less precisely equidistant than in Melanesia.[1] No panpipes of other populations for which there is information have seven intervals in an octave. Their absence in panpipes elsewhere as far as is known, makes the Melanesian-Andean parallel very good evidence of diffusion. However, it must be taken into consideration that information of the pitch series of panpipes of other populations is severely limited. This is due not only to a paucity of information for some but also, in cases where there is an adequate sample, to a lack of knowledge of the notes that were used when there are more notes in panpipes than are likely to exist in an entire scale.

Although the 31 pitch patterns cannot be regarded as alternatives for determining the likelihood of the indepen-

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[1] A scale of equidistant notes in an octave has been reported by Zemp (1971: V.1) on the basis of a musical study. In parts of the Andean area, however, a pentatonic scale is reported to be prevalent (Stevenson 1968:246).

dent development of an eight note scale, it is at least possible to estimate the minimum and maximum number of notes that are likely to be contained in one octave. An upper limit of twelve and a lower limit of three seems to be a reasonable estimate because if there were more than twelve the tonal distinctions would be very small and, if less than three, there would be too little tonal variety. Either extreme is not likely to occur. This estimate does not consider the possible number of ways in which notes can be spaced within an octave because this information could not be determined from the data in the survey. Theoretically, the possibilities are unlimited. Taking into consideration only the number of notes in the octave and not their distance relationships to each other, there is a 10% probability of any one recurring by chance.

N Completeness of pattern (127, 129, 130, 131)

One-half pattern (129) and parts of a pattern (130) could be rated very good evidence of diffusion because they have not been found elsewhere than in Andean and Melanesian panpipes. However, there are few data outside these areas to indicate whether panpipes elsewhere follow a similar pattern.

O Decorations (138)

Only undecorated panpipes (138) have parallels in the Andean area and in Melanesia. Most panpipes everywhere are undecorated, so that this trait is rejected as evidence of diffusion.

Reported uses (141, 142, 143, 144, 145)

There are insufficient data outside the Melanesian and Andean areas to permit a rating of any of the parallels in usage of the panpipe as evidence of diffusion.

Q Number of tubes (146, 147, 148)

The widespread distribution of panpipes with few, moderate and many tubes disqualifies this attribute as evidence of a historical relationship.

Four of the tests attempt to rate the total evidence obtained from rating the individual traits. These are: 1) number, which states whether the parallels form the majority of the descriptive features of one of the populations; 2) exhaustiveness, which states whether the parallels include almost all of the features found in one population that also occur anywhere else outside of it; 3) degree of similarity resulting, which states whether the parallels make for greater likeness between any two of the populations than between any of the others; 4) local relationships, which states whether the parallels appear gradually at one end of a developmental continuum in either of the major areas under comparison (Tolstoy 1972:834-35).

These four criteria have been applied to the total body of panpipe evidence with the following results: 1) Number: 81 of the 127 traits in the total list occur either in the Melanesian or Andean groups. 59 of the 127 features in the total list of panpipe traits are shared by the Melanesian and Andean populations. Of the 59 parallels, 11 are rated good evidence of a historical relationship, 3 are satisfactory, 5 are poor and 34 are rejected. Six parallels could not be rated because of insufficient information outside the areas under comparison. 2) Exhaustiveness: most of the features shared by the Andean and Melanesian groups are also found elsewhere. 3) Degree of similarity: there is greater similarity between the Melanesian (Type IV) and the Andean (Type I) panpipe populations than there is between them and any populations that are geographically closer. 4) Local relationships: Pacific Type IV panpipes have a continuous distribution from northern New Guinea through the islands of New Ireland, New Britain, the Solomons and New Hebrides. South American Type I panpipes have a scattered distribution along the western coast and throughout the Amazonian area. There is no apparent developmental continuum, for the morphological features which distinguish the subgroups of Pacific Type IV and South American Type I are difficult to rate on a developmental basis.

Test 10 is concerned with the convergence of the evidence, i.e. the extent to which traits satisfy tests that are independent of each other. Eleven parallels were rated good evidence of a historical relationship. All satisfy the tests of distribution, world infrequency, plurality of alternatives and redundancy.

CHAPTER IV

Analysis and Discussion of Results

Three main approaches were used to investigate the reliability of the panpipe as an indicator of a historical relationship between the Old and New Worlds: 1) A practical technique was devised for ascertaining the pitch sequence from panpipe morphology; 2) Information from the literature and data obtained from a survey of museum collections were analyzed to obtain reliable evidence pertaining to the world distribution of panpipe attributes; 3) A panpipe typology was established for panpipes for South America and the Pacific; 4) Tolstoy's method in long range comparison was applied to the parallel between Melanesian and Andean panpipe types. In this final chapter, the results are analyzed in relationship to the literature and goals of this study.

Problems of panpipe musical scales

The graphic method that was used to convert metric distances into acoustic distances resulted in a model which helps to distinguish the musical sophistication of four general categories of pitch sequences, suggesting the value of each as an indicator of a culture historical relationship. When tube lengths were plotted on semi-logarithmic paper some panpipe populations appeared as lines with a smooth downward curvature. Others were represented by straight lines, in some of which the plotted points marked the beginning and end of an octave whereas in others the octave was not represented in the pitch series. Some panpipe groups appeared as a series of line segments of varying slope.

Each of the patterns conveys information about the musical properties of the panpipe group. Some indicate the musical standard which governed the selection of tube lengths while others demonstrated that the musical standard, if any, cannot be ascertained from the physical properties of the individual instruments comprising the group. Smooth downward curves on semi-logarithmic paper suggest that the panpipes were constructed according to a rule of uniform length increments between adjacent tubes. It is evident that the physical appearance of the instrument was an important consideration in the manufacture of these instruments. The octave is rarely represented in the pitch series and the interval relationships are inconsistent, not only within the group but within a single panpipe. It is possible that selected tubes were sounded during a performance, while others were placed in the instrument only for the sake of appearance. In order to ascertain the musical scale it would be necessary to listen to the melodies that were played. A similarity of this feature in distantly separated panpipe populations is, alone, weak evidence of a historical relationship, for standards of metric proportions in a musical instrument may be independently applied. This was pointed out by Wead (1902), Roberts (1932) and Schlesinger (1939) and some of my museum data suggest this to be the case. The Machiguenga of the Peruvian montaña and the Moré of the central Amazon employ this principle and it occurs in some recent Italian and Egyptian panpipes, which makes it appear unlikely that the feature can be attributed to a historic relationship.

Panpipe groups represented by straight lines suggest that the pitch intervals between the pipes are equal, the degree of slope of the lines indicating the number of intervals in the octave. If the straight lines of a panpipe population exhibit the same slope and if the octave is represented in the pitch series, the instruments were constructed according to a culturally standardized sequence of equal pitch intervals. Parallels in panpipes following a scale containing the same number of equal pitch intervals suggest the possibility of a historical relationship, but this is not necessarily the case. During the early part of this century, it was assumed that scales of equal pitch intervals constituted proof of contact, but now it is generally accepted in musicology that such scales may exist for reasons not related to common musical theory. Parallels in equal interval scales are but one part of a total body of evidence that should be considered in the evaluation of a diffusion hypothesis. Anthropologists who cite scale similarity as evidence of panpipe diffusion are evidently not aware of present views in musicology.

If the octave is not represented in the pitch series of panpipes that appear as straight lines, it is possible that the instruments were constructed according to a rule of equal metric proportions. This is only likely, however, if each panpipe has a narrow span that does not extend much beyond the medium register, for within this range equal metric proportions and equal pitch proportions are approximately equivalent.

Panpipe measurements that appear as line segments of varying slope indicate that the pitch sequence is based on intervals of various sizes, which can mean either musical sophistication or simplicity, depending upon the extent of intra-group homogeneity. If a single population is represented and if the pattern of lines is random and if the octave is not represented, it is apparent that the panpipes are merely sound makers rather than musical instruments. It is likely that they were used for purposes of communication rather than to perform melodies. Although it is ethnographically significant that the artifact is a signaling device rather than a musical instrument, its specific pitch pattern is useless for tracing culture historical relationships. However, if the octave is consistently represented in such a panpipe population, it may mean that the pitch series of each instrument is a partial scale. The pattern of line segments will be a random one if different notes of the scale were selected for each panpipe. This pattern occurs in many Melanesian panpipes, where the practice is to make a new instrument for each performance. Given an adequate sample, it is possible to determine the number and size of the intervals of the musical scale that the panpipes follow. The third possibility is that the pattern of line segments is uniform throughout a population, which characterizes it as a musically sophisticated one. Almost unlimited possibilities exist for the division of the octave into uneven intervals. Therefore, similar patterns existing in distantly separated groups are strong evidence of a close relationship.

Our analysis has demonstrated that panpipes do not necessarily reveal musical scale merely because each tube represents a single unchangeable note. The selection of tube lengths may be governed by a number of different principles other than the custom which prevails in our culture of incorporating an entire musical scale into each instrument. If pitch pattern is to be used for comparative purposes, it is necessary to be aware of the cultural significance of the various principles that may be applied in its selection.

Panpipe relationships within the New World

In all of the New World, prehistoric panpipes are known from the Andean area, coastal Ecuador, western Mexico and the Gulf Coast and various parts of eastern North America. The chronological priority of the panpipe in South America is supported by later dates attributed to the few Mexican and North American panpipes that are known. Its priority in the Andean area relative to the rest of South America, however, is established only by negative evidence, i.e. no prehistoric panpipes are as yet known elsewhere. This may well be due to greater archaeological activity and more favorable conditions for preservation on the western coast. The ethnographic distribution pattern also favors western South America as the area of the initial appearance of the panpipe in the New World. Its presence has not been reported in the eastern and southern parts of South America, and the simplest panpipes appear in the northern, eastern and southern peripheries of the distribution area. This is the pattern to be expected if it is assumed that the center of panpipe dispersal in the New World was the western part of the continent.

Although the bulk of existing evidence points in the same direction, the Andean area cannot be taken as the only possible center. It has long been assumed in American archaeology that cultural influences before the rise of Chavín went from the Andean area into the Amazon Basin. Lathrap's work with pottery styles suggests, however, that some influences went in the opposite direction (1970). Panpipes with features strikingly similar to those of ancient Peru, and distinctly different from those occurring elsewhere, have survived until recently among some tropical forest peoples. The possibility cannot be ruled out that cultural currents carried their prototypes upstream to the Andes from an original home in the Amazon area if, as Lathrap suggests, some major migrations went in that direction.

The Bahia panpipes from Ecuador were included in Estrada and Meggers in a complex of traits asserted to be of trans-Pacific origin (1961). Marschall, in reconstructing panpipe diffusion within the New World, regarded the Bahia panpipes to be the earliest (1965:139). It appears, however, that Early Horizon Period specimens from the southern Andean coast may be older than those from Ecuador. Considering the time depth of the Early Horizon in the Andean area, it is possible that the antiquity of the panpipe in the New World extends back as far as 900 B.C., but there is as yet no way to date the specimens more accurately within the 700 year period of that horizon. The most conservative estimate places them near the upper end of the time range, which makes the Andean panpipes probably as early as the Ecuadorian ones. If a genetic relationship exists between the Andean and Ecuadorian specimens, an antiquity of the panpipe in the New World greater than 250 B.C. must be assumed in order to allow time for diffusion between sites almost a thousand miles apart. Present information does not suggest a probable direction of the diffusion that resulted in the panpipe being common throughout the entire Andean area by the Early Intermediate Period.

A relationship between panpipes that were excavated from graves of ancient Peru and some that are played in South America today, particularly in the Andean area, is indicated by musical trait parallels. When comparisons by means of musical similarity indices were made of all seventeen groups (types and sub-types) included in this study, all sub-types of Type I (Andean) clustered strongly by themselves and none clustered with other South American types. Panpipes of the Andean type are widely dispersed from Panama in the north to the Central Andean highlands in the south and extend eastward into the Amazon basin and also include prehistoric specimens from the coastal Andean area. Thus, similarity in musical traits, some of which do not occur elsewhere than among Andean type panpipes, supports widespread panpipe diffusion and a long continuity of panpipe musical traditions.

Morphological traits, on the other hand, fail to substantiate a historical relationship among the groups of panpipes that are linked by musical features. Comparisons by means of morphological similarity indices resulted in strong culstering, not only of South American types that are dissimilar in musical features, but also of Pacific and South American types for which no evidence of a relationship can be found. For example, Type I of the Pacific and Types I-4 and III of South America form a strong cluster. A historical relationship among these three groups appears unlikely inasmuch as Type I (Pacific) is restricted in distribution to the Admiralty Islands, Type I-4 (South America) is mainly northwest Amazonian in distribution and Type III (South America) is widespread, occurring primarily on the southern, eastern and northern peripheries of the area of distribution. What these types have in common, as do all types that cluster strongly on the basis of morphological similarity coefficients, is simplicity of construction. None are characterized by features which readily distinguish them from panpipes of other regions. However, sub-types of Andean type panpipes are characterized by morphological features that are typical of specific regions. All five are so distinctly different in appearance that a relationship among them could not be posited on morphological grounds. Evidence of a relationship exists only in musical features.

At least three unusual morphological panpipe features have persisted from prehistoric to recent times: double row of tubes, chain ligature and the insertion of a plug as a distal stop. These traits are typical of prehistoric Peruvian panpipes and occur in some panpipes of the western Amazonian area that were collected in the late nineteenth century, but are unknown features of recent panpipes of the area. The double row of tubes is characteristic only of the Central Andean highlands (Type I-1) where, in recent panpipes, both rows of tubes are closed at the distal ends, the one row half the length of the other. Panpipes from the area that were collected during the early part of this century were like the prehistoric ones, i.e., the tubes of each row are of the same length, one row open and one row closed, like the prehistoric specimens.[1]

A feature of the panpipes of Panama (Type I-2) which was present in the Andean area prehistorically is the two part panpipe linked with a cord. A similar instrument is

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[1]Except for one specimen in the collection of Dr. Alan Sawyer, said to have originated in northern Peru associated with material in the Recuay style, prehistoric panpipes with one row half the length of the other are unknown.

represented in Inca art. The natives of Panama often hold the two parts together when playing the instrument so that the shortest tubes are in the center. This suggests a possible relationship with the doubly graduated panpipes of the Bahia and Recuay figurines, both of which have the shortest tubes in the center.[1]

The few dates we have for panpipes of Mexico and North America are compatible with a northward diffusion of the panpipe from South America. Upper Tres Zapotes, the period to which the only dated Mexican panpipe is assigned, has a beginning date of A.D. 250. This is later than the dates assigned to the earliest panpipes of South America and, according to the excavator, the panpipes were among a complex of traits that appeared simultaneously and full blown without local antecedents, indicating the entrance of alien influences into the area (Drucker 1943:88). The North American joined tubes are not securely dated within the time span of Hopewell. None of the artifacts has been directly dated, but only by association with other objects from the mounds in which they were discovered. It is therefore not possible to say with certainty whether the North American or Mexican panpipes were the earlier. There may have been an overlap in time between Hopewell and the culture of Tres Zapotes. Nevertheless, on the basis of the estimated beginning dates for each of the

[1]There is an illustration of a figurine in the Recuay style representing a man blowing a panpipe with shortest tubes in the center while holding it upside down (Wiener 1880:625).

cultures, Mexican panpipes could have been ancestral to those of Hopewell (Tekiner 1974).

There are no morphological parallels to support relationships among panpipes of South, Middle and North America. All that can be discerned of panpipe details from the fragmentary Mexican panpipes and figurines is that they are simply graduated panpipes with five tubes. The Hopewell joined tubes necessarily differ in form because of the different problems involved in making a panpipe from copper rather than reed or clay. There is also no spatial continuity which supports a relationship among panpipes of the widely separated areas in which they have been found. Panpipes are not known from Panama to Mexico, and in all of North America there is evidence of their use only in Hopewell.

More than the meager evidence that has been presented here is required to make an acceptable case for south to north panpipe diffusion in the New World. Discontinuity in distribution is one of the main obstacles to making a convincing argument for the relationship of all New World panpipes through a single source which originated in, or was initially introduced into, South America. When, in addition, relationships cannot be demonstrated on the basis of form, the problem defies solution and can only await the discovery of new relevant data.

<u>Panpipe relationships within the Old World</u>

The earliest known Chinese panpipes are from Han times, which is later than those of Classic Greek culture for which there is reliable evidence. Whether the panpipe initially appeared in the Far East or in the Near East cannot be stated on the basis of present evidence. We do know that it played an important role in the musical culture of the Han period, for frescoes and stone carvings of the time show it to have been used in folk music, religious ceremonies and court rituals. These varied uses and the existence of several forms suggest a prior long development in Chinese music.

Panpipes have not been reported for any period in the area between eastern Asia and the Russian Caucasus, except for the Neolithic bone tubes from the Lake Baikal area of Siberia, previously discussed. Therefore, it would have to be judged on grounds other than distribution data whether early Chinese and Classic Greek panpipes had separate origins or whether they are the products of some historical contact. A relationship between early Chinese and Hellenic panpipes could be posited on the basis of two forms, one of which is uncommon and the other unknown elsewhere in the world. A rectangular panpipe is first reported in China during the Wei dynasty (Chuang 1963: 100). A similar panpipe is depicted in classic Greek art, and it may precede the Greek culture in Anatolia, for a rectangular instrument that appears to be a panpipe is represented in Hittite stone carvings. However, the rectangular panpipe occurs in Brazil and in Africa, even though it is uncommon in both places. On the other hand, there is an unusual variation of the rectangular panpipe that has a large square cut out of the lower end of the rectangle, so that several tubes are more than twice as long as the first six or seven. This feature is represented only in a stone carving of the Han dynasty in Ch'engtu, China and in Greek sculpture; it is unknown elsewhere in the world.

Recent panpipes of the Caucasus also suggest a relationship to Chinese panpipes on the basis of form. The panpipes of the Caucasus are doubly graduated, i.e. the notes of the scale alternate between two sides of the instrument, a tube arrangement that has been cited as evidence of contact between South America and East Asia. If this parallel constitues valid evidence of New World-Old World contact, the evidence applies as well to eastern and western Asian panpipes. If the latter relationships could be more firmly substantiated, greater credence could be given to Okladnikov's identification of the Neolithic Siberian bone tubes as panpipes. They might be viewed as representing the possible prototype of both eastern and western Asiatic panpipes, for early migrations of central Asiatic tribes went in both directions.

The form of the panpipes of the Karen of Burma suggests a relationship with Chinese panpipes, for they are also doubly graduated. Panpipes do not appear in the modern music cultures of Burma or India nor are they known for any other hinterland tribes. Like the Russian panpipes, those of the Karen constitute only an isolated piece of evidence to support a historical relationship with panpipes of China.

Panpipes of the recent musical cultures of Korea and Japan and countries of the Indo-China peninsula resemble in form the more recent panpipes of China, but there is no indication when contact might have taken place.

Cultures of prehistoric central Europe may be linked to those of southeastern Europe and the Near East by the Hallstatt and La Tène panpipes. Both instruments have tubes of graduated lengths, the common variety that provides little basis for evaluation as evidence of diffusion. Although the time and space gaps between prehistoric European and Greek panpipes cannot be filled by comparative data, known Greek influences in both the Hallstatt and La Tène cultures suggest that the European panpipes are probably of eastern Mediterranean origin.

In Melanesia today there is a more concentrated distribution of panpipes than elsewhere in the world and the greatest heterogeneity of form. Nothing is known of panpipes in the Pacific Islands before the early nineteenth century, but there is evidence, other than chronological data, of time depth in Melanesia. All Type IV panpipes, which consist of five sub-types distributed continuously throughout most of the chain of Melanesian islands, share similar musical features. All cluster strongly together when comparisons are made by means of similarity indices and none cluster with other Pacific types. In morphological features, however, the clustering of sub-groups of Melanesian Type IV does not follow the same pattern. Only IV-1 and IV-2 cluster by themselves. The other five sub-types of Type IV cluster either with other Pacific types or with South American types and sub-types. As is the case in the Andean area, the distribution of musical traits indicates widespread panpipe diffusion, probably over a long period of time, which is not substantiated by the distribution pattern of morphological traits. Only a few of the uncommon morphological features, such as the step ligature and pointed distal ends occur throughout much of Melanesia. Others, such as the double row of tubes which is restricted primarily to the Solomon Islands and the herringbone ligature which occurs only in New Hebrides, tend to distinguish the panpipes of the various major island groups from each other.

None of the evidence permits a reliable estimate of the direction of diffusion, either within Melanesia or between Melanesia and either the Asian or American continent. Panpipe distribution in the east ends in westernmost Polynesia and in the west in central New Guinea. Elsewhere in the Pacific, there is no reliable evidence of the panpipe which might suggest a prehistoric route to Melanesia. The panpipes of eastern Indonesia are disqualified because of the possibility that they represent a recent introduction and those of the Philippines because they differ markedly from true panpipes.

Panpipe relationships between the Old and New Worlds

The results of the computer analysis of types and subtypes substantiates the greater importance of musical traits over morphological ones as evidence of historical relationships. In the Pacific, panpipe groups that are most similar in musical traits are those that are geographically closer to each other, while those that differ greatly in musical trait content are most distant from each other. In South America, groups that cluster strongly together are not continuously distributed as in the Pacific, but their distribution is primarily in the Andean and adjacent areas. On the other hand, when comparisons are made on the basis of morphological traits, groups that cluster strongly together do not appear to be related on the basis of distribution, either within South America or within the Pacific. Furthermore, as far as possible relationships between panpipe types of South America and the Pacific are concerned, comparisons based on musical traits also provide more convincing evidence of contact than those based on morphological ones. For example, in musical features, sub-types I-5 of South American and IV-4 of the Pacific are the only two which cluster strongly by themselves. Their distribution and an unusual trait that is characteristic of each add support to a relationship that is indicated by similarities in musical features.

Type I-5 of South America consists largely of panpipes that were excavated from prehistoric graves in the coastal Andean area. A few are the products of Amazonian tropical forest peoples of the last century and may represent the survival of musical and morphological traditions that were once characteristic of Andean panpipes. Type IV-4 of the Pacific has primarily a Solomon Islands distribution with a few specimens reported from New Guinea. The most striking feature that is characteristic of both these South American and Pacific types is a double row of tubes, those of one row closed at the distal ends and those of the other row open throughout (61). This trait appears otherwise in South America only in Type I-1 of the Central Andean highlands, but is a feature only of those double row panpipes that were collected about half a century ago.[1] In the Pacific, the trait occurs otherwise only in Type IV-3, which also has a primarily Solomon Islands distribution. The main distinctions between Pacific sub-types IV-3 and IV-4 have to do with ligature and tube number.

As far as the data of this study are concerned, musical features appear to be more reliable indicators of diffusion than morphological ones, both within South America and within Melanesia. Inasmuch as the double row of tubes occurs in the South American and Pacific groups having the strongest musical links and, furthermore, that it is a trait which in South America is characteristic mainly of archaeological panpipes, the case for a prehistoric relationship between Melanesia and South America is greatly strengthened.

Another strong cluster linking panpipes of South America with those of the Pacific on the basis of musical comparisons is formed by IV-5 of the Pacific and I-3, I-4 and I-5 of

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[1]All the tubes of the more recent double row panpipes of sub-type I-1 are closed at the distal ends. Like the earlier variety, these function to enable the simultaneous blowing of two notes that are an octave's distance apart because the second row of tubes is half the length of the other.

South America. Sub-type I-5 of South America has other unusual morphological features in addition to the double row of tubes which has been discussed as possible evidence of a relationship with Sub-type IV-4 of the Pacific. They are as follows: 1) The proximal opening is formed by cutting a stalk of reed through a growth node and then piercing the node in its center (trait 43). 2) A piece of reed of smaller diameter is inserted into the proximal opening (trait 44). 3) A plug of wood or gourd is inserted to close the distal end of a tube which has been cut through its hollow part (traits 51, 52). 4) A rectangular piece is cut out of the distal end of tubes that are open throughout (trait 55). All these features occur in Type IV-5 of the Pacific and do not occur in other South American or Pacific types nor elsewhere in the world, as far as is known.

A third strong cluster based on musical traits is formed by sub-type IV-3 of the Pacific and sub-types I-2, I-3 and I-4 of South America. However, any relationship that the musical similarities among these groups may possibly suggest is not supported by morphological trait parallels that can be interpreted as reliable evidence of cultural connections.

All sub-types of Type I South American panpipes and all sub-types of Type IV Pacific panpipes are included in at least one of the three musical clusters which encompass both Old World and New World panpipes. Furthermore, adding to the probability that the similarities are indicative of a relationship, is the fact that no other South American or Pacific types, other than I and IV respectively, form part of the three clusters nor do any of them cluster together either within South America, within the Pacific or between South America and the Pacific.

When comparisons are made by means of morphological similarity indices a quite different pattern emerges. Three strong clusters are formed which include both South American and Pacific types, but there is no support from the geographic distribution pattern of the panpipes nor parallels in musical features to suggest that the similarities result from cultural connections. One interpretation of the results is that a large number of morphological traits making up the structure of the panpipe represent the most obvious or the simplest solution of the problem at hand and thus tend to arise independently.

The panpipe's reputation as indication of prehistoric trans-Pacific contact was built on published statements of the following Old World-New World parallels: 1) musical scale, 2) ligature with a supporting stick, 3) doubly graduated tube arrangement, 4) double row of tubes and the 5) linkage with a cord of a panpipe that is separated into two parts. Let us summarize the results of this study as they bear upon the probability that these parallels result from relationships between the Old and New Worlds.

1. There is strong evidence that some musical features of Melanesian and Andean panpipes are related, but it cannot be stated with certainty that musical scale can be included

among them. There is a similarity of pitch pattern of many Andean and Melanesian panpipe populations, and pitch pattern is the closest approximation to musical scale that could be obtained from available data. Whether or not the pattern of seven approximately equal intervals actually represents the scale which forms the basis of the music in areas where this pattern occurs is a moot point, but it is nonetheless the prevailing pattern in many panpipe populations of western South America and the Pacific. This pattern could not be traced further by means of investigations of panpipes because the instrument no longer exists in the native music cultures of surrounding areas and older specimens were not available for study.

2. The use of a stick together with a tie is a simple and obvious way to add rigidity to a panpipe, especially when the instrument is a large one. The trait is too widespread throughout the world to be rated good evidence of historical relationships.

3. There are five doubly graduated tube arrangements. In China, at least one form results from the application of a rule of separating supposed male and female elements by alternating the notes of the scale between two sides of a panpipe. Inasmuch as a similar form occurs in South America where the concept is unknown, the trait showed promise of providing an important piece of evidence of culture contact. When each of the five panpipe shapes which result from this practice is viewed as a separate state of the attribute, the

following three qualify as good evidence of a relationship between Melanesian and Andean panpipes: 1) lengths that alternate between two rows (trait 63); 2) the shortest tube in the center (trait 72); 3) one short and one long tube in the center (trait 73). However, a panpipe with the longest tube in the center (trait 71) and a panpipe in two parts whose shape is changeable depending upon the way in which the parts are pieced together (trait 74) do not appear in Melanesia and therefore were not included among the panpipe parallels evaluated in this study. The variety having its longest tube in the center occurs in the Andean area and in the Caucasus, suggesting either a separate independent invention in western Asia or an indirect relationship with Andean panpipes through a source that is unknown at present.

4. The prehistoric trans-Pacific diffusion of the two row panpipe with one row of open and one row of closed tubes receives support from its restricted distribution in Melanesia, its prehistoric presence in the Andean area and its co-occurrence in both areas with musical features that are not known to occur in panpipes elsewhere.

5. Panpipes that are linked with a cord do not occur in Melanesia and could therefore not be rated according to the criteria that were applied to Andean-Melanesian parallels. The trait occurs in Burma, is represented in Inca art objects and in panpipes that are played in Panama today.

Thus, of the five published parallels which have resulted in the panpipe being cited as evidence of trans-Pacific contact, this study has demonstrated that the most reliable evidence applies to the double row panpipe. A survey of museum specimens, an extensive search of the literature and the procedures applied to the data furnished five additional traits which bolster a hypothesis of Melanesian-South American culture contact: chain tie (26), step tie (27), herringbone tie (28), tubes that are unclosed at the distal ends (47) and a rectangular piece cut out of the distal ends of some tubes (55). The chain tie is widespread in both South America and Melanesia. The step tie is common in Melanesia and is known to have occurred in only a few prehistoric South American panpipes. The herringbone tie is restricted primarily to the New Hebrides in Melanesia, and in the Andean area it occurs in several prehistoric panpipes. There is insufficient information outside of the Pacific and South America to know whether these ties are obvious ways of joining tubes in a row. The herringbone tie appears to be the least likely of the three to be reinvented, but there is no way to substantiate this impression with the data that is presently available. Unclosed tubes and a rectangular piece cut out of the distal ends of tubes occurs in Melanesia only in bundle pipes, which are widespread there. Although there are no bundle panpipes in South America, these features occur in prehistoric double row specimens from the Andean area.

There are problems inherent both in the panpipe itself and in the available data which suggest reasons why methods that succeeded in demonstrating the probability of the trans-

Pacific diffusion of the bark beater and paper making industry were not equally rewarding when applied to panpipe data. A task that is basic to a proper application of the procedures recommended for long range comparison is a definition of the logical structure of a limited segment of culture, from which the possibilities for variation and combination of traits can be established. The bark beater complex constitutes a segment of culture that is more easily isolated than is that of the panpipe, for fewer traits on which the purpose of the bark beater depends have links outside of itself. The purpose of a bark beater can be stated in practical terms and its logical structure defined by situating the traits as alternatives in bark cloth production. The panpipe, on the other hand, is one of many wind instruments and wind instruments are but one category of the total inventory of musical instruments, the purpose of which is to make music. All the musical instruments used by any group of people, plus their singing, humming or whistling of melodies, constitute their music making equipment, the theoretical basis of which is a culturally standardized series of pitch intervals, or a musical scale.

Musical scale is one of the most important featres of panpipe structure, for it is linked to the goal of the panpipe. Because each tube represents a single unvariable pitch, I expected that tube dimensions would reveal the series of pitch intervals which form the basis of the music of the people who made the panpipes. This, however, was rarely the case. I was able to identify only general categories of pitch patterns for many panpipe groups. These categories furnished musical variables for a panpipe classification in terms of five features: register of instrument, spread of instrument, pitch pattern, representation of octave and completeness of pattern.

The question arose as to the significance of the similarities I found (or even of more precise identities in musical scale than I was able to demonstrate) as indicators of panpipe diffusion. The organ of transmission of a musical scale occurring in a panpipe population may well be an instrument other than the panpipe. What is even more likely, a scale may be carried in the heads of voyagers and be incorporated into any musical instrument they choose. For example, there are no xylophones in Melanesia and there are panpipes only in the extreme eastern islands of Indonesia. The xylophones of Indonesia have scales of seven equal intervals in an octave, like many panpipes of Melanesia. Further, the xylophones exhibit the same method of arranging the notes as I described for Melanesian panpipes, i.e. notes are omitted from the series of eight equidistant ones, so that double and triple gaps appear in the series. This pattern also occurs in xylophones of Africa (Jones 1971:97-104). However, a similar one does not appear in the few Indonesian or African panpipes I have observed. It is evident that it is necessary to look outside the limited segment of culture as defned by the panpipe to find evidence of the diffusion of musical scales.

A serious problem was the lack of sufficient distribution data elsewhere in the world, which weakened the reliability of the test of world infrequency when applied to a number of Melanesian-Andean trait parallels. Furthermore, trait parallels that afford convincing evidence of diffusion on the basis of some of the tests cannot strongly support a case for prehistoric trans-Pacific contact because of a lack of prehistoric data in the Pacific islands.

I believe that this study helps to distinguish trans-oceanic parallels to which Tolstoy's criteria can be effectively applied from those that are not likely to demonstrate the probability of diffusion in a manner more convincing than the usual impressionistic statements that are made. Certainly, musical instruments should be eliminated from consideration unless included in an extensive musical research project involving a study of the music itself. Even such a study would have built in limitations because the kind of information that can be obtained about prehistoric music is very limited.

This study also points out problems that may arise when attempting to describe the logical structure of an artifact which has a primarily aesthetic or ceremonial function. Similarities in designs (Ekholm 1953, 1962; Heine Geldern 1959, 1962; Heine Geldern and Ekholm 1951), in lot games (Erasmus 1950), in divining practices (Obayashi 1959), in calendrical symbols (Kelley 1960; Kirchoff 1966), symbols of rank (Heine-Geldern and Ekholm 1951) and wheeled toys (Ekholm

1946) are among those that have been proposed by serious scholars. If the method in long range comparison is to be applied, it should first be made certain that the structure can be de cribed as strictly as was done for the bark beater industry. The best results can be expected if the parallels represent utilitarian objects whose purpose can be specifically stated and if they constitute a discrete taxonomic category. Then the object can be defined as a limited segment of culture and the logic of its structure can be more easily described than was possible for the panpipe.

There are three tenuous pieces of evidence which suggest reasons in addition to data deficiency which might account for the inconclusiveness of the results of this study. 1) Similarity in form of recent Russian and early Chinese panpipes, 2) Neolithic Siberian tubes which might be panpipes and 3) the probable representation of the panpipe in Hittite art suggest the possibility of early links among panpipes of eastern and western Asia. If the panpipe existed in the Asian Neolithic, it could have been introduced into the New World via the Bering Straits when the immigrants' cultural baggage consisted of Old World Neolithic traditions. It is possible that the panpipe is part of an ancient cultural substratum that has been said to be responsible for similarities that are found between primitive peoples of Asia and the Americas. Color direction concepts, numerical classifiers in language, dragon ideas and the world tree are features that have been mentioned as occurring around the edges of the Pacific, which probably derive from early migrations (Coe 1968:175, 177). Perhaps panpipes should be included in this list. If the panpipe originally spread throughout the world when Upper Paleolithic and Neolithic migrations were taking place and trans-Pacific voyages were later responsible for the transfer of some features between the Old and New Worlds, this would account for the lack of clustering and continuum of most of the parallels in the distribution pattern.

So little of the world evidence of the panpipe is presently available that a single new piece of information to fill one of the many missing pieces in the reconstruction of panpipe history might change the picture significantly. More panpipe data from Asia are particularly needed to throw light on panpipe origins and a possible relationship between panpipes of East Asia and South America.

APPENDIX 1

Descriptions of Regional Panpipe Collections

The underlined names within each major geographic area are the panpipe proveniences which were secured from catalogues of the museum collections. South American panpipe collections were selected for inclusion in a particular major geographic area on the basis of information of the location of the group given in Handbook of South American Indians (Steward 1963) and by the collector. It is indicated in parentheses after each South American collection whether the provenience is that of an ethnic group (eth.), a geographic location (loc.) or a linguistic group (ling.). Most Pacific proveniences are geographic locations. Only ethnic groups are indicated (eth.). The numbers following the sample number of the collection are the serial numbers I have assigned to the panpipes included in the study. Information supplied by a museum about a specimen, its museum catalogue number and the type to which I have assigned it is located in Appendix 2. The specimens are listed in Appendix 2 in sequence according to my serial numbers within each major geographic area.

South America

1) Panama

Cuna (eth.), Tupi (eth.), San Blas (loc.), Darien (loc.). South of isthmus of Panama. 23 panpipes: 37, 43-48, 50, 51, 54, 56-62, 182, 337, 338, 545, 546, 777, 778.

All panpipes are separated into two parts with four tubes in one part and three in the other. The two parts are linked together with a loose cord. All panpipes are doubly graduated, the sequence of notes alternating from one part of the panpipe to the other. There are two methods of tube joining: 1) a cord is wound around and between each tube and 2) many rows of cord are wound closely around the first tube, then two tubes together followed by three and four together. The majority of panpipes span approximately one and three quarter octaves in high, medium, low and very low ranges. Three panpipes span less than an octave. The total span of the collection is three octaves with the mean in the medium range. The majority of panpipes have four notes in an octave with the octave not represented in the pitch series. When two panpipes (consisting of four parts) are combined so that the sequence of notes alternates between them, the octave is represented in the pitch series and there are seven approximately equal intervals in an octave.

2) North Central Amazon

Wayana (eth.). British Guiana, Surinam, French Guiana. 16 panpipes: 14, 15, 18, 19, 89, 344-347, 514, 736, 752, 838-841.

There are four or five tubes in each panpipe arranged in a single, simply graduated row and fastened with cord wound back and forth between the individual tubes. The proximal ends are round and the distal ends cut through the node. The spread of individual panpipes is less than one octave to one and a half octaves in high, medium and low ranges. The total span of the collection is less than two octaves in medium range. The spacing of the notes is uneven and highly variable. The octave is not represented in the pitch series.

3) Northern Colombia

Noaname (eth.). 3 panpipes: 542-544.

Each panpipe has two, three or four tubes arranged in a single, simply graduated row and fastened with fiber wound back and forth between the tubes. The proximal ends are round and the distal ends cut through the node. Each panpipe spans one-fourth octave in medium range. The spacing of the notes is uneven and variable. There are very small distances between notes.

4) Northwest Amazon

Makiritaré (eth.). Venezuela. 2 panpipes: 279, 281.

There are five tubes in one panpipe and six in the other, each arranged in a single, simply graduated row. The tubes are joined with a cord wound back and forth between each one. The proximal ends are round and the distal ends are cut through the node. The span of individual panpipes is one and one third octaves in medium and low ranges. The pitch pattern of both is four notes in the octave with the octave not represented in the pitch series. The two panpipes apparently constitute a pair, for the one supplies the alternate notes of the scale that are missing in the other. When the two series of pitches are combined, there are seven approximately equal intervals in the octave with the octave represented.

Piapoco (eth.). Northwest Colombia. 3 panpipes: 436-438.

Each panpipe has five tubes arranged in a single, simply graduated row. The tubes are joined by means of a cord wound around and between each. The proximal ends are round and the distal ends cut crosswise through the node. One panpipe spans half an octave with the notes closely spaced. Two panpipes span one and a quarter octaves each with four notes within the distance of a single octave and the octave not represented. When the two panpipes are combined, there are seven approximately equal intervals in the octave with the octave represented in the pitch series.

Baniwa (eth.), Aiary River. 4 panpipes: 507, 551-553.

Each panpipe has six, seven, eight or ten tubes arranged in a single simply graduated row and joined with cord wound back and forth between the tubes. The proximal ends are round and the distal ends cut through the node. One panpipe has eight uneven intervals in an octave with the octave represented in the pitch series. The notes of the other panpipe are also irregularly spaced, but not in the same manner and the octave is not represented. Three panpipes span less than an octave and one spans slightly over an octave in medium and high ranges. The spread of the collection is approximately one and a third octaves.

Esmeraldas (loc.), Cayapa (eth.), Payamino (loc.), Jivaro (eth.), Putumayo River (loc.), Southeast Colombia (loc.), Ecuador (loc.), Northwest Brazil (loc.). 15 panpipes: 40, 49, 53, 78, 91, 142, 166, 269, 272, 350, 351, 549, 802, 803, 846.

Each panpipe consists of 14, 15, 17, 20, 21, 24, 26, 27, 28 or 29 tubes arranged in a single, irregular row. The tubes are joined with horizontal and diagonal sticks placed proximally and distally on either side of the panpipe and fastened with a criss cross ligature. The proximal openings are round and the distal ends are cut crosswise at varying distances below the node. The range of individual panpipes is two to four octaves in very high, high, medium and low ranges. The spread of the collection is four octaves in medium range. Within the distance of an octave there may be 5, 6, 7, 8, 9, 10 or 11 notes. The octave is represented in the pitch series throughout the range of most of the panpipes. Frequently the same note is repeated in the pitch series of a single panpipe.

Sibondoy (eth.), Putumayo River, Colombia. 2 panpipes: 548, 796.

One panpipe has 16 and the other 17 tubes arranged in a single, simply graduated row. The tubes are joined by means of sticks fastened diagonally and the distal end horizontally at the proximal end on both sides of the panpipe. The sticks are fastened to the tubes with a ligature wound back and forth between each one. The spread of the individual panpipes is one to three octaves in high, medium and low ranges. Most panpipes have six unevenly spaced notes in an octave with the octave occasionally represented in the pitch series.

Witoto (eth.), East Ecuador. 2 panpipes: 342, 407a.

Each panpipe has three tubes arranged in a single, simply graduated row. The tubes are painted yellow and are wrapped in a piece of bark cloth to join them. The proximal ends are round and the distal ends cut through the node. The notes are irregularly spaced in a different manner in each panpipe and the octave is not represented in the pitch series.

Uaupés (loc.) on Caiary River, Northwest Brazil. 12 panpipes: 419s-424s, 425-427, 443, 500, 705.

Each panpipe has 6, 8, 9, 12, 13, 16 or 17 tubes arranged in a single, simply graduated row. The tubes are joined by means of two sticks placed horizontally, one on each side of the panpipe on the proximal end and two sticks placed diagonally, one on each side at the distal end. The sticks are fastened to the tubes with a criss cross ligature. The proximal ends are round and the distal ends are cut through the node. The spread of the individual panpipes is one half to two and a quarter octaves in high, medium, low and very low ranges. There are three, four, five or six notes in an octave with the octave occasionally represented in the pitch series. The distances between notes are approximately evenly divided throughout the range of each panpipe. Some of the pitch patterns suggest that two panpipes might have been combined to complete a scale of seven approximately equal intervals in an octave. The spread of the collection is four octaves in high, medium, low and very low ranges.

Colombia (loc.). 5 panpipes: 447, 456, 517-519.

There are seven, eight and nine tubes arranged in a single, simply graduated row. The proximal ends are round and the distal ends cut through the node. The tubes are joined by two sticks placed horizontally across the proximal end of the panpipe, one on each side, fastened with a criss cross ligature. In the medium range of each panpipe there are five or six notes in an octave with the octave represented in the pitch series. In the low range, there is as much as a half octave's distance between notes. The notes are spaced irregularly throughout the range of each panpipe. The span of the individual panpipes is approximately two octaves in high, medium and low ranges. The spread of the collection is two and a half octaves with the mean in the medium range.

Colombia (loc.) 3 panpipes: 176, 850, 851.

Each panpipe has ten or twelve tubes arranged in a single row. All are doubly graduated with one long and one short tube in the center. They are joined by means of sticks which are fastened to the tubes with a criss cross ligature. The spread of the individual instruments is one and a half to two octaves in very high, high and medium ranges. The total spread is two and a half octaves. There are seven unequal intervals in the octave with the octave represented in the pitch series of all three panpipes. There is no apparent consistency in the spacing of the notes.

5) Western Amazon

Bora (eth.), Colombia-Peru border. 5 panpipes: 29, 30, 55, 456, 457.

Three panpipes have three tubes each, arranged in a single, simply graduated row and joined with cord and an asphalt-like material. The proximal ends are round and the distal ends are cut through the node. Each spans approximately one third octave in low frequency. The notes are spaced irregularly with no consistency among the three panpipes. Two panpipes have nine and ten tubes each, arranged in a single simply graduated row and joined with sticks placed horizontally across the proximal end and fastened with a criss cross ligature. Because some of the tubes are missing, the pitch pattern cannot be determined.

Tucano (eth.), Tiquié River, Western Brazil. 6 panpipes: 74, 428, 448, 449, 506, 515.

Each panpipe has six, seven, nine or ten tubes arranged in a single, simply graduated row. Two methods of tube joining are represented: 1) two sticks are placed horizontally across the proximal end of the panpipe, one on each side, and fastened with a criss cross ligature and 2) a flexible splint is wrapped around all tubes. The proximal ends are round and the distal ends cut through the node. There are four unevenly spaced notes in an octave with the octave occasionally represented in the pitch series. 448 and 449 are designated by the collector as a pair. When these two are combined so that successive notes of the scale alternate between them, there are seven approximately equal intervals in an octave with the octave represented in the pitch series. The other four panpipes have a similar manner of spacing notes, suggesting that each represents one of a pair, the other member of which is missing. The spread of the individual instruments is one and a half to two and a half octaves in high, medium and low ranges. The spread of the collection is two and three quarter octaves with the mean in the medium range.

Yagua (eth.), Mazan, Loreto and Ampiyacu Rivers, Western Brazil. 13 panpipes: 85, 86, 233-238, 389, 390, 792, 793.

The number of tubes in the individual panpipes is as follows: 10, 11, 12, 13, 16, 19, 20, 24, 27, 30, and 32. All are arranged in a single, simply graduated row. The proximal ends are round and the distal ends are cut through the natural node of the reed. The tubes are joined by several rows of string wound around each tube and tied between the tubes. In a few cases, a stick is added for support. Five panpipes from the Mazan River span one and a half to two octaves in very high, high and medium ranges. Together they span two and a quarter octaves with the mean in the high range. Two panpipes have seven approximately equal intervals in an octave. In the other three panpipes the individual notes are spaced at the same distances, except that one or more notes are omitted from the series. The pattern is not consistent for any one instrument throughout the total range of the panpipe. Panpipes from the Loreto and Ampiyacu Rivers span three and a half octaves each in very high, high, and medium registers. The notes are spaced unevenly in groups of one, two and three notes with no consistent pattern throughout the range of a single panpipe or between panpipes. Six notes to an octave predominates. Because of the inconsistent patterning, there is no suggestion of a standard pitch pattern.

<u>Omagua</u> (eth.), western Brazil-eastern Peru. 1 panpipe: 538.

The panpipe has eleven tubes arranged in a single, simply graduated row. The proximal ends are round and the distal ends cut through the node. The tubes are joined with a chain ligature of cord across the middle of the instrument and a horizontal stick fastened with a criss cross ligature at the proximal end. The spread of the panpipe is one and a third octaves in high and medium registers. There are seven approximately equal intervals in an octave throughout the total range with the octave represented.

Upper Amazon (loc.). 2 panpipes: 513, 786.

There are seven tubes in one panpipe and twelve in the other. Both are arranged in a single, simply graduated row. The tubes of one are joined with a chain ligature; the tubes of the other have a cord wound around each tube in turn with a stick inserted through the tie for support. The spread of panpipe 786 is one and a half octaves ranging from high to medium registers. There are seven approximately equal intervals in the octave throughout its range with the octave represented in the pitch series. Panpipe 513 spans less than an octave and contains seven unevenly spaced notes.

6) Central Amazon

Chacobo (eth.), Beni Province (loc.), Chiquito (eth.), Huanyam (eth.), Amniapé (eth.), Eastern Bolivia and western Brazil. 9 panpipes: 41, 181, 349, 508, 510, 512, 522, 523, 526.

All panpipes have four or five tubes arranged in a single, simply graduated row and joined with a back and forth tie. The proximal ends are round and the distal ends either cut through the node or below the node. The spread ofeach instrument is less than one octave or slightly more than one octave. The notes are unevenly and inconsistenly spaced and the octave is not represented in the series of pitches.

Nambicuara (eth.), Tupari (eth.), Trumaí (eth.), Central Brazil. 6 panpipes: 25, 181, 349, 430-432.

Each panpipe has four, five or six tubes arranged in a single, simply graduated row and joined by a cord wound around and between each tube. The proximal ends are round and the distal ends are cut through the node. The spread of individual panpipes is slightly less than one octave in medium and low registers. There are either four or six unevenly spaced notes in an octave, the manner of spacing differing for each panpipe. The octave is not represented in the pitch series.

More (eth.), western Brazil. 24 panpipes: 485-499, 501-505, 530, 535-537, 554, 555.

Each panpipe has 4, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17 or 21 tubes arranged in a single, simply graduated row. The tubes are joined by placing two sticks, one on each side horizontally across the proximal end of the instrument and attaching the tubes to the sticks with a criss cross ligature of cord. The proximal ends are round and the distal ends cut through the node. Most of the panpipes are decorated with brightly colored feathers. Within the range of a single panpipe the number of notes in an octave is highly variable. In the high registers there may be as few as three notes in an octave with as many as ten, eleven and twelve notes in an octave in the low registers. In the medium registers there are either seven, eight or nine notes in an octave. The octave is not represented in the pitch series in the high registers but is sometimes represented in medium and low registers.

The pattern of spacing the notes is characteristic of panpipes that are constructed according to equal metric proportions between adjacent tubes. The spread of individual panpipes ranges from less than one octave to three octaves in very high, high and medium registers. The spread of the collection is three octaves with the mean in the medium register.

Paressí (eth.), central Brazil. 1 panpipe: 509.

There are five tubes arranged in a single, simply graduated row joined with a chain ligature. The proximal ends are round and the distal ends cut through the node. There are four notes in an octave with the octave no represented in the pitch series.

Cayabí (eth.), Mato Grosso, Brazil. 2 panpipes: 327, 328.

There are six tubes in each panpipe arranged in a single, simply graduated row and fastened with a chain ligature. The proximal ends are round and the distal ends cut crosswise through the node. The span of the individual panpipes is approximately one fourth octave in low register.

Trumaí (eth.) Rio Xingú, central Brazil. 3 panpipes: 430-432.

Each panpipe has four or six tubes arranged in a single simply graduated row and joined by a cord wound around and between each tube. The proximal ends are round and the distal ends are cut through the node. The spread of the individual panpipes is slightly less than one octave in medium and low registers. There are either four or six notes in an octave, unevenly spaced in a different manner in each panpipe.

7) Montaña

Iquitos (loc.), Peru; Ucayali River (loc.), Peru. 3 panpipes: 513, 675, 676.

Two panpipes have five tubes each and one panpipe has twelve tubes arranged in a single, simply graduated row and fastened with a chain ligature. There are four or five unevenly spaced notes in an octave with the octave not represented in the pitch series.

Campa (eth.), Peru. 7 panpipes: 13, 26, 27, 28, 38, 434, 435, 797.

Each panpipe has five, nine, ten or twelve tubes arranged in a single, simply graduated row. There are two methods of tube joining: 1) back and forth tie and 2) one or two sticks placed horizontally across the instrument and fastened to the tubes with a criss cross ligature. The proximal ends are round and the distal ends are cut through the node or below the node. The projecting portion of those cut below the node are cut on a bias. There are six, seven, eight or nine notes in an octave with the octave rarely represented in the pitch series. The distances between notes increase progressively toward the higher ranges, suggesting that the panpipes were constructed according to metric proportions between adjacent tubes. The spread of individual instruments ranges from less than one octave to two octaves in high, medium and low ranges. The spread of the collection is three octaves with the mean in the medium range.

Machiguenga (eth.), southern Peru, east of the Andes. 34 panpipes: 352-384, including 366a.

Twenty of the panpipes have five tubes. The others have 8, 9, 11, 12, 13 or 16 tubes. There are two ways of joining the tubes: 1) chain tie or 2) two or three sticks are placed across the proximal and distal ends of the panpipe and are fastened to the tubes with a criss cross ligature.

On the smaller panpipes the sticks are placed horizontally. An additional stick is placed diagonally across the larger panpipes. All are arranged in a single, simply graduated row. The proximal ends are round and the distal ends cut below the node on a bias.

None of the five tube panpipes span a full octave and there is no consistency within the group in the distances between notes. All are in the medium range, a few panpipes having one note that extends into the low and high registers. The total spread of the twenty panpipes is one and one quarter octave with a mean in the medium range.

The following description applies to the larger panpipes with eight to fourteen tubes. Within the range of a single panpipe the number of notes in an octave is from four to ten. The number of notes in an octave increases as the pitch decreases. In the low register there are usually ten notes in an octave, while in the high register there are as few as three or four notes in an octave. The octave is not represented in the pitch series in the high registers, but is occasionally represented in the medium and low ranges for the more notes there are in an octave, the more likely it is that the octave is represented. In the medium to low ranges, the distances between the notes tend to be approximately equal. The pattern is characteristic of panpipes that are constructed according to equal metric proportions between adjacent tubes.

8) Central Andean Highlands

Aymara (ling.), Quechua (ling.), La Paz (loc.), Chucuito (loc.), Puno (loc.), Peru and Bolivia near Lake Titicaca. 71 panpipes: 16, 17, 36, 63, 75, 76, 79-82, 90, 113, 165, 179, 180, 180a, 264-266, 276, 277, 394, 395, 421-424, 429, 451-455, 458-463, 668, 684-699, 730, 744-746, 774, 775, 807-813, 847, 848.

Three methods of tube arrangement are represented in the collection: 1) single row, simply graduated; 2) double row with one row of simply graduated closed tubes and one row of simply graduated open tubes, both rows of the same length; 3) double row, both rows simply graduated, one row of tubes one-half the length of those in the other row. Fifteen specimens are double row panpipes with one row of open tubes and one row of closed tubes of the same length that were collected in the late nineteenth and early twentieth centuries. All double row panpipes collected since the early 1930's have all tubes closed at the distal ends, one row one-half the length of the other. The number of tubes in the single row panpipes are always six or seven; in the double row panpipes there are either six, seven or eight tubes in each row. The proximal ends of the tubes are round. The distal ends of the closed tubes are cut either through the node or below the node. The open tubes are cut on a bias at the distal ends. The method of tube joining is uniform throughout the collection. A flexible splint is wrapped around all tubes and a cord is passed back and forth between the tubes to hold the splint in place.

The spread of the individual panpipes is one and a half to two and a quarter octaves in very high, high, medium low and very low registers. The majority of panpipes have four notes in the octave with the octave not represented in the series of pitches. Some have three or five notes in the octave, also with the octave not represented in the pitch series. In many panpipes the distances between the notes are evenly divided, but in others they are not.

Some panpipes have been designated by the collector as members of a pair. When these are combined so that the series of increasing pitches alternates between the two instruments, the octave is represented in the pitch series and there are seven approximately equal intervals in an octave. This may be the prevalent pattern of the collection, but is discernible only when both members of the pair are present. Tubes of the second row of all double row panpipes furnish the next higher octave of the tubes of the first row when adjacent tubes are blown simultaneously.

The use of panpipe 89, according to the collector, is by cattlement. The collector of panpipe 684 states that it is used as a dance accompaniment.

9) Archaeological Andean Area

Inca (eth.). 1 panpipe: 84; Chancay (loc.) 1 panpipe: 663; Ancon (loc.) 1 panpipe: 670; Huacho (loc.) 3 panpipes: 662, 665, 726; Ocucaje (loc.) 2 panpipes: 539, 660; Arica (loc.) 1 panpipe: 798.

All are reed, double row panpipes with seven or eight tubes in each row which are simply graduated. The tubes of one row are closed at the distal ends and the tubes of the other row are open throughout. They are joined with a finely made chain ligature which, in some cases, covers the entire panpipe. Frequently, cords of different colors are used by means of which a design is worked into the binding. The proximal ends of the closed tubes are round and completely open. The proximal ends of the open tubes are cut through the node with an opening pierced in the center of each. The distal ends of the closed tubes are cut through the hollow part of the reed and a well fitting piece of wood or gourd or a plug of cotton is inserted as a stop. Two or more of the distal ends of the open tubes of all panpipes have a rectangular piece cut out. There are four, dive and six notes in an octave. The distances between the notes is variable.

Paracas (loc.) 10 panpipes: 900-904, 914-919.

All panpipes are made of clay. Each has two, four, six, seven or fifteen tubes arranged in a single, simply graduated row. Several of the panpipes have two holes in either end, presumably for the insertion of a carrying cord. Six panpipes were measured. In each, there are four notes within the distance of an octave, the pattern of spacing of the notes differing in each instrument.

Pachacamac (loc.) 5 reed panpipes: 661, 671, 771, 773. 1 silver panpipe: 678.

All reed panpipes have a double row of tubes with seven or eight tubes in each row which are simply graduated. Both rows are of the same length with one row of tubes closed at the distal ends and one row open throughout. Each panpipe has four, five, six or nine closed tubes and an equal number of open tubes. The proximal ends are narrowed by the insertion into the opening of a piece of reed of narrower diameter. The distal ends are either cut through the node or cut through a hollow part of the reed. In the case of the latter, a piece of wood is inserted as a distal closure. The tubes of three of the panpipes are joined with a chain ligature and one with a step ligature. The spread of the individual panpipes is from one to one and three quarter octaves in high and medium ranges. There are four, five and six notes in an octave with the octave not represented. The pattern of spacing the notes is variable.

The silver panpipe is so small it seems unlikely it was used as a musical instrument. The tubes are almost equal in length, making for very slight pitch distinctions.

Virú (loc.) and Chimbote (loc.) 6 silver panpipes: 677, 679-683.

The number of tubes in each panpipe are five, six and ten. They are arranged in a single, simply graduated row. The tubes are very small and of almost equal length.

Ica (loc.) 6 panpipes: 32, 540, 541, 664, 667, 669.

Five are double row panpipes and one is a single row panpipe, all arranged in a single, simply graduated row. There are four, five or seven closed tubes in each panpipe. The double row panpipes have an equal number of open tubes. Three kinds of proximal openings are represented in the collection: 1) round and completely open; 2) a reed of smaller diameter inserted or 3) cut crosswise through the node with an opening pierced in the center. The distal ends are cut through a hollow part of the reed and a piece of wood or cotton is inserted as a distal closure. The tubes are joined with chain ligatures of colored cord. One panpipe is decorated with shells. The spread of the individual panpipes is less than one octave to one and one half octaves in medium register. One panpipe has six irregular divisions of the octave and one has four irregular divisions with the octave not represented in either of them. Four panpipes could not be measured because they were damaged.

Nazca (loc.) 3 reed panpipes: 727, 769, 770, 26 clay panpipes: 64, 71, 72, 178, 445, 446, 720, 725, 731, 784, 785, 823, 900-912.

The reed panpipes are all simply graduated double row with 5 closed tubes and five open tubes of equal lengths. The proximal ends are either round and completely open or cut crosswise through the node with an opening pierced in the center. The distal ends are cut through the hollow part of the reed and a piece of wood or gourd is inserted. The open tubes have a rectangular piece cut out of the distal ends. The tubes are joined by means of a chain ligature made of colored cord, which covers a large part of the panpipe.

The clay panpipes are made of either red or brown clay and most are undecorated, but a few have white linear decorations. There are 6, 7, 8, 10, 11, 12, 13 or 15 tubes in each panpipe. The proximal openings are either round or oval. The spread of the individual instrument ranges from less than an octave to three octaves in high, medium and low ranges. There are either four, five or six notes in an octave. The divisions are irregular and the octave is not represented in the pitch series.

Pacific Islands

1) New Guinea

Massim (eth.). 4 panpipes: 183-186.

There are three reed panpipes and one made of bird quills. Each panpipe has seven, nine or ten tubes. The tubes of reed are fastened by means of sticks placed horizontally and diagonally across the instrument and fastened with a back and forth tie. The bird quills are joined with tar. The proximal ends are round and the distal ends cut crosswise through the natural node of the reed. The proximal ends of the bird quills furnish the distal stops for the panpipe tubes. The tubes of all are arranged in a single, simply graduated row. The spread of the individual instruments ranges from one to two octaves in high and medium registers. The mean is in the medium register. Three pitch patterns are represented: 1) Six approximately equal intervals in an octave with the octave represented in the pitch series; 2) seven approximately equal intervals with the octave represented in the pitch series; 3) four unequal intervals with the octave not represented in the pitch series.

Eastern highlands. 2 panpipes: 387-88.

Both panpipes have four tubes joined by a simple tie that is wound around and between each tube. The proximal ends are round and the closure for the distal ends is formed by cutting below the growth node. The projecting portion below the node is indented on two sides. Both panpipes are arranged in a single row that is simply graduated. The spread of both instruments is less than an octave in the medium range.

Both panpipes have four unequal intervals in less than one octave. The size of the intervals differs in each instrument.

Sepik River. 16 panpipes: 407s, 556-576.

There are five single row simply graduated panpipes with three, four, five or six tubes joined with a step ligature. The proximal ends are round and the distal ends cut crosswise through the node. One panpipe has a double row of tubes with one row open and the other closed. The instruments individually span less than an octave or slightly more than an octave in low and medium ranges. The spread of the collection is slightly less than two octaves. Two length patterns are represented: 4 unequal intervals in less than an octave and 5 unequal intervals in less than an octave with the octave represented in the pitch series. The notes are in groups of two, three and four. The notes within each group are closely spaced and equidistant. The groups are separated by two or three full steps.

Nine are bundle panpipes with 3, 4 or 5 tubes. Most of the tubes are hollow throughout, but on one each panpipe is closed at the distal end. Some open tubes have a rectangular piece cut out of the distal ends. They are in the low and very low ranges.

Mengen (eth.) 8 panpipes: 409-15, 417.

Five are single row simply graduated panpipes with 5, 6, 7 or 8 tubes joined with a step ligature at the distal end and a chain ligature at the proximal end. The proximal ends are round and the distal ends cut crosswise through the node.

Three are bundle panpipes with 9 tubes each which are hollow throughout. The tubes are joined by a fiber fastened around all. All panpipes are in the medium range and they span one-half to one and one quarter octaves. The octave is represented in the pitch series of the four panpipes than span a full octave and more. The notes are in groups of two, three and four which are closely spaced and equidistant from each other. The groups of notes are separated from each other by two or three full steps. They appear to be extracted from a full pattern of eight equidistant notes to an octave, suggesting either that a scale is completed by the combination of several panpipes or that each panpipe was made for the purpose of playing a particular melody that does not require the entire series of notes that constitute a scale.

Piago of South Papua. 12 panpipes: 140, 143-6, 148-52, 175, 177.

Each panpipe has five or six tubes joined by fiber wound around and between each tube. The proximal ends are round and the distal ends are cut crosswise through the node. The tubes are arranged in a single graduated row. All of the instruments span less than one octave in medium and high ranges. Together, the 12 panpipes span almost two octaves with the mean in the medium range. There are groups of notes that are spaced equidistantly, which are consistently of the same distance from each other in all panpipes. In some panpipes there are one or two notes that are separated from these groups by a full step. The spacing between the regularly spaced notes is such that 10 equidistant notes would fit into the space of one octave if all the gaps were filled.

2) Admiralty Islands. 19 panpipes: 8, 241-244, 268, 268a, 302, 335, 417s, 474, 573-80.

These are very small panpipes of 4, 5, 6 and 8 tubes of approximately equal lengths. The tubes of some panpipes are joined by a clay sheath into which a few linear decorations are incised. Others have fiber wound back and forth many times between the tubes. The proximal ends are round and the distal ends cut crosswise through the node. All are single row panpipes, some of which are simply graduated and others are irregular. None of the panpipes span a full octave and all are in the medium range. Together they span one and three quarter octaves with a medium mean range. There are 4, 5, and 6 unequal intervals in less and an octave with very small pitch distinctions. In some, there are repetitions of the same notes in one panpipe.

3) New Ireland

New Hanover. 7 panpipes: 651a, 653, 654, 654a, 655, 655a, 656.

Each panpipe has 6, 12, 13, 18, 21, 22 or 23 tubes, all of which are joined by a chain ligature at the proximal end and a step ligature at the distal end. The proximal ends are round and the distal ends cut crosswise through the node. The tubes of all panpipes are arranged in a single, graduated row. The spread of individual instruments ranges from less than one octave to 3½ octaves in medium and high ranges. The spread of the collection is approximately four octaves with the mean in the medium range. The length pattern of each panpipe is 7 approximately equal intervals in an octave with the octave represented in the pitch series. This pattern is consistent through the range of each panpipe.

Feni. 8 panpipes: 588, 590, 591, 598, 609, 621, 624, 636.

Each panpipe has 6, 7, 8, 9, 11, 13, 14 or 15 tubes joined with a chain ligature at the proximal end and a step ligature at the distal end. The proximal ends are round, and the distal ends are cut crosswise through the node, except that the first tube which sounds the lowest note, is cut well below the node. The tubes are arranged in a single graduated row. The spread of each instrument is from one to two octaves in medium and high ranges. The entire collection encompasses three octaves with the mean in the medium range. There are two length patterns: 5 equal intervals with the octave represented and 5 unequal intervals with the octave represented. The notes are narrowly spaced in groups of two's, three's and four's with a full step or two steps between each group. There is no consistent pattern within the total range of any single panpipe. The notes of each panpipe are apparently extracted from a scale of 8 equidistant notes to an octave.

Lihir. 1 panpipes: 187, 188, 586, 599, 603, 612, 613, 619, 620, 627, 630, 633.

Each panpipe has 6, 7 or 14 tubes, joined by a chain ligature at the proximal ends and a step ligature at the distal ends. The proximal ends are round and the distal ends are cut crosswise through the node. The tubes are arranged in a single graduated row. The register of each instrument is one to two octaves in medium and high ranges. The collection encompasses three octaves with the mean in the medium range. Each panpipe has five unequal intervals with the octave represented. The notes are in groups of two's, three's and four's, the group separated by gaps of 2, 3 and 4 full steps.

King. 7 panpipes: 625, 629, 632, 635, 637, 662.

Each panpipe has 5, 6 or 8 tubes, joined with a chain tie at the proximal ends and a step tie at the distal ends. The proximal ends are round and the distal ends are cut crosswise through the node or below the node. The tubes are arranged in a single graduated row. Some panpipes do not encompass an octave and others range from one to two octaves in medium and high ranges. The collection encompasses three octaves with the mean in the medium range. The length pattern is five unequal intervals in the octave with the octave represented in the panpipes that span an octave or more. The panpipes that do not span an octave also have five unequal intervals. The notes are in groups of two's, three's and four's.

Pt. Sulphis. 2 panpipes: 587, 600.

There are eight tubes in each panpipe which are joined by a chain tie at the proximal end and a step tie at the distal end. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of both instruments is from one to two octaves in the medium range. Together they span 2½ octaves. The pitch pattern is five unequal intervals in the octave with the octave represented.

Muliama. 5 panpipes: 592, 594, 595, 614, 626.

Each panpipe has five, seven, or eight tubes that are joined by a chain tie at the proximal end of the instrument and a step tie at the distal end. The proximal ends are round and the distal ends are cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of the individual instruments is under one octave to two octaves in the medium range. The collection covers two octaves in medium range. The pitch pattern is the same as described for other panpipe groups in New Ireland.

Nissan. 4 panpipes: 650, 651, 800, 825.

Each panpipe has 7, 8, 9, or 14 tubes that are joined with a chain tie at the proximal end and a step tie at the distal end. The proximal ends are round and the distal ends are cut crosswise through the node, except the longest tube which is cut well below the node. The tubes are arranged in a single graduated row. The spread of the individual instruments are from one to three octaves in medium and high ranges. The collection encompasses three octaves with a mean in the medium range. The length pattern is five unequal intervals in the octave with the octave represented in the pitch series. The notes of some panpipes are spaced in groups of two's, three's and four's, as described for the other New Ireland panpipe groups. In other panpipes there are six approximately equidistant notes with the octave represented in the pitch series.

There are 11 panpipes with the following proveniences: Lambom, Sebung, Ronarum, Natanawarau, Komalabu, St. Johns, Byron Straits, Kalil and Lamassa Is. They are morphologically homogenous, all features identical with panpipes of Muliama. The musical features are the same as described for Feni Island.

Nusa. 3 panpipes: 249, 252, 835.

One panpipe has 10 tubes, the other 14 and the third 15. They are joined with a step ligature. The proximal ends are round and the distal ends are cut crosswise through the node or below the node. The tubes are arranged in a single graduated row. The spread of the instruments is from one to three octaves in medium and high ranges. The three instruments encompass 3 octaves with a mean in the medium range. There are 7 approximately equal intervals in the octave with the octave represented.

4) New Britain

Matupi. 4 panpipes: 11, 258, 610, 615.

Each panpipe has five, ten or twelve tubes. Three methods of tube joining are represented: 1) horizontal sticks are fastened with a criss-cross tie; 2) the tubes are wrapped in a leaf and tied with string and 3) tubes are joined with a step ligature. The proximal ends are round and the distal ends are cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of the individual instruments ranges from under one octave to three octaves in the low, medium, high and very high ranges. The collection spans 3½ octaves with the mean in the medium range. There are two length patterns represented: 1) four irregular divisions in less than an octave and 2) five and six unequal intervals in the octave with the octave represented. Some of the notes in all the panpipes are spaced at the same distances from each other, but the spacing is not consistent among the group nor is it consistent within any single panpipe.

Apparently, a set of panpipes is required to complete a scale, or each panpipe contains only the notes required to play a specific melody.

Jaquinot Bay. 10 panpipes: 308, 309, 311, 312, 313, 315, 316, 317, 319, 320.

Four are single row graduated panpipes, each with seven or eight tubes that are joined by a step tie at the distal ends and fiber wound around and between the tubes at the proximal ends. The proximal ends are round and the distal ends cut crosswise through the node. The instruments range from one to two octaves in medium to high ranges. The spread of the collection is three octaves with a mean in the medium range. The individual length patterns are five unequal intervals in an octave with the octave represented and six unequal intervals with the octave not represented. The spacing is even between groups of two and four notes but there are uneven steps between the groups of notes. Six bundle panpipes have the tubes joined by fiber which is wrapped around them. The notes are irregularly spaced within the distance of approximately an octave. Some tubes of a single panpipe are of the same length. Most tubes are open throughout but a few are closed at the distal ends. Some proximal openings are cut crosswise through the node and a hole is pierced in the center.

Blanche Bay. 1 panpipe: 411s.

The panpipe has 28 tubes which are joined by a step tie. The proximal ends are round and the distal ends cut crosswise through the node. They are in a single graduated row.

There are approximately eight equidistant notes in an octave which range from low through very high ranges. In the high and very high ranges, a few notes are omitted from the series of equidistant notes.

Gazelle Peninsula (Baining, Nakanai Mts.) 10 panpipes: 253, 255, 409s, 410s, 412s, 414s, 415s, 466, 467, 617, 700, 834.

Each single row panpipe has 4, 5, 7, 8, 10 or 11 tubes which are joined either by fiber wound around and between each tube, cloth wrapped around or a step and chain ligature combined. The chain ligature is at the proximal end and step ligature at the distal end. The proximal ends are round and the distal ends are cut crosswise through the node or crosswise below the node. The arrangement of tubes is in a single graduated row. The spread of the instruments ranges from less than one octave to two octaves in very high, high, medium and low ranges. The spread of the collection is over three octaves with the mean in the medium range. Four length patterns are represented in the collection: 1) 5 unequal divisions in less than an octave; 2) 6 unequal division in less than an octave; 3) 5 unequal intervals with the octave not represented and 4) 7 approximately equal intervals with the octave represented. Those that are unequally spaced appear to be extracted from a scale of 8 approximately equidistant notes in an octave. There are 2 bundle panpipes of 10 hollow tubes each wrapped together with pieces of raw fiber. There are 5 unequal intervals with the octave represented in the pitch series. The range is from low to medium.

South Cape. 6 panpipes: 65, 66, 262, 826-8.

Each single row panpipe has six tubes joined by a chain tie at the proximal ends and a step tie at the distal ends. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of the instruments is under one octave to two octaves in medium and high ranges. All instruments have 5 unequal intervals in the octave with the octave represented in the pitch series. The notes are in groups of two, three and four. One bundle panpipe has seven tubes hollow throughout with five irregular divisions and octave not represented. The range is from medium to low. One bundle panpipe has 7 tubes with openings pierced through the node.

Willaumez Peninsula. 3 panpipes: 247, 259, 607.

There are nine tubes in each panpipe with three methods of tube joining represented: 1) fiber wound around and between each tube; 2) fiber wrapped around all tubes; and 3) a step tie. The tubes are arranged in a single graduated row. The spread of each instrument is from one to two octaves in medium and low ranges. The spread of the collection is 2½ octaves with a mean in the medium range. The pitch patterns are : 1) 5 unequal intervals with octave not represented and 5 unequal intervals in octave with octave represented.

Ahuat. 3 panpipes: 310, 313a, 318.

One panpipe has six tubes joined with a chain tie at the proximal end and a step tie at the distal end. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are arranged in a single graduated row. The spread is one octave in medium range. The pitch pattern is 5 unequal intervals in octave with octave represented. There are 2 bundle panpipes with 8 tubes each wrapped with fiber. The notes are irregularly spaced with octave not represented.

Bismark Archipelago. 14 panpipes: 203-11, 214, 215, 465, 472, 583.

Each panpipe has 5, 6, 7, 8, 9 or 13 tubes. There are three methods of tube joining: 1) fiber wrapped around and between each tube; 2) cloth wrapped around tubes; 3) a step tie. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are arranged either in a single graduated row or in a double graduated row. The spread of the instruments is one to two octaves in the medium range. The spread of the collection is from two to three octaves with the mean in medium range. The individual pitch pattern is 5 unequal intervals in octave with octave represented. There are three bundle panpipes with 7 hollow tubes. The proximal ends are cut through the natural node in the center with a hole pierced. The divisions are irregular with no discernible pattern.

Kilenge. 2 panpipes: 830, 831.

Each panpipe has six tubes that are joined by fiber wrapped around all the tubes and wound into a circular pattern in the center. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are in a single graduated row. The spread of each instrument is one octave in medium range. Their combined spread is 1½ octaves in medium to high ranges. There are five approximately equal intervals in the octave with the octave represented.

New Britain (specific locality unknown--collected by Parkinson in 1899). 3 panpipes: 212, 213, 408a.

Each panpipe has six or seven tubes joined with a chain tie at proximal ends and step tie at distal ends. The proximal ends are round and the distal ends cut through node. The tubes are arranged in a single graduated row. There are six notes in an octave with the octave not represented in the pitch series. The notes are arranged in groups of 1, 2 and 3 notes unevenly spaced. The pattern of arranging the groups differs in each panpipe, but the space between adjacent notes is the same in all panpipes. Parkinson indicated that they are used as love charms.

New Britain (specific locality unknown). 14 panpipes: 191, 245, 254, 256, 257, 260, 480, 601, 605, 618, 641, 833, 836.

Panpipe No. 191 is a double row panpipe with a row of closed tubes and a row of open tubes, a panpipe style that is characteristic of the Solomon Islands and infrequently found elsewhere. The others are single row panpipes with tubes arranged in a graduated row. Panpipes 191, 254, 257, 480, 601, 605, 618, 833 and 836 have 5 or 6 notes in an octave in groups of 1, 2 and 3 notes, the groups spaced approximately according to the same pattern. The octave is represented in some panpipes while in others it is not. The remainder of the panpipes have varied, irregular note sequences.

5) Solomon Islands

Guadalcanal. 4 panpipes: 202, 307, 332.

Two are single row simply graduated panpipes of 8 and 14 tubes each. One is a double row panpipe with 22 closed tubes and 22 open tubes. The proximal ends are round and the distal ends are cut through the natural node of the reed. The tubes are fastened with two sticks placed horizontally, one on each side of the panpipe and fastened with a criss-cross ligature. The individual length patterns are 6 and 7 approximately equal intervals in an octave with the octave represented. There are groups of 2, 3 and 4 notes. The notes appear to be extracted from a sequence of eight equidistant notes in an octave. The spread of the individual instruments is from one to three octaves in low, medium, high and very high ranges. The collection spans over three octaves with the mean in the medium range.

There is one bundle panpipe with eight tubes that are wrapped in raw fiber. The proximal openings are formed by cutting through the node and piercing a hole in the center. The panpipe spans one octave with unequal spacing between notes.

Buka. 15 panpipes: 9, 196, 223, 250, 396, 399, 473, 476, 477, 481, 382, 649, 767, 768.

Each panpipe has 2, 3, 4, 6, 7, 8 or 9 tubes. The following methods of tube joining are represented: 1) fiber wound around and between each tube; 2) fiber wound around all tubes; 3) step tie; 4) chain tie; 5) step tie and chain tie combined; and 6) horizontal and diagonal sticks fastened with criss cross ties. Three methods of tube arrangement are represented: 1) a single simply graduated row; 2) double simply graduated rows, one row open and one closed and 3) bundled. The proximal ends of all panpipes are round and the distal ends are cut crosswise either through the node or below the node. The spread of the instruments range from less than one octave to two octaves. Very low, low, medium and high ranges are represented. The spread of the collection is slightly more than 3 octaves with the mean in the medium range. Two length patters are represented: 1) 2, 3, and 4 irregular divisions in less than an octave and 2) 5 unequal intervals in octave with octave represented. There are groups of two, three and four notes at equal distances from each other, the groups separated by one or two full steps. In the bundle panpipes, some notes of the same pitch are repeated and there is no consistency in the pattern.

Hornbostel reported a panpipe of Buka having a double row with the sequential notes of the scale alternating between the two rows (Hornbostel 1912: 473, 495).

New Georgia. 3 panpipes: 301, 304, 402.

Each panpipe has either 8 or 13 tubes joined by placing sticks horizontally across the instrument and fastened with a criss cross tie. The proximal ends are round. The distal ends are cut crosswise through the natural node. The tubes are arranged either in a single graduated row or a double graduated row. The spread of the instruments range from one to three octaves in the very low, low and medium ranges. The spread of the collection is two to three octaves with the mean in the medium range. All panpipes have six notes to the octave with the octave represented in the pitch series. The spacing of the notes is unequal. The six notes appear to be extracted from a scale that has eight equidistant notes in an octave.

Bouganville, Kieta, Telei, Buin, Tzicot, Nasioi. 24 panpipes: 192-5, 197-200, 3106, 314, 647, 712, 728, 741, 748-50, 753, 755.

Each panpipe has 2, 3, 4, 5, 6, or 10 tubes. Three methods of tube joining are represented: 1) fiber wrapped around and between each tube; 2) a step ligature; 3) the tubes of the bundle panpipes are joined by fiber wrapped around all tubes. The proximal ends of all panpipes are round and the distal ends are cut crosswise through the node or crosswise below the node. The projecting portion which results when the cut is made below the node is indented on both sides. Spread of the individual instruments ranges from one to two octaves in very low, low, medium and high ranges. The spread of the collection is over three octaves with the mean in the medium range. The following length patterns are represented: 1) 2, 3, 4, 5 irregular divisions in less than an octave; 2) 5 unequal intervals in octave with octave represented and 3) 5 unequal intervals in octave with octave not represented.

Choiseul. 6 panpipes: 4, 5, 92, 93, 303, 305.

Each panpipe has 7, 8 or 9 tubes joined by placing two sticks horizontally across both sides of the instrument and fastened with a criss cross tie. The proximal ends are round and the distal ends are cut crosswise through the node. All are double row panpipes, both rows of the same length with one open and one closed. The spread of the individual instruments is in low and medium ranges. The spread of the collection is 3 octaves with the mean in medium frequency. The length pattern is five unequal intervals in octave with octave represented in the pitch series. The spacing of notes is unequal with a similar pattern in all panpipes. They appear to be extracted from a scale of 8 equidistant notes in an octave.

Malaita. 10 panpipes: 83, 201, 397, 400, 401, 403, 714-17.

Each panpipe has 11, 12, 13, 14 or 15 tubes that are joined either by a chain tie or by placing sticks horizontally across the instrument and fastening them with a criss-cross tie. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of the instruments range from 1 to 3 octaves in very low through very high ranges. The spread of the collection is over 4 octaves with a mean in the medium range. There are two length patterns represented: 1) 5 unequal intervals to octave with octave represented and 2) 7 equal intervals in octave with octave represented.

Solomon Islands (2 from Alu-571 and 640; other localities not specified). 20 panpipes: 239, 240, 246, 261, 263, 271, 306, 314, 336, 391, 464, 475, 483, 571, 640, 646, 648, 734, 772, 859.

Each panpipe has 4, 6, 7, 8, 9, 12, 13, 15, 18 or 22 closed tubes. Five methods of tube joining are represented in the group: 1) fiber wound around and between each tube; 2) sticks placed horizontally across instrument and fastened with a criss cross tie; 3) step tie; 4) chain tie and 5) step and chain tie combined, the chain tie at the proximal end , the step tie at the distal end. The proximal ends of all tubes are round. The distal ends are cut crosswise through the node or below the node. Three tube arrangements are represented: 1) single row simply graduated; 2) double row simply graduated, both rows of same length and 3) single row graduated in two series with one of the shortest and one of the longest tubes in the center. The spread of the individual instruments is from one to three octaves in low, medium, high and very high ranges. The spread of the collection is over four octaves with a mean in the medium range. The following length patterns are represented: 1) 5 equal intervals in octave with octave represented; 2) 7 equal intervals in octave with octave represented; and 3) 5 unequal intervals in octave with octave represented.

The distal ends of some tubes of the bundle panpipes have a rectangular piece cut out. The proximal ends of some tubes are cut through the node with a hold pierced in the center.

6) <u>New Hebrides</u>

<u>Santo</u>. 8 panpipes: 283, 288, 291, 305A, 658, 659, 710, 713.

Each panpipe has 6, 9 or 10 tubes arranged in a single graduated row, except for one bundle panpipe. The proximal ends are cut through the hollow part of the reed, except that some proximal ends of the bundle panpipe are cut through the node with a hole pierced in the center. The distal ends are cut through the node or below the node. There are three methods of joining the tubes: 1) a herringbone ligature in two or three rows; 2) sticks placed horizontally and diagonally across the instrument and fastened with a criss cross tie. The spread of individual instruments is one to two octaves in low, medium and high ranges. The spread of the collection is three octaves with a mean in the medium range. The following length patterns are represented: 7 equal intervals and 9 equal intervals with octave represented; 5 unequal intervals and 7 unequal intervals with octave represented.

Tanna. 6 panpipes: 292, 293, 294, 295, 297, 468.

There are 6, 7, 9, 10, 12 or 13 tubes in each panpipe which are joined by a herringbone tie in two or three rows or with sticks placed horizontally on each side of the instrument and fastened with a criss cross tie. The proximal ends are round and the distal ends are cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of the individual instruments is from one to two octaves in medium and high ranges. The spread of the collection is 3 octaves with the mean in the medium range. The octave is represented in the pitch series of all panpipes. There are five or seven unequal intervals. There are groups of two and three equidistant notes, the groups separated by one or two full steps. The general pattern of the collection is consistent but there are differences in the sizes of the intervals.

Aoba. 7 panpipes: 289, 298, 299, 300, 330, 657, 660.

Each panpipe has 7 or 17 tubes which are joined by a herringbone or a step tie. The proximal ends are round and the distal ends cut crosswise through the node or below the node. Those that are cut through the node are sharpened to a point. The tubes are arranged in a single graduated row. The spread of the individual instruments is from one to three octaves in low, medium, high and very high ranges. The spread of the collection is 3 octaves with the mean in the medium range. There are 4, 5 or 6 unequal intervals in the octave with the octave represented in the pitch series of all panpipes. The notes are in groups of two and three.

Malo. 6 panpipes: 110, 112, 284, 286-7, 290, 329.

Each panpipe has 3, 8, 9 or 10 tubes joined with a herringbone tie of plant fiber in two and three rows. The proximal ends are round and the distal ends are cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of the instruments range from less than one octave to 2 octaves, all in the medium range. The spread of the collection is 2 octaves. All panpipes except one have 7 approximately equal intervals in the octave with the octave represented.

Efate. 2 panpipes: 708, 711.

One panpipe has 8 and the other has 9 tubes. They are joined by plant fiber wound around all tubes and between each in three rows. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of each instrument is one octave in the medium range. Each has 7 approximately equal intervals in the octave with the octave represented.

Ureparapara. 2 panpipes: 284, 331.

Each panpipe has 8 or 10 tubes joined by 10 or 12 rows of fiber wound around each tube in turn. The proximal ends are round and the distal ends cut crosswise through the node. The tubes are arranged in a single graduated row. The spread of each instrument is slightly more than one octave in the medium range. One panpipe has 7 unequal intervals in the octave with the octave represented. The other panpipe has 7 equal intervals in the octave with the octave represented.

Malekula. 9 panpipes: 219-20, 222, 224-6, 303a, 306a, 469, 820.

Eight are bundle panpipes with 6, 7, 8 or 10 tubes. All tubes are open at the distal ends. Some proximal ends are round, having been cut through a hollow part of the tube. Some proximal ends are cut through the node with a hold pierced in the center. Fiber is wrapped around the tubes to fasten them together. Some have several rows of circular patterns made with the fiber in the center of each tube. In some panpipes the octave is represented and in others it is not. The spread of the individual panpipes is 1½ to 3 octaves in medium, low and very low ranges. Span of the collection is 3½ octaves in low range. There are 5 and 7 irregular divisions in the octave. No. 469 is a single row graduated panpipe with 5 tubes fastened together with a chain ligature. The panpipe spans less than an octave. The divisions are irregular.

New Hebrides (no specific provenience). 8 panpipes: 111, 221, 270, 296, 707, 733, 795, 853a.

Each panpipe has 4, 6, 7, 8, 9 or 10 tubes joined either with a herringbone or chain tie. The proximal ends are round and the distal ends are cut either through or below the natural node of the reed. Some of the distal ends are pointed. The first tube of some of the panpipes is cut well below the natural node, so that it projects far beyond the others. The spread of individual panpipes is 1/2 octave to 1½ octaves in medium and high ranges. The spread of the collection is three octaves with mean in the medium range. The following length patterns are represented: 5, 6, 7, 8 notes to the octave with octave represented. The notes are arranged in groups of two and three, equidistantly spaced within the group. The groups are separated from each other by one or two full steps.

7) Fiji. 3 panpipes: 117, 118, 119.

Each panpipe has 3, 4 or 11 tubes. They are attached by fiber wound around and between each tube in several rows. The proximal ends are either round or indented on both sides, one side indented more deeply than the other. The distal ends are cut through the node and some are pointed. The tubes are arranged in a single graduated row. The spread of two panpipes is under one octave, one in the medium and one in the high range. The distances between notes are irregular and differ in each panpipe.

Polynesia

1) Samoa. 2 panpipes: 1, 248.

Each panpipe has 7 tubes joined by three rows of fiber twisted around and between the tubes. The proximal ends of one panpipe are round and in the other panpipe they are indented on both sides, one side deeper than the other. The distal ends are cut through the node and some are round. The spread of each panpipe is between one and 1½ octaves in the medium range. The octave is represented in both panpipes. The distances between notes are irregular.

Buck describes a 5 tube Samoan panpipe (like 1, above), which he says is like those he has seen from Tonga (1941:173), and which he believes was present in pre-European times. Anderson (1934:270) mentions a 33 tube panpipe fastened by means of supporting sticks across the proximal and distal ends of the instrument. It resembles certain panpipes from the Solomon Islands, except that the sticks at the distal end are placed closer to the extreme end of the panpipe than is the case with Solomon Islands panpipes. Buck believes that this panpipe was brought into Samoa and Tonga in recent times by laborers from the Solomon Islands.

2) Tonga. 2 panpipes: 267, 704.

One is a 10 tube panpipe arranged in a single irregular row. The other is a 6 tube doubly graduated panpipe with the longest tube in the center. The proximal ends are indented on both sides. In order to fasten the tubes together, fiber is wound first around all tubes; then another piece of fiber is wound back and forth between the tubes. The spread of both instruments is under one octave with the register of each in medium range. The ten tube panpipe has very closely spaced notes with some repeated in the series. In the six tube panpipe the notes are more widely spaced in an irregular manner.

Buck mentions a Tongan panpipe with 4 tubes arranged in a single graduated row and bound by two horizontal rows of fiber. The proximal ends are indented. (1941:173).

Philippines

1) Luzon. 10 panpipes: 218, 227, 228, 229, 230, 231, 232, 273, 274, 275.

Each panpipe has 6 or 7 tubes, all in a single row, but with three methods of arrangement: 1) simply graduated; 2) irregular and 3) doubly graduated, with longest tube in the center. The proximal and distal ends are round, cut through the hollow part of the reed. All tubes are open throughout. They are fastened by means of a splint that is wrapped around all tubes and fastened with fiber. The spread of all panpipes is less than an octave in low and very low range. The spread of the collection is 2 octaves with the mean in the medium range. The distances between the notes are irregular and there is not apparent consistency of pattern in the collection.

Indonesia

1) Timor. 4 panpipes: 701-3, 852a.

The panpipes have 9, 10 or 12 tubes joined in three ways: 1) a stick placed horizontally across the instrument and fastened with a criss cross ligature; 2) sticks placed horizontally and diagonally across the instrument and fastened with a criss cross ligature and 3) flexible splints wrapped several times around and fastened with a back and forth tie. The proximal ends are all indented on both sides, one side deeper than the other. The spread of the individual instruments is from one to two octaves in medium to high ranges. The spread of all is about 3 octaves with the mean in high range. The octave is represented in the pitch series. The divisions are irregular. There are 6, 7, or 8 notes in an octave.[1]

2) Western Java. 4 panpipes: 850a, 851a, 854, 855.

The panpipes have 3, 5, 7, or 12 tubes arranged in a single graduated row. The proximal ends are round and the distal ends are cut either through the node or below the node. The tubes are fastened either by braided fiber that is wound around all the tubes and then wired to the individual tubes or flexible splints are wound around and fastened to each tube with fiber. One panpipe is enameled in blue and yellow. The spread of the individual instruments ranges from less than one octave to 2½ octaves with register in medium and high ranges. The octave is represented in the pitch series of one panpipe. The distances between the notes are irregular.

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[1] A panpipe from Timor is illustrated in Bastian (1886: fig. 4).

Africa

1) Egypt. 8 panpipes: 120-123, 325, 406-8.

Each panpipe has 18, 19, 20, 21 or 23 tubes arranged in a single simply graduated row. The tubes are joined by placing two sticks horizontally across the proximal end of the instrument, one on each side and two sticks diagonally across the distal end, one on each side and fastening the sticks to the tubes with a criss cross tie. The proximal ends are round and the distal ends cut crosswise below the node. The spread of the individual instruments range from one to three octaves in medium, high and very high ranges. The spread of the collection is 3½ octaves with mean in the high range. There are either 5, 6, 7, 8, 9 or 10 intervals in the octave. In the medium range the number of notes in an octave is 7 or 8. The intervals between the notes increase progressively toward the higher range. The octave is not represented throughout the total range. In those ranges having the most notes, the octave is represented. Despite their not being from the same collection, this group of Egyptian panpipes are homogeneous in form. They are similar to those I have described from Italy.

2) Congo. 7 panpipes: 439, 706, 842-845, 857.

Each panpipe has either 3, 4, 5 or 12 tubes, all of which are arranged irregularly. The tubes are joined by fiber wound around and between each. The proximal ends are round and the distal ends cut crosswise through the node or crosswise below the node. Both of these methods of cutting the distal ends are represented in single panpipes. The 5 tube panpipe is cut through a hollow portion and a wooden piece is inserted. The spread of the individual instruments ranges from less than one to two octaves in low and medium ranges. The spread of the collection is two octaves with mean in low range. The panpipes that span less than an octave have either three, four or five tubes. Those that span more than an octave have 8 irregular divisions with the octave not represented.

Europe

1) Italy. 3 panpipes: 95, 96, 97.

The number of tubes is 19 and 25, which are joined by placing sticks horizontally and diagonally across the proximal and distal ends on both sides of the instrument. They are fastened to the tubes with a criss cross tie. The proximal ends are round and the distal ends cut crosswise below the node. The tubes are arranged in a single graduated row. The register and spread of the instruments is over 3 octaves in very high, high, medium and low ranges. There are 7 irregular divisions in the octave in the medium range. In the high ranges the intervals between notes become increasingly greater. A few of the shortest tubes are stopped at both ends.

APPENDIX 2

List of Museum Specimens

<u>Key to identification of museums referred to in Appendix 2</u>

AMNH	American Museum of Natural History, New York City
FMNH	Field Museum, Natural History, Chicago
GM	Gemeente Museum, The Hague, Netherlands
Heye	Heye Foundation, New York City
LC	Library of Congress, Washington, D.C.
LM	Linden Museum, Stuttgart, Germany
ME	Musee d'Ethnographie, Geneva, Switzerland
MH	Musee de l'Homme, Paris, France
MM	Museum of Man, San Diego, California
MMA	Metropolitan Museum of Art, New York City
MVBa	Museum für Völkerkunde, Basel, Switzerland
MVBe	Museum für Völkerkunde, Berlin, Germany
MVF	Museum für Völkerkunde, Frankfurt, Germany
MVV	Museum für Völkerkunde, Vienna, Austria
PMH	Peabody Museum of Harvard University, Cambridge
PMY	Peabody Museum of Yale University, New Haven
RM	Rijksmuseum, Leiden, Netherlands
SI	Smithsonian Institution, Washington, D.C.
TM	Tropenmuseum, Amsterdan, Netherlands
UI	University of Indiana, Bloomington, Indiana

Panama

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
37	Heye	11/4747	San Blas	Harrower	--	I-2
43	AMNH	1/5283	Cuna	--	--	I-2
44	AMNH	1/5284	Cuna	--	--	I-2
46	Heye	12/8709	Darien	Verrill	--	I-2
47	Heye	12/9139	Tupi	--	--	I-2
48	Heye	11/4753	San Blas	--	--	I-2
50	Heye	12/9137	Tupi	Verrill	--	I-2
51	Heye	20/4490	Cuna	--	--	I-2
54	Heye	11/4752	San Blas	--	--	I-2
56	Heye	11/4752	San Blas	--	--	I-2
57	Heye	11/4751	San Blas	--	--	I-2
58	Heye	12/8708	Darien	--	--	I-2
59	Heye	12/8710	Darien	--	--	I-2
60	Heye	11/4748	San Blas	--	--	I-2
61	Heye	12/7639	Darien	Verrill	--	I-2
62	Heye	12/7639	Darien	Verrill	--	I-2

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
182	FMNH	6478-9	Cuna	Pizarro	1891	I-2
337	MV-Ba	IVb3724	Cuna	Herrmann	1964	I-2
338	MV-Ba	IVb3727	Cuna	Herrmann	1964	I-2
545	MV-Be	VA62852	Cuna	Nordenskiold	1928	I-2
546	MV-Be	VA62853	Cuna	Nordenskiold	1928	I-2
777	MH	32.98.249	Cuna	Kantulo	--	I-2
778	MH	32.98.103	Cuna	Kantulo	--	I-2
		North Central Amazon				
14	AMNH	40.1/2812	Ayana	--	--	III
15	AMNH	40.1/2814	Ayana	--	--	III
18	AMNH	40.1/3166	Wayana	--	--	III
19	AMNH	40.0/6046	Tampoca (Fr.Guiana)	--	--	III
89	PMY	144551	Br. Guiana	--	--	III
344	MV-Ba	IVC9987a	Ayana	Malken	1964	III
345	MV-Ba	IVC9987b	Ayana	Malken	1964	III
346	MV-Ba	IVC9987c	Ayana	Malken	1964	III

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
347	MV-Ba	IVC9987d	Ayana	Malken	1964	III
514	MV-Be	VB14611	Wayana	Fürst	1966	III
736	MH	39.25.454	Ayana	Sangries	--	III
752	MH	39.25.449	Ayana	Sangries	--	III
838	RM	2352#114	Ayana	--	1937	III
838	RM	2352#115	Ayana	--	1937	III
840	RM	2352#116	Ayana	--	--	III
841	RM	2352#117	Ayana	--	1937	III
			North Colombia			
542	MV-Be	VA64963	Noaname	Malkin	--	III
543	MV-Be	VA64964	Noaname	Malkin	--	III
544	MV-Be	VA64965	Noaname	Malkin	--	III
			Northwest Amazon			
40	Heye	22/3695	Peru	Fritts	--	II
49	Heye	1/1835	Ecuador	Savilto	--	II
53	Heye	2/3859	Esmeraldas	Barrett	--	II

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
78	PMH	30/1790	Payamino, Ecuador	Spencer	1940	II
91	PMY	148251	--	Zalensky	--	II
142	UI	3041/pp12	Cayapa,Ecuador	--	--	II
166	UI	3041/pp13	Cayapa,Ecuador	C. Orr	--	II
171	UI	3041-71-A	N.W.Brazil Coast	--	--	III
176	UI	3041-132A	Bogota	Hurt	--	III
269	MVV	76139	Ecuador	--	--	II
272	MVV	143125	Ecuador	--	--	II
342	MV-Ba	IVC11754	Witoto,Ecuador	Malkin	1965	III
343	MV-Ba	IVC11755	Witoto,Ecuador	Malkin	1965	III
350	MV-Ba	IVC4456	Rio Putumayo	Pillichody	1928	II
351	MV-Ba	IVC4457	Colombia Ecuador Border	Pillichody	1928	II
407a	MV-Ba	IVC11753	Witoto	Malkin	1965	III
416	MV-Ba	18608	Rio del Meta	Marchand	1941	--
419	ME	29728	Colombia	Baer	1960	--
419S	LM	79927	Uaupés	Zarges	1912	I-3
420	ME	29729	Colombia	Baer	--	--

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
420S	LM	79921	Uaupés	Zarges	1912	I-3
421S	LM	79926	Uaupés	Zarges	1912	I-3
422S	LM	79930	Uaupés	Zarges	1912	I-3
423S	LM	79927	Uaupés	Zarges	1912	I-3
424S	LM	79932	Uaupés	Zarges	1912	I-3
425	LM	79922	Uaupés	Zarges	1912	I-3
426	LM	79929	Uaupés	Zarges	1912	I-3
427	LM	79925	Uaupés	Zarges	1912	I-3
436	LM	82133	Piapoco	Bleil	1913	I-4
437	LM	94773	Piapoco	Bleil	1913	I-4
438	LM	94774	Piapoco	Bleil	1913	I-4
443	MVF	40026	Uaupés	Zarges	1912	I-3
444	MVF	40302	Colombia	Petersen	1959	--
447	MVF	40183	Colombia	Petersen	1959	--
500	MV-Be	VB6323	Uaupés	Koch	1905	I-3
507	MV-Be	VB6317	Baniwa	Koch	1905	--
517	MV-Be	VB13829a	Colombia	Petersen	1959	--

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
518	MV-Be	VB13829b	Colombia	Petersen	1959	--
519	MV-Be	VB13829c	Colombia	Petersen	1959	--
520	MV-Be	VB10622	Witoto	Preuss	1920	--
532	MV-Be	VB13934a	S. Colombia	Petersen	1959	--
533	MV-Be	VB13934b	S. Colombia	Petersen	1959	--
534	MV-Be	VB10224	Witoto	Preuss	1920	--
548	MV-Be	VA65127	Sibundoy	Malkin	--	--
549	MV-Be	VA64177	Jivaro	Hopp	1958	II
551	MV-Be	VB6319	Baniwa	Koch	1905	--
552	MV-Be	VB6320	Baniwa	Koch	1905	--
553	MV-Be	VB6321	Baniwa	Koch	1905	--
705	MV-Be	VB6322	Uaupes	Koch	1905	I-3
779	MH	85.90.102	Makiritaré	Chaffanbon	1885	I-4
781	MH	85.90.103	Makiritaré	Chaffanbon	1885	I-4
796	MH	39.14.49	Sibundoy	Alba	--	I-4
802	MH	51.37.230	Metis de Mito	Reichlen	--	II
803	MH	51.37.174	Metis de Mito Contumazu	Reichlen	--	II

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
846	RM	2406#9	Ecuador	--	1939	II
850	GM	Ama 9-56	Colombia	--	1930	--
851	GM	--	Colombia	--	1930	--
			Western Amazon			
29	AMNH	40.0/8219	Bora	--	--	III
30	AMNH	40.0/8218	Bora	--	--	III
41	Heye	23/684	Beni Province	Malkin	--	--
55	Heye	20/4704	Bora	--	--	III
74	PMH	F38	Rio Tiquié	Rice	1917	I-3
85	PMY	56727	Yagua	--	--	--
86	PMY	56727	Yagua	--	--	--
181	FMNH	155070	Beni, Bolivia	Malkin	1960	III
233	FMNH	none	Yagua	--	1970	--
234	FMNH	none	Yagua	--	1970	--
235	FMNH	none	Yagua	--	1970	--
236	FMNH	none	Yagua	--	1970	--
237	FMNH	none	Yagua	--	1970	--

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
238	FMNH	none	Yagua	--	1970	--
389	FMNH	IVC13288	Yagua	Malkin	1970	--
390	FMNH	IVC13289	Yagua	Malkin	1970	--
428	LM	114280	Rio Tiquié	Kemmler	1858	--
433	LM	91395	Chimane	Nordenskiold	1916	--
448	MVF	48058a	Tucano	Hahn Hissink	1969	I-3
449	MVF	48058b	Tucano	Hahn Hissink	1969	I-3
456	MVF	40271a	Bora	Petersen	1959	III
457	MVF	40271b	Bora	Petersen	1959	III
495	MV-Be	VB11949	Rio Guaporé Brazil	Snethlage	1934	IV
506	MV-Be	VB6325	Tucano	Koch	1905	I-3
511	MV-Be	VB11950	Rio Guaporé Brazil	Snethlage	1934	IV
515	MV-Be	VB6324	Tucano Rio Tiquié	Koch	1905	I-3
516	MV-Be	VB13049	Upper Amazon	--	1937	I-5
523	MV-Be	VB13141	Chiquito	Snethlage	1934	III

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
524	MV-Be	VB417	Yagua	Standiger	1883	--
529	MV-Be	VB4535	Bolivia	Perl	1898	--
538	MV-Be	VA351	Omagua	Abendroth	1871	I-5
786	MH	37.16.10	Upper Amazon	Carrey	1852	I-5
792	MH	51.24.4	Yagua	Flornoy	--	--
			Central Amazon			
25	AMNH	40.0/6658	Nambicuara	--	--	--
41	Heye	23/684	Chacobo	Malkin	--	III
42	AMNH	--	Xirgú Rio	Carneiro	--	--
181	FMNH	155070	Beni, Bolivia	Malkin	1960	III
327	MV-Ba	IVC12067	Cayabí	--	--	I-5
328	MV-Ba	IVC12066	Cayabí	--	--	I-5
340	MV-Ba	IVC4185a	Apinayé	Speiser	1927	--
349	MV-Ba	IVC9043	Tupari	Casper	1957	III
430	LM	11713	Trumaí	Meyer	1900	III
431	LM	87469	Rio Xingú	Meyer	1900	--
432	LM	11704	Trumaí	Meyer	1900	--

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
485	MV-Be	VB11895	Moré	Snethlage	1934	IV
486	MV-Be	VB12064	Moré	Snethlage	1934	IV
487	MV-Be	VB11786	Moré	Snethlage	1934	IV
488	MV-Be	VB11796	Moré	Snethlage	1934	IV
489	MV-Be	VB11833	Moré	Snethlage	1934	IV
490	MV-Be	VB12117	Moré	Snethlage	1934	IV
491	MV-Be	VB13212	Moré	Snethlage	1934	IV
492	MV-Be	VB12089	Moré	Snethlage	1934	IV
493	MV-Be	VB12065	Moré	Snethlage	1934	IV
494	MV-Be	VB11853	Moré	Snethlage	1934	IV
496	MV-Be	VB11804	Moré	Snethlage	1934	IV
497	MV-Be	VB11864	Moré	Snethlage	1934	IV
498	MV-Be	VB11779	Moré	Snethlage	1934	IV
499	MV-Be	VB11808	Moré	Snethlage	1934	IV
501	MV-Be	VB11832	Moré	Snethlage	1934	IV
502	MV-Be	VB11794	Moré	Snethlage	1934	IV
503	MV-Be	VB13214	Moré	Snethlage	1934	IV

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
504	MV-Be	VB13218	Moré	Snethlage	1934	IV
505	MV-Be	VB12015	Moré	Snethlage	1934	IV
508	MV-Be	VB10982	Amniapé	Snethlage	1934	I-4
509	MV-Be	VB2010	Paressí	Stunen	1889	I-5
510	MV-Be	VB11051	Amniape	Snethlage	1934	I-4
512	MV-Be	VB13146	Chiquito	Snethlage	1934	III
521	MV-Be	VB2618	Mehinacú	Steinen	1889	I-4
522	MV-Be	VB10701	Huanyam	Snethlage	1934	I-4
523	MV-Be	VB13171	Chiquito	Snethlage	1934	III
526	MV-Be	VB10812	Huanyam	Snethlage	1934	I-4
530	MV-Be	VB12355	Moré	Snethlage	1934	IV
531	MV-Be	VB11826	Moré	Snethlage	1934	IV
535	MV-Be	VB11828	Moré	Snethlage	1934	IV
536	MV-Be	VB13213	Moré	Snethlage	1934	IV
537	MV-Be	VB11827	Moré	Snethlage	1934	IV
550	MV-Be	VB6772	Guarani	Mayntzhusen	1910	--
554	MV-Be	VB11797	Moré	Snethlage	1934	IV
555	MV-Be	VB11803	Moré	Snethlage	1934	IV

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
735	MH	39.88.755	Tupi	Levi Shauss	--	--
740	MH	39.88.787	Tupi	Levi Shauss	--	--
782	MH	39.88.96	Nambicuara	Levi Shauss	--	III
804	MH	39.88.97	Nambicuara	Levi Shauss	--	--
806	MH	39.88.98	Nambicuara	Levi Shauss	--	--
			Montaña			
13	AMNH	40.0/6992	Campa	Rios	--	IV
20	AMNH	40.0/7442	Conibo	--	--	--
23	AMNH	40.0/7440	Conibo	--	--	--
24	AMNH	40.0/6995	Montaña	--	--	--
26	AMNH	40.0/6993	Campa	--	--	IV
27	AMNH	40.0/6994	Campa	--	--	IV
28	AMNH	40.0/6996	Campa	--	--	IV
38	Heye	15/9945	Campa	--	--	IV
352	MV-Ba	IVC13982	Machiguenga	Baer	1968	IV
353	MV-Ba	IVC13980	Machiguenga	Baer	1968	IV

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
354	MV-Ba	IVC1376	Machiguenga	Baer	1968	IV
355	MV-Ba	IVC13969	Machiguenga	Baer	1968	IV
356	MV-Ba	IVC13983	Machiguenga	Baer	1968	IV
357	MV-Ba	IVC13974	Machiguenga	Baer	1968	IV
358	MV-Ba	IVC13973	Machiguenga	Baer	1968	IV
359	MV-Ba	IVC13981	Machiguenga	Baer	1968	IV
360	MV-Ba	IVC13975	Machiguenga	Baer	1968	IV
361	MV-Ba	IVC13977	Machiguenga	Baer	1968	IV
362	MV-Ba	IVC13872	Machiguenga	Baer	1968	IV
363	MV-Ba	IVC13970	Machiguenga	Baer	1968	IV
364	MV-Ba	IVC14002	Machiguenga	Baer	1968	IV
365	MV-Ba	IVC13978	Machiguenga	Baer	1968	IV
366	MV-Ba	IVC13969	Machiguenga	Baer	1968	IV
366a	MV-Ba	IVC13971	Machiguenga	Baer	1968	IV
367	MV-Ba	IVC13998	Machiguenga	Baer	1968	IV
368	MV-Ba	IVC14004	Machiguenga	Baer	1968	IV
369	MV-Ba	IVC13999	Machiguenga	Baer	1968	IV

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
370	MV-Ba	IVC14000	Machiguenga	Baer	1968	IV
371	MV-Ba	IVC13991	Machiguenga	Baer	1968	IV
372	MV-Ba	IVC14001	Machiguenga	Baer	1968	IV
373	MV-Ba	IVC13989	Machiguenga	Baer	1968	IV
374	MV-Ba	IVC13988	Machiguenga	Baer	1968	IV
375	MV-Ba	IVC13997	Machiguenga	Baer	1968	IV
376	MV-Ba	IVC13986	Machiguenga	Baer	1968	IV
377	MV-Ba	IVC14005	Machiguenga	Baer	1968	IV
378	MV-Ba	IVC13990	Machiguenga	Baer	1968	IV
379	MV-Ba	IVC14003	Machiguenga	Baer	1968	IV
380	MV-Ba	IVC13992	Machiguenga	Baer	1968	IV
381	MV-Ba	IVC13996	Machiguenga	Baer	1968	IV
382	MV-Ba	IVC13987	Machiguenga	Baer	1968	IV
383	MV-Ba	IVC13993	Machiguenga	Baer	1968	IV
384	MV-Ba	IVC13995	Machiguenga	Baer	1968	IV
392	MV-Ba	IVC14006	Piro	Baer	--	--
434	LM	58915	Campa	Schortau	1916	IV

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
435	LM	58916	Campa	Schortau	1916	IV
450	LM	45947	Piro	Binder	--	--
513	MV-Be	VB485	Iquitos	Standinger	1883	I-5
675	MV=Be	VA64007	Rio Ucayali	Walter	1902	I-5
676	MV-Be	VA64007	Rio Ucayali	Walter	1902	I-5
797	MH	86.109.35	Campa	Olivier	--	IV
			Central Andes			
16	AMNH	--	Bolivia	--	--	I-1
17	AMNH	--	Bolivia	--	--	I-1
36	Heye	13/4487	Aymaras	Verril	--	I-1
63	PMH	30/8413	Lake Titicaca	Agassez	1875	I-1
75	PMH	30/3855	Puno Peru	Tschopik	1940	I-1
76	PMH	30/75777	Aymara Bolivia	Farabee	1909	I-1
79	PMH	30/3853	Aymara Puno	--	1940	I-1
80	PMH	30/3858	Aymara Puno	--	1940	I-1
81	PMH	30/3858	Aymara Puno	--	1940	I-1
82	PMH	30/3856	Aymara Puno	--	1940	I-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
88	PMY	145446	Peru	--	--	I-1
90	PMY	231449	Cuzco	--	--	I-1
113	LC	887	La Paz, Bolivia	Miller	--	I-1
165	UI	3041	Peru	Doughty	--	I-1
179	FMNH	6215	Bolivia	Saffud	1871	I-1
180	FMNH	6212	Bolivia	Saffud	1871	I-1
180A	FMNH	6213	Bolivia	Saffud	1871	I-1
264	MVV	29/1970	Peru	--	1970	I-1
265	MVV	29/1970	Peru	--	1970	I-1
266	MVV	140743	Peru	--	1961	I-1
276	MVV	138077	Aymara Bolivia	--	1958	I-1
277	MVV	L1/1938	Peru	--	1938	I-1
394	MV-Ba	--	Lake Titicaca	Baer	--	I-1
395	MV-Ba	--	Lake Titicaca	Baer	--	I-1
421	ME	33141	Quechua,Peru	Christinat	1966	I-1
422	ME	33142	Quechua,Peru	Christinat	1966	I-1
423	ME	33143	Quechua,Peru	Christinat	1966	I-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
424	ME	33144	Quechua	Christinat	1966	I-1
429	LM	39072	Bolivia	Pelzer	1905	I-1
451	MVF	48069	La Paz	Hahn Hissink	1969	I-1
452	MVF	48068b	La Paz	Hahn Hissink	1969	I-1
453	MVF	48068a	La Paz	Hahn Hissink	1969	I-1
454	MVF	30574	Aymara,Quechua	Wegner	1930	I-1
455	MVF	21369	La Paz	Posnansky	1913	I-1
458	MVF	20335a	La Paz	Hahn	1913	I-1
459	MVF	20335b	La Paz	Hahn	1913	I-1
460	MVF	48069	La Paz	Hahn Hissink	1969	I-1
461	MVF	48070a	La Paz	Hahn Hissink	1969	I-1
462	MVF	48070b	La Paz	Hahn Hissink	1969	I-1
463	MVF	48072	La Paz	Hahn Hissink	1969	I-1
668	MV-Be	VA17108	Quechua	Weberbauer	1906	I-1
684	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
684	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
685	MV-Be	VA34541	Aymara	Posnansky	1912	I-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
686	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
687	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
688	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
689	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
690	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
691	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
692	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
693	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
694	MV-Be	VA34541	Aymara	Posnanský	1912	I-1
695	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
696	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
697	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
698	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
699	MV-Be	VA34541	Aymara	Posnansky	1912	I-1
730	MH	37.3.18	Bolivia	Seuer	1907	I-1
744	MH	85.24.1	La Paz,Bolivia	Montes	1885	I-1
745	MH	32.56.7	LaPaz, Bolivia	Joseph	--	I-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
746	MH	30.27.1	Bolivia	Teutsch	--	I-1
774	MH	51.8.1	Puno,Peru	d'Harcourt	--	I-1
775	MH	51.8.2	Puno,Peru	d'Harcourt	--	I-1
790	MH	33.72.72	La Paz	Metraux	1931	I-1
807	MH	85.24.2	Bolivia	Montes	1885	I-1
808	MH	08.23.841	Aymara,Quechua	Montfor	1903	I-1
809	MH	08.23.839	La Paz	Crequi	1903	I-1
810	MH	65.41.145	La Paz	Girault	1956	I-1
811	MH	65.41.146	La Paz	Girault	1956	I-1
812	MH	65.41.147	La Paz	Girault	1956	I-1
813	MH	65.41.148	La Paz	Girault	1956	I-1
847	RM	3392-1	Cuzco	--	1957	I-1
848	RM	3392-2	Cuzco	--	1957	I-1
892	SI	210439	Aymara	Safford	--	I-1
893	SI	95908	Quechua	--	--	I-1
895	MM	1950-31-26	Peru	--	--	I-1

Archaeological Andean Area

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
32	AMNH	41.0/1626	Ica	Juillard	Before 1924	I-5
33	AMNH	B/7715	--	--	--	--
34	AMNH	41.0/3758	Pica Valley,Chile	--	1921	I-5
35	Heye	21/2240	Trujillo, Peru	--	--	--
64	PMH	86917	Nazca	Tello	1915	V
68	PMH	30/4618	Coastal Peru	Bliss	1942	--
69	PMH	30/6957	Peru	--	--	--
70	PMH	30/5365	Peru, So. Coast	Tozzer	1946	V
71	PMH	30/5364	Nazca, So. Coast	--	--	V
72	PMH	30/4525	Nazca, So. Coast	Bliss	1942	V
84	PMY	26962	Inca	--	--	--
178	FMNH	170488	Site:Majora Chico Nazca Valley	Kroeber	1926	V
445	MVF	28805	Nazca	--	--	V
446	MVF	28804	Nazca	--	--	V
539	MV-Be	VA44743	Ocucaje	Zypen	1907	I-5
540	MV-Be	VA12138	Ica	Bolivan	1897	I-5

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
541	MV-Be	VA45323	Ica	Zypen	1907	I-5
547	MV-Be	VA32899	Chuncho	Zypen	1907	--
660	MV-Be	VA44744	Ocucaje	Zypen	1907	I-5
661	MV-Be	VA40298	Pachacamac	Zypen	1907	I-5
662	MV-Be	VA31351	Huacho	Zypen	1907	I-5
663	MV-Be	VA22458	Chancay	Baessler	--	I-5
664	MV-Be	VA45326	Ica	Zypen	--	I-5
665	MV-Be	VA31350	Huacho	Zypen	--	I-5
666	MV-Be	VA8589	Cazco	--	1888	--
667	MV-Be	VA45324	Ica	Zypen	1907	I-5
669	MV-Be	VA45322	Ica	Zypen	1907	I-5
670	MV-Be	VA22915	Ancón	Baessler	1899	I-5
671	MV-Be	VA40297	Pachacamac	Zypen	1907	I-5
672	MV-Be	VA40295	Pachacamac	Zypen	1907	I-5
677	MV-Be	VA21863	Viru	Baessler	1899	--
678	MV-Be	VA40758	Pachacamac	Zypen	1899	--
679	MV-Be	--	Chimbote	Plock	1897	--

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
680	MV-Be	VA21865	Viru	Vaessler	1899	--
681	MV-Be	VA21868	Viru	Baessler	1899	--
682	MV-Be	VA21866	Viru	Baessler	1899	--
683	MV-Be	VA21864	Viru	Baessler	1899	--
720	MH	50.22.1	Nazca	Levi Shauss	--	V
722	MH	41.11.2	Chile	Ratton	--	--
723	MH	32.102.2	Daquito Argentini	Guarano	--	--
724	MH	41.11.45	No. Chile	Cruz-Montt	--	V
725	MH	64.86.30	Nazca	D'Harcourt	--	V
726	MH	51.1.9	Huacho	D'Harcourt	--	I-5
727	MH	53.19.997	Nazca	Reichlen	--	I-5
729	MH	30.19.1374	Peru	Capitan	--	I-5
731	MH	64.86.27	Nazca	D'Harcourt	--	V
732	MH	53.19.1190	Nazca	Reichlen	--	V
769	MH	970.52.2	Nazca	Lyons	1870	I-5
770	MH	970.52.1	Nazca	Lyons	1870	I-5
771	MH	51.1.11	Pachacamac	D'Harcourt	--	I-5

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
773	MH	51.1.10	Pachacamac	D'Harcourt	--	I-5
784	MH	64.86.29	Nazca	D'Harcourt	--	V
785	MH	64.86.28	Nazca	D'Harcourt	--	V
798	MH	87.115.145	Arica, Chile	Angrand	--	I-5
823	MH	3342	Nazca	--	--	V
861	Heye	24/1885	Cajamarca	--	--	--
862	Heye	17/6354	Tiahuanaco	--	--	--
865	Sawyer Col.	--	Late Chancay	--	--	--
866	Sawyer Col.	--	Vicusneg.	--	--	--
869	Sawyer Col.	--	Recuay, Santa Valley	--	--	--
870	Sawyer Col.	--	Viru	--	--	--
872	Sawyer Col.	--	No. Peru highlands	--	--	--
874	MM	7109	Nazca, Ica	--	--	V
890	Heye	16/9701	--	--	--	V
891	Heye	16/8978	--	--	--	V
901	AMNH	412/6307	Nazca	--	--	V
902	AMNH	41.2/6353	Early Nazca	--	--	V
904	AMNH	41.2/6214 G42-1	Paracas	--	--	V

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
906	Heye	16/8979	Nazca	--	--	V
907	Heye	16/9703	Nazca	--	--	V
908	Heye	21/2272	Trujillo	--	--	V
909	Heye	16/9702	Nazca	--	--	V
911	Heye	11/2564	Nazca	--	--	V
912	Heye	11/2563	Nazca	--	--	V
914	AMNH	41.2/6105	Paracas	--	--	V
915	AMNH	41.2/6217	Paracas	--	--	V
916	AMNH	41.2/6034	Paracas	--	--	V
917	AMNH	41.2/6035	Paracas	--	--	V
918	AMNH	175	Paracas	--	--	V
919	AMNH	41.2/6216	Paracas	--	--	V
			New Guinea			
183	FMNH	275811	New Guinea	Fuller	1935	--
184	FMNH	275812	New Guinea	Fuller	1935	--
185	FMNH	275810	Massim	Fuller	1935	--

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
186	FMNH	275813	Massim	Fuller	1935	--
385	MV-Ba	V/b12124	No. highlands	Hoeltker	1939	IV-5
386	MV-Ba	V/b18974	So. highlands	--	--	IV-5
387	MV-Ba	V/b18334	E. highlands	Stocklin	1962	IV-5
388	MV-Ba	V/b18335	E. highlands	Stocklin	1962	IV-5
407S	LM	1735	Lowlands	Mayer	1899	IV-3
409	ME	16565	Mengen	Speiser	1930	IV-1
410	ME	16566	Mengen	Speiser	1930	IV-1
411	ME	16567	Mengen	Speiser	1930	IV-1
412	ME	16671	Mengen	Speiser	1930	IV-5
413	ME	16670	Mengen	Speiser	1930	IV-5
414	ME	9448	New Guinea	--	--	IV-1
415	ME	16568	Mengen	Speiser	1930	IV-5
417	ME	--	New Guinea	Speiser	1930	IV-5
556	MV-Be	VI-38739	Sepik	Roesicke	1912	IV-5
557	MV-Be	VI-49323	Sepik	Roesicke	1912	IV-5
558	MV-Be	VI-40364	Sepik	Roesicke	1912	IV-5
559	MV-Be	VI-49671	Middle Sepik	--	1908	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
560	MV-Be	VI-49321	Sepik	Roesicke	1912	IV-5
561	MV-Be	VI-49322	Sepik	Roesicke	1912	IV-5
562	MV-Be	VI-30576	No. N. Guinea	Roesicke	1912	IV-4
563	MV-Be	VI-49208	Middle Sepik	Roesicke	1912	IV-4
564	MV-Be	VI-49475	Middle Sepik	Roesicke	1912	IV-4
565	MV-Be	VI-40236	Middle Sepik	Roesicke	1912	IV-4
566	MV-Be	VI-40237	Middle Sepik	Roesicke	1912	IV-4
567	MV-Be	VI-49304	Sepik	Roesicke	1912	IV-5
568	MV-Be	3863	Middle Sepik	Roesicke	1912	IV-5
569	MV-Be	VI-40238	Sepik	Roesicke	1912	IV-5
570	MV-Be	404	Middle Sepik	Roesicke	1912	IV-5
584	MV-Be	298	North Coast	Finsch	1883	IV-1
602	MV-Be	VI-33184	No. N. Guinea	Neuhauser	1912	IV-5
			S. Papua			
140	UI	3091.3	Piago	Landtmann	1911	II
143	UI	3041-53a	Piago	Landtmann	1911	II
144	UI	3041-54a	Piago	Landtmann	1911	II

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
145	UI	3041-59a	Piago	Landtmann	1911	II
146	UI	3041-56a	Piago	Landtmann	1911	II
147	UI	3041-55a	Piago	Landtmann	1911	II
148	UI	3041-75a	Piago	Landtmann	1911	II
149	UI	3041-63a	Piago	Landtmann	1911	II
150	UI	3041-76a	Piago	Landtmann	1911	II
151	UI	3041-73a	Piago	Landtmann	1911	II
152	UI	3041-52a	Piago	Landtmann	1911	II
175	UI	--	Piago	Landtmann	1911	II
177	UI	3041-77a	Piago	Landtmann	1911	II
			Admiralty Islands			
8	AMNH	80.0/5118	Usiai	--	--	I
241	MVV	69686	--	--	1902	I
242	MVV	69685	--	--	1902	I
243	MVV	69690	--	--	1902	I
244	MVV	69689	--	--	1902	I
268	MVV	69687	--	--	1902	I

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
268A	MVV	69688	--	--	1902	I
302	MV-Ba	10076	Manus	Bubler	1932	I
335	MV-Ba	10075	Manus	Bubler	1932	I
417S	LM	60992	Bismark Arch.	Hekele	1909	I
418S	LM	23029	Hercules R.	Mencke	1902	I
474	MVF	23927	--	Kanielzko	1929	I
573	MV-Be	VI29232	Nouru	N. Guinea Co.	1907	I
574	MV-Be	VI16919	--	Möwe	1899	I
575	MV-Be	VI16117	--	Möwe	1899	I
576	MV-Be	VI16918	--	Möwe	1899	I
577	MV-Be	249	--	N. Guinea Co.	1907	I
578	MV-Be	VI29233	Nouru	Thurnwald	1904	I
579	MV-Be	VI17462	Manus	Thilenius	1899	I
580	MV-Be	VI17463	Manus	Thilenius	1899	I
			New Ireland			
187	FMNH	11263	Lihir	Dorsey	1908	IV-1
188	FMNH	11262	Lihir	Dorsey	1908	IV-1
249	MVV	90590	Nusa	--	1913	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
252	MVV	27635	Nusa	--	1887	IV-1
334	MV-Ba	Vb10785	N. Ireland	Bubler	1932	IV-1
416S	LM	45845	N. Ireland	--	1926	IV-1
470	MVF	26172a	N. Ireland	--	--	IV-1
471	MVF	26172b	N. Ireland	--	--	IV-1
472a	MVF	6356	N. Ireland	--	--	IV-1
572	MV-Be	VI5011	North Coast	--	1883	IV-1
581	MV-Be	VI2840	N. Ireland	--	1880	IV-1
582	MV-Be	VI6222	N. Ireland	Finsch	1883	IV-1
585	MV-Be	VI24295	N. Ireland	Stephan	1905	IV-1
586	MV-Be	VI38077	Lihir	Walden	1909	IV-1
587	MV-Be	--	N. Ireland	--	1876	IV-1
588	MV-Be	VI37675	Feni	Schlaginhayfen	1908	IV-1
589	MV-Be	VI37105	Feni	Schlaginhayfen	1908	IV-1
590	MV-Be	VI37677	Feni	Schlaginhayfen	1908	IV-1
591	MV-Be	VI36877	N. Ireland	Schlaginhayfen	1908	IV-1
592	MV-Be	VI33637	Muliama	Schlaginhayfen	1908	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
593	MV-Be	VI34936	N. Ireland	Schlaginhayfen	1908	IV-1
594	MV-Be	VI33639	Muliama	Schlaginhayfen	1908	IV-1
595	MV-Be	VI33636	Muliama	Schlaginhayfen	1908	IV-1
596	MV-Be	VI24293	King	Stephan	1905	IV-1
597	MV-Be	VI10656	N. Ireland	Hoppe	1888	IV-1
598	MV-Be	VI37106	Feni	Schlaginhayfen	1908	IV-1
599	MV-Be	VI38081	Lihir	Walden	1909	IV-1
600	MV-Be	VI11926	N. Ireland	--	1976	IV-1
603	MV-Be	VI38083	Lihir	Walden	1909	IV-1
604	MV-Be	VI38100	N. Ireland	Walden	1909	IV-1
608	MV-Be	VI34935	N. Ireland	Schlaginhayfen	1908	IV-1
609	MV-Be	VI37641	Feni	Schlaginhayfen	1908	IV-1
611	MV-Be	VI1473	--	--	1876	IV-1
612	MV-Be	VI38077	Lihir	Walden	1909	IV-1
613	MV-Be	VI38094	Lihir	Walden	1909	IV-1
614	MV-Be	VI33638	Muliama	Schlaginhayfen	1908	IV-1
616	MV-Be	VI24285	West Coast	Stephan	1905	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
619	MV-Be	VI38097	Lihir	Walden	1909	IV-1
620	MV-Be	VI38087	Lihir	Walden	1909	IV-1
621	MV-Be	VI37640	Feni	Schlaginhayfen	1908	IV-1
622	MV-Be	VI24290	King	Stephan	1905	IV-1
623	MV-Be	VI38099	N. Ireland	Walden	1909	IV-1
624	MV-Be	VI37639	Feni	Schlaginhayfen	1908	IV-1
625	MV-Be	VI24289	King	Stephan	1905	IV-1
626	MV-Be	VI33640	Muliama	Schlaginhayfen	1908	IV-1
627	MV-Be	VI38085	Lihir	Walden	1909	IV-1
628	MV-Be	VI24287	King	Stephan	1905	IV-1
629	MV-Be	VI24288	King	Stephan	1905	IV-1
630	MV-Be	VI38082	Lihir	Walden	1909	IV-1
631	MV-Be	VI38098	West Coast	Walden	1909	IV-1
632	MV-Be	VI24286	King	Stephan	1905	IV-1
633	MV-Be	VI38089	Lihir	Walden	1909	IV-1
634	MV-Be	VI28548	S.New Ireland	Friederici	1909	IV-1
635	MV-Be	VI24291	King	Stephan	1905	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
636	MV-Be	VI37063	Feni	Schlaginhayfen	1908	IV-1
637	MV-Be	VI24292	King	Stephan	1905	IV-1
638	MV-Be	VI34934	N. Ireland	Schlaginhayfen	1908	IV-1
639	MV-Be	VI1473a	N. Ireland	--	1876	IV-1
642	MV-Be	VI4998	No. New Ireland	--	1883	IV-1
650	MV-Be	VI11484	Nissan	--	1892	IV-1
651	MV-Be	VI37374	Nissan	Thurnwald	--	IV-1
824	RM	686-133	N. Ireland	Schilbing	--	IV-1
825	RM	1485-388	Nissan	--	1880	IV-1
835	RM	568-66	N. Ireland	--	1886	IV-1
			<u>New Hanover</u>			
651a	MV-Be	VI38101	Lavongai	Walden	1909	IV-1
653	MV-Be	VI1058	N. Hanover	--	1876	IV-1
654	MV-Be	VI35996	N. Hanover	--	1910	IV-1
654a	MV-Be	VI38101	N. Hanover	Walden	1909	IV-1
655	MV-Be	VI1062b	N. Hanover	--	1876	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
655a	MV-Be	VI2685	N. Hanover	--	1880	IV-1
656	MV-Be	VI10803	N. Hanover	--	1888	IV-1
			New Britain			
11	AMNH	5/664	Matupi	--	--	IV-1
65	PMH	D-1139	So. Cape	--	1918	IV-5
66	PMH	D-1138	So. Cape	--	1918	IV-1
191	FMNH	98547	N. Britain	--	--	IV-3
203	FMNH	137571	Bismark Archip.	Lewis	1913	IV-5
204	FMNH	137572	Bismark Archip.	Lewis	1913	IV-5
205	FMNH	137573	Bismark Archip.	Lewis	1913	IV-1
206	FMNH	137574	Bismark Archip.	Lewis	1913	IV-1
207	FMNH	137575	Bismark Archip.	Lewis	1913	IV-1
208	FMNH	137576	Bismark Archip.	Lewis	1913	IV-1
209	FMNH	137710	Bismark Archip.	Lewis	1913	IV-1
210	FMNH	137711	Bismark Archip.	Lewis	1913	IV-1
211	FMNH	137577	Bismark Archip.	Lewis	1913	IV-1
212	FMNH	107438	N. Britain	Parkinson	--	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
213	FMNH	107439	N. Britain	Parkinson	--	IV-1
214	FMNH	145837	Bismark Archip.	Voodgt	1910	IV-5
215	FMNH	145838	Bismark Archip.	Voodgt	1910	IV-1
216	FMNH	148069	N. Britain	Voodgt	1910	IV-5
217	FMNH	107437	N. Britain	--	--	IV-5
245	MVV	84286	Open Bay	--	1908	IV-1
247	MVV	27572	Willaumez	--	1887	IV-1
251	MVV	11724	N. Britain	--	1879	IV-1
253	MVV	79846	Gazell Pen	--	1904	IV-1
254	MVV	9450	N. Britain	--	1879	IV-1
255	MVV	64533	Gazell Pen	--	1899	IV-1
256	MVV	9451	N. Britain	--	1879	IV-1
257	MVV	101203	N. Britain	--	1918	IV-1
258	MVV	25806	Matupi	--	1887	IV-5
259	MVV	27582	Willaumez	--	1887	IV-5
260	MVV	9452	N. Britain	--	1879	IV-1
262	MVV	64536	South Cape	--	1899	IV-5

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
308	MV-Ba	V/b8304	Jacquinot	Speiser	1930	IV-5
309	MV-Ba	V/b8305	Jacquinot	Speiser	1930	IV-5
310	MV-Ba	V/b8148	Gasmata	Speiser	1930	IV-5
311	MV-Ba	V/b8431	Jacquinot	Speiser	1930	IV-5
312	MV-Ba	V/b8430	Jacquinot	Speiser	1930	IV-5
313	MV-Ba	V/b8428	Jacquinot	Speiser	1930	IV-5
313a	MV-Ba	V/b8427	Ahuat	Speiser	1930	IV-5
315	MV-Ba	V/b8424	Jacquinot	Speiser	1930	IV-1
316	MV-Ba	V/b8423	Jacquinot	Speiser	1930	IV-1
317	MV-Ba	V/b8426	Jacquinot	Speiser	1930	IV-5
318	MV-Ba	V/b8315	Ahuat	Speiser	1930	IV-5
319	MV-Ba	V/b8429	Jacquinot	Speiser	1930	IV-1
320	MV-Ba	V/b8425	Jacquinot	Speiser	1930	IV-1
408S	LM	IC5312	N. Britain	Parkinson	1899	IV-5
408Sa	LM	IC5313	N. Britain	Parkinson	1899	IV-1
409S	LM	85107	Nakanai	--	1913	IV-1
410S	LM	74409	Gazelle	Burger	--	IV-5

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
411S	LM	30873	Blanche Bay	Kramer	1903	IV-1
412S	LM	85107	Nakanai	Besenbruch	1913	IV-5
414S	LM	74648	Gazelle	Burger	1911	IV-5
415S	LM	IC5538	Nakanai	--	1899	IV-1
465	MVF	26204	Bismark Archip.	--	1928	IV-1
466	MVF	20158	Baining	Bley	1913	IV-5
467	MVF	20157	Baining	Bley	1913	IV-5
472	MVF	26173	Bismark Archip.	Heller	--	IV-4
478	MVF	24907	Sulka	--	1929	IV-5
479	MVF	24908	N. Britain	--	1937	IV-5
480	MVF	30921	N. Coast	--	1937	IV-1
583	MV-Be	VI14861	Bismark Archip.	--	1897	IV-1
601	MV-Be	VI32119	N. Britain	--	1910	IV-1
605	MV-Be	VI17750	N. Britain	--	1900	IV-1
606	MV-Be	VI37475	N. Britain	Thurnwald	--	IV-5
607	MV-Be	VI9633	Willaumez	Finsch	1888	IV-1
610	MV-Be	VI13279	Matupi	--	1896	IV-3

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
615	MV-Be	VI13278	Matupi	--	1896	IV-3
617	MV-Be	VI27110	Baining	--	1907	IV-5
618	MV-Be	VI6084	N. Britain	Finsch	1884	IV-1
641	MV-Be	VI35071	S. Coast	Schoede	1910	IV-1
700	MV-Be	VI22886	Nakanai	Mowe	1903	IV-1
826	RM	1137-11	South Cape	--	--	IV-1
827	RM	1137-11	South Cape	--	--	IV-1
828	RM	1137-11	South Cape	--	--	IV-1
829	RM	4247-119	N. Britain	Gerbrands	1967	IV-5
830	RM	4247-105	Kilenge	Gerbrands	1967	--
831	RM	4247-104	Kilenge	Gerbrands	1967	IV-5
832	RM	316-146	N. Britain	Rohlp	--	IV-1
833	RM	265-128	N. Britain	Godeffroy	1880	IV-1
834	RM	1485-429	Nakanai	--	--	IV-5
836	RM	316-145	N. Britain	Rohlp	--	IV-1

Solomon Islands

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
3	AMNH	--	Choiseul	--	--	IV-3
4	AMNH	80.0/4812	Chaiseul	--	1929	IV-3
5	AMNH	80.0/9876	Ngela	--	1939	IV-3
9	AMNH	80.0/563	Buka	--	1907	IV-1
83	PMH	70/4791	N. Malata	--	--	IV-3
92	PMY	232274	Choiseul	--	--	IV-3
93	PMY	232275	Choiseul	--	--	IV-3
192	FMNH	112713	Bouganville	Dorsey	1908	IV-4
193	FMNH	112715	Bouganville	Dorsey	1908	IV-4
194	FMNH	112465	Bouganville	Dorsey	1908	IV-4
195	FMNH	112793	Bouganville	Dorsey	1908	IV-4
196	FMNH	112577	Buka	Dorsey	1908	IV-4
197	FMNH	112460	Bouganville	Dorsey	1908	IV-4
198	FMNH	112712	Bouganville	Dorsey	1908	IV-4
199	FMNH	112716	Bouganville	Dorsey	1908	IV-4
200	FMNH	112714	Bouganville	Dorsey	1908	IV-4

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
201	FMNH	277020	Mono	Fuller	--	--
202	FMNH	89916	Guadalcanal	Harrison	--	IV-3
223	FMNH	112579	Buka	Dorsey	1908	IV-5
239	MVV	119.470	Solomon Islands	--	1925	IV-3
240	MVV	43007	Solomon Islands	Reischek	1891	IV-3
246	MVV	65593	Solomon Islands	--	1900	IV-1
250	MVV	44977	Buka	--	1892	IV-1
261	MVV	65594	Solomon Islands	--	1900	IV-5
263	MVV	23925	Solomon Islands	--	1886	IV-5
271	MVV	43006	Solomon Islands	--	1891	IV-3
301	MV-Ba	V/b7665	New Georgia	Paravicini	1929	IV-3
303	MV-Ba	V/b11762	Choiseul	--	1933	IV-3
304	MV-Ba	V/b7666	New Georgia	Paravicini	1929	IV-3
305	MV-Ba	V/b11761	Choiseul	--	1933	IV-3
306	MV-Ba	V/b8183	Bouganville	Speiser	1930	IV-5
307	MV-Ba	V/b6961	Guadalcanal	Paravicini	1929	IV-3
314	MV-Ba	V/b8215	Buin, Boug.	Speiser	1930	IV-5

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
332	MV-Ba	V/b6769	Guadalcanal	Paravicini	1929	IV-3
333	MV-Ba	V/b7059	Guadalcanal	Paravicini	1929	IV-5
336	MV-Ba	V/b118	Solomon Islands	--	1887	IV-3
391	MV-Ba	V/b8183	Buin, Boug.	Speiser	1930	--
396	MV-Ba	V/b12484	Buka	Wirz	1950	IV-4
397	MV-Ba	V/b7523	Malaita	Paravicini	1929	IV-1
398	MV-Ba	V/b8182	Buka	Speiser	1930	IV-4
399	MV-Ba	V/b12532	Buka	Wirz	1950	--
400	MV-Ba	V/b7383	Malaita	Paravicini	1929	IV-1
401	MV-Ba	V/b7522	Malaita	Paravicini	1929	IV-3
402	MV-Ba	V/b7513	New Georgia	Paravicini	1929	IV-3
403	MV-Ba	V/b7421	Malaita	Paravicini	1929	IV-3
464	MVF	4636	Solomon Islands	--	--	IV-5
473	MVF	6357b	Buka	--	--	IV-5
475	MVF	25631	Solomon Islands	--	1927	IV-1
475a	MVF	E1804	Trobriand	Gerlach	--	IV-3
476	MVF	7574	Buka	Lejeune	--	IV-1

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
477	MVF	6358	Buka	--	--	IV-1
481	MVF	6357	Buka	--	--	IV-1
482	MVF	6361	Buka	--	--	IV-5
483	MVF	33691	Solomon Islands	--	1941	IV-4
571	MV-Be	VI-12337b	Alu	Ribbe	1894	IV-3
640	MV-Be	VI-12337a	Alu	Ribbe	1894	IV-3
646	MV-Be	VI-37366	Solomon Islands	Thurnwald	--	IV-3
647	MV-Be	VI37371	Buin, Boug.	Thurnwald	--	IV-3
648	MV-Be	VI-37367	Solomon Islands	Thurnwald	--	IV-4
649	MV-Be	VI-11655	Buka	Wegener	1893	IV-1
712	MH	34.188.1271	Telei, Boug.	--	1934	--
714	MH	970.101.26-D	Malaita	Zemp	--	IV-3
715	MH	970.101.25-D	Malaita	Zemp	--	IV-3
716	MH	970.101.24-D	Malaita	Zemp	--	--
717	MH	970.101.23-D	Malaita	Zemp	--	--
728	MH	34.188.435	Bouganville	O'Reilly	--	IV-4
734	MH	90.63.	Solomon Islands	Pineau	--	IV-3

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
737	MH	34.188.431	Buka	O'Reilly	--	--
741	MH	34.188.430	Bouganville	O'Reilly	--	--
747	MH	61.103.105	Solomon Islands	Korrigans	--	IV-3
748	MH	34.188.505	Bouganville	O'Reilly	--	IV-4
749	MH	34.188.433	Bouganville	O'Reilly	--	IV-4
750	MH	34.188.432	Bouganville	O'Reilly	--	IV-4
753	MH	34.188.1883	Bouganville	O'Reilly	--	IV-5
755	MH	34.188.436	Bouganville	O'Reilly	--	IV-5
766	MH	34.188.1371	Bouganville	O'Reilly	--	IV-4
767	MH	34.188.1369	Buka	O'Reilly	--	IV-4
768	MH	34.188.1370	Buka	O'Reilly	--	IV-4
772	MH	30.29.504	Solomon Islands	Chauvet	--	IV-3
783	MH	34.188.1270	Buin, Boug.	O'Reilly	--	IV-5
800	MH	34.188.427	Nissan	O'Reilly	--	IV-1
816	MH	34.188.434	Bouganville	O'Reilly	--	IV-5
817	MH	34.188.428	Bouganville	O'Reilly	--	IV-4
818	MH	34.188.429	Bouganville	O'Reilly	--	IV-4
859	TM;	--	Solomon Islands	--	--	IV-5

New Hebrides

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
110	LC	433	Malo	Elkin	1924	IV-2
111	LC	435	New Hebrides	Elkin	1924	IV-2
112	LC	434	New Hebrides	Elkin	1924	IV-2
219	FMNH	132917	Malekula	Lewis	1913	IV-5
220	FMNH	132942	Malekula	Lewis	1913	IV-5
221	FMNH	133356	Santo	Lewis	1913	--
222	FMNH	132765	Malekula	Lewis	1913	IV-5
224	FMNH	132915	Malekula	Lewis	1913	IV-5
225	FMNH	132992	Malekula	Lewis	1913	IV-5
226	FMNH	132916	Malekula	Lewis	1913	IV-5
270	MVV	1	New Hebrides	Cook	1806	IV-2
283	MV-Ba	V/b3323	W. Santo	Speiser	1912	--
284	MV-Ba	V/b3327	N. Malo	Speiser	1912	IV-2
285	MV-Ba	V/b3340	Ureparapara	Speiser	1912	--
286	MV-Ba	V/b3324	Malo	Speiser	1912	IV-2
287	MV-Ba	V/b3326	N. Malo	Speiser	1912	IV-2
288	MV-Ba	V/b3322	E. Santo	Speiser	1912	--

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
289	MV-Ba	V/b3333	S.W. Aoba	Speiser	1912	IV-2
290	MV-Ba	V/b3328	N. Malo	Speiser	1912	IV-2
291	MV-Ba	V/b3321	Ne Santo	Speiser	1912	--
292	MV-Ba	V/b3339	Tana	Speiser	1912	--
293	MV-Ba	V/b3336	Tana	Speiser	1912	IV-2
294	MV-Ba	V/b3338	Tana	Speiser	1912	--
295	MV-Ba	V/b3334	Tana	Speiser	1912	IV-2
296	MV-Ba	V/b3336	N. Pentecost	Speiser	1912	IV-2
297	MV-Ba	V/b3337	Tana	Speiser	1912	--
298	MV-Ba	V/b3331	Tana	Speiser	1912	IV-2
299	MV-Ba	V/b3332	Aoba	Speiser	1912	IV-2
300	MV-Ba	V/b3330	Ne Aoba	Speiser	1912	IV-2
303a	MV-Ba	V/b3345	Malekula	Speiser	1912	IV-5
304a	MV-Ba	V/b3346	New Hebrides	Speiser	1912	IV-5
305a	MV-Ba	V/b3343	Santo	Speiser	1912	IV-5
306a	MV-Ba	V/b3344	E. Malekula	Speiser	1912	IV-5
329	MV-Ba	V/b3325	Malo	Speiser	1912	IV-2
330	MV-Ba	V/b3329	Aoba	Speiser	1912	IV-2

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
331	MV-Ba	V/b3341	Ureparapara	Speiser	1912	--
468	MVF	1530	Tana	--	--	--
469	MVF	25545	E. Malekula	--	1927	IV-2
657	MV-Be	VI-42751	Aoba	--	1934	IV-2
658	MV-Be	VI-16155	Santo	Thilenius	1898	--
659	MV-Be	VI-11074	Santo	--	1890	IV-2
660	MV-Be	VI-11274	Aoba	--	1891	--
661	MH	93.31.184	New Hebrides	--	--	IV-2
708	MH	34.186.226	Efate	--	1934	--
710	MH	34.186.205	Santo	--	1934	IV-2
711	MH	34.186.225	Efate	--	1934	--
713	MH	34.186.206	Santo	--	1934	--
733	MH	30.29.439	New Hebrides	Chauvet	--	IV-2
795	MH	org.104	New Hebrides	--	--	--
820	MH	93.31.183	New Hebrides	--	--	IV-5
821	TM	1322-237	New Hebrides	--	1939	IV-2

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
			Tonga Samoa			
1	AMNH	80.0/3308	Samoa	Johannesen	1914	
117	SI	23942	Fiji	Brower	--	
118	SI	2900	Fiji	Wilkes	1842	
119	SI	23940	Fiji	Brower	--	
248	MVV	22913	Samoa	--	1886	
267	MVV	90	Tonga	Cook	1806	
704	MV-Be	--	Tonga	--	--	
			Philippines			
218	FMNH	34481	Luzon	Ayer	--	III
227	FMNH	108027	Luzon	Cole	1908	III
228	FMNH	109028	Luzon	Cole	1908	III
230	FMNH	109025	Luzon	Cole	1908	III
231	FMNH	109026	Luzon	Cole	1908	III
232	FMNH	90369	Luzon	Simons	1906	III
273	MVV	30944	Luzon	--	1889	III
274	MVV	L39/1937	Luzon	--	--	III
275	MVV	42084	Luzon	--	--	III

Indonesia

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
701	MV-Be	IC9205	Timor	Risdel	--	
702	MV-Be	IC21711	Timor	--	--	
703	MV-Be	IC21215	Timor	Jacobsen	--	
850a	TM	1055/4	W. Java	--	1936	
852a	TM	H2059	Timor	--	--	
851a	TM	1055/5	W. Java	--	1936	
854	TM	1462/1	W. Java	--	1941	
855	TM	H322	W. Java	--	1874	
			Africa			
94	PMY	206192	Rhodesia	--	--	
115	LC	662	Africa	Miller	--	
120	SI	95188	Cairo	Grant	1892	
121	SI	237836	Egyptian Sudan	Friedenwald	--	
122	SI	95187	Cairo	--	--	
123	SI	95705	Cairo	Goode	--	
325	MV-Ba	III5669	Cairo	Gough	1921	
406	ME	3605	Oran Egypt	Tournier	1905	

Serial #	Museum	Cat. #	Provenience	Collection	Date	Type
407	ME	6359-136	Egypt	Bedot	1913	
408	ME	6358-137	Egypt	Bedot	1913	
439	LM	38365	Majumbe, Congo	Visser	1905	
440	MVF	35721	Male, Ethiopia	Pauli	1950	
441	MVF	18418	Abyssinia	Katz	1913	
442	MVF	24903	Bayanzi, Central Africa	Konitzko	1925	
706	MV-Be	IIIC3828	Lower Congo	--	--	
751	MH	31.74.2551	N. Cameroons	--	--	
776	MH	50.48.2	Africa	--	--	
794	MH	97.48.9	N. Zambezi	Foo	1897	
842	RM	2866-74	Congo	Fontaine	1950	
843	RM	2866-75	Congo	Fontaine	1950	
844	RM	2866-76	Congo	Fontaine	1950	
845	RM	2866-77	Congo	Fontaine	1950	
856	TM	A10431	Angola, Congo	deGroot	1928	
857	TM	A10973	Congo	--	1900	
859	MMA	89.14.2843	Africa	--	--	

Serial #	Museum	Cat. #	Proveniènce	Collection	Date	Type
			Asia			
12	AMNH	70.0/8685	Burma	--	--	
754	MH	31.6.105	Annam	Colani	--	
814	MH	40.9.20	Annam	Bertrand	--	
815	MH	--	Indochina	--	--	
819	MH	56.56.13	Vietnam	Laforet	--	
821	MH	68.115.103	Cambodia	--	--	
822	MH	31.42.212	Annam	--	--	
849	GM	--	Japan	--	--	
			Europe			
95	LC	371A	Milan, Italy	Miller	1923	
96	LC	372B	Milan, Italy	Miller	1923	
99	LC	367A	Milan, Italy	Miller	1923	
718	MH	35.31.1	Basque Prov.	--	1935	
719	MH	30.54.1714	Basque Prov.	--	1862	
853	MMA	89.4.3172	Spain	--	--	

TABLE 4

A Rating of Parallels Between Melanesian and And Andean Panpipes*

Melanesian and/or Andean Traits	And.	Mel.	Distribution Elsewhere	Frequency Elsewhere	# Alter-natives	Rating
6 reed	x	x	1,2,3,4,5	common	7	rejected
10 composite	x	x	1,2,3,4,5	common	1	rejected
18 tied w. fiber	x	x	1,2,3,4,5	common	8	rejected
19 tied w. cord	x	x	1,2,3,4,5	common	8	rejected
20 around & btw.	x	x	1,2,3,4,5	moderate	9	poor
22 criss cross	x	x	1,2,3,4,5	moderate	9	poor
23 back & forth	x	x	1,2,3,4,5	moderate	9	poor
25 wrapped around all		x				
26 chain	x	x	1,2	1-rare 2-moderate	9	good
27 step	x	x		absent	9	good
28 herringbone	x	x	2	rare	9	good
30 few elements	x	x	1,2,3,4,5	common	1	rejected
31 many elements	x	x	1,2,3,4,5	common	1	rejected
32 one tie	x	x	1,2,3,4,5	common	2	rejected

Melanesian and/or Andean Traits	And.	Mel.	Distribution Elsewhere	Frequency Elsewhere	# Alter-natives	Rating
33 two ties	x	x	1,2,3,4,5	common	2	rejected
34 three ties	x	x	1,2,3,4,5	common	2	rejected
35 no support	x	x	1,2,3,4,5	common	5	rejected
36 splint around	x					
37 horiz. stick(s)	x	x	1,5	moderate	5	satisfactory
38 horiz. & diag. sticks	x	x	1,2,3,4,5	moderate	5	poor
40 btw. 2 rows		x				
41 round openings	x	x	1,2,3,4,5	common	3	rejected
43 node pierced	x	x		absent	3	good
44 reed inserted	x	x		absent	3	good
46 indented 2 sides	x					
47 no closure	x	x	2	rare	6	good
48 through node	x	x	1,2,3,4,5	common	6	rejected
49 below node	x	x	1,2,4,5	moderate	6	rejected
50 gourd plug	x					
51 wood plug	x					
52 fiber plug	x					

Melanesian and/or Andean Traits	And.	Mel.	Distribution Elsewhere	Frequency Elsewhere	# Alter-natives	Rating
54 Crosswise	x	x	1,2,3,4,5	common	4	rejected
55 rect. piece out	x	x		absent	4	good
56 rounded	x	x	1,2	moderate	4	satisfactory
57 pointed		x				
58 on bias	x	x	1,2,4,5	moderate	4	poor
59 no tiering	x	x	1,2,5	rare	7	satisfactory
60 one row	x	x	1,2,3,4,5	common	7	rejected
61 2 rows same l.	x	x	2	rare	7	good
62 2 rows ½ leng.	x					
63 alt. lengths	x	x		absent	7	good
64 one row grad. one row irreg.		x				
65 3 rows	x					
66 4 rows	x					
67 irreg.		x				
70 simply grad.	x	x	1,2,3,4,5	common	11	rejected
71 longest in middle	x		1,2,3,5			

Melanesian and/or Andean Traits	And.	Mel.	Distribution Elsewhere	Frequency Elsewhere	# Alternatives	Rating
72 shortest in middle	x	x	3	rare	11	good
73 1 short, 1 long in mid.	x	x		absent	11	good
74 interchange.	x		3		11	
78 very high	x	x	1,2,4,5	moderate	4	rejected
79 high	x	x	1,2,4,5	common	4	rejected
80 medium	x	x	1,2,4,5	common	4	rejected
81 low	x	x	1,2,4,5	common	4	rejected
82 very low	x	x	1,2,4,5	moderate	4	rejected
83 under 1 oct.	x	x	1,2,4,5	moderate	3	rejected
84 1-2 octaves	x	x	1,2,4,5	common	3	rejected
85 2-3 octaves	x	x	1,2,4,5	common	3	rejected
86 over 3 oct.	x	x	1,2,4,5	moderate	3	rejected
89 medium mean	x	x	1,2,4,5	common	4	rejected
93 1-2 oct.(mean)	x	x	1,2,4,5	common	3	rejected
94 2-3 oct.(mean)	x	x	1,2,4,5	common	3	rejected

Melanesian and/or Andean Traits	And.	Mel.	Distribution Elsewhere	Frequency Elsewhere	# Alter-natives	Rating
119 7 intervals	x	x	unknown	unknown	9	
127 comp. pattern	x	x	1,2,4,5	common	3	rejected
128 ½ pat. linked	x				3	
129 ½ pat. unlinked	x				3	
130 incomplete pattern (not ½)		x			3	
131 no pattern	x	x	1,2,4,5	common	3	rejected
132 incised	x					
137 shells	x					
138 undecorated	x	x	1,2,3,4,5	common	6	rejected
139 signaling		x				
140 love charm		x				
141 orchestra	x	x	4			
142 pastoral	x	x	4			
143 dance	x	x				
144 solo	x	x	4			
145 duet	x	x	4			

Melanesian and/or Andean Traits	And.	Mel.	Distribution Elsewhere	Frequency Elsewhere	# Alternatives	Rating
146 few tubes	x	x	1,2,3,4,5	common	2	rejected
147 mod. tubes	x	x	1,2,3,4,5	common	2	rejected
148 many tubes	x	x	1,3,4,5	common	2	rejected

*See pages 96 and 97 for an explanation of the rating.

TEKINER DATA -- MUSICAL SCALE TRAITS 2/10/74 16:21: 2 PAGE 1

	IP	IIP	IIIP	IV1P	IV2P	IV3P	IV4P	IV5P	I1S	I2S	I3S	I4S	I5S	IIS	IIIS	IVS	VS
IP	5.00	2.50	3.00	1.70	1.30	1.20	2.30	1.75	0.50	0.25	0.60	1.00	1.00	1.30	1.80	1.60	1.45
IIP	2.50	5.00	0.50	3.00	2.70	2.40	3.30	3.00	1.40	1.50	1.80	2.00	2.50	2.20	1.20	1.00	1.20
IIIP	3.00	0.50	5.00	0.70	0.80	0.20	0.30	1.75	0.20	0.25	0.25	1.00	1.00	0.30	1.80	1.60	2.50
IV1P	1.70	3.00	0.70	5.00	4.70	3.90	4.00	3.80	3.30	3.20	2.20	3.10	3.30	2.60	1.70	1.60	1.20
IV2P	1.30	2.70	0.80	4.70	5.00	4.10	3.30	4.00	3.30	3.50	3.20	2.90	3.20	3.00	1.20	1.30	1.10
IV3P	1.20	2.40	0.20	3.90	4.10	5.00	3.60	4.30	3.60	3.80	3.50	2.90	2.90	2.60	1.10	1.30	1.30
IV4P	2.30	3.30	0.30	4.00	3.30	3.60	5.00	4.25	2.60	2.75	2.75	3.10	3.50	2.00	1.75	1.40	0.75
IV5P	1.75	3.00	1.75	3.80	4.00	4.30	4.25	5.00	3.00	3.50	3.70	3.50	3.50	1.80	1.60	1.40	1.10
I1S	0.50	1.40	0.20	3.30	3.30	3.60	2.60	3.00	5.00	4.50	4.80	3.70	3.70	2.30	0.90	1.30	1.60
I2S	0.25	1.50	0.25	3.20	3.50	3.80	2.75	3.50	4.50	5.00	4.70	3.80	3.70	2.50	1.25	1.10	1.25
I3S	0.60	1.80	0.25	2.20	3.20	3.50	2.75	3.70	4.80	4.70	5.00	3.75	3.75	1.80	1.00	1.40	1.25
I4S	1.00	2.00	1.00	3.10	2.90	2.90	3.10	3.50	3.70	3.80	3.75	5.00	4.50	1.50	1.70	1.30	1.00
I5S	1.00	2.50	1.00	3.30	3.20	2.90	3.50	3.50	3.70	3.70	3.75	4.50	5.00	2.20	1.70	1.30	1.00
IIS	1.30	2.20	0.30	2.60	3.00	2.60	2.00	1.80	2.30	2.50	1.80	1.50	2.20	5.00	1.00	1.00	1.25
IIIS	1.80	1.20	1.80	1.70	1.20	1.10	1.75	1.60	0.90	1.25	1.00	1.70	1.70	1.00	5.00	2.70	2.25
IVS	1.60	1.00	1.60	1.60	1.30	1.30	1.40	1.40	1.30	1.10	1.40	1.30	1.30	1.00	2.70	5.00	2.50
VS	1.45	1.20	2.50	1.20	1.10	1.30	0.75	1.10	1.60	1.25	1.25	1.00	1.00	1.25	2.25	2.50	5.00

Table 5

TEKINER -- MORPHOLOGICAL TRAITS

	IP	IIP	IIIP	IV1P	IV2P	IV3P	IV4P	IV5P	I1S	I2S	I3S	I4S	I5S	IIS	IIIS	IVS	VS
IP	15.00	10.50	9.50	10.30	9.80	8.00	9.50	8.20	9.70	7.00	8.80	12.00	8.80	7.50	11.10	8.90	4.30
IIP	10.50	15.00	11.50	9.30	10.30	10.00	10.00	8.60	9.70	9.00	11.80	12.50	8.80	9.50	12.20	10.70	6.80
IIIP	9.50	11.50	15.00	7.20	8.80	9.00	8.00	7.70	9.70	8.00	9.30	10.50	6.80	9.50	10.75	8.70	5.80
IV1P	10.30	9.30	7.20	15.00	11.50	9.70	10.70	8.80	8.00	8.00	10.00	9.30	9.50	7.70	9.10	10.30	5.50
IV2P	9.80	10.30	8.80	11.50	15.00	9.80	9.70	10.80	8.00	6.80	10.00	9.00	6.10	8.80	10.30	10.00	4.30
IV3P	8.00	10.00	8.00	9.70	9.80	15.00	10.00	8.20	9.80	5.50	13.20	9.50	7.80	11.50	8.80	11.00	4.70
IV4P	9.50	10.00	8.00	10.70	9.70	10.00	15.00	9.20	10.70	9.00	9.80	10.50	9.80	7.00	9.80	9.80	3.80
IV5P	8.20	8.60	7.70	8.80	10.80	8.20	9.20	15.00	6.80	6.00	8.20	8.20	8.30	7.70	8.70	8.10	2.50
I1S	9.70	9.70	9.70	8.00	8.00	9.80	10.70	6.80	15.00	7.20	10.00	11.10	8.30	9.10	10.00	10.30	4.30
I2S	7.00	9.00	8.00	8.00	6.80	5.50	9.00	6.00	7.20	15.00	7.80	9.50	6.80	7.50	8.75	8.80	2.30
I3S	8.80	11.80	9.30	10.00	10.00	13.20	9.80	8.20	10.00	7.80	15.00	11.30	8.50	11.70	10.00	12.80	5.50
I4S	12.00	12.50	10.50	9.30	9.00	9.50	10.50	8.20	11.10	9.50	11.30	15.00	10.30	10.00	14.75	12.20	4.80
I5S	8.80	8.80	6.80	9.50	6.10	7.80	9.80	8.30	8.30	6.80	8.50	10.30	15.00	6.80	8.40	8.70	3.80
IIS	7.50	9.50	9.50	7.70	8.80	11.50	7.00	7.70	9.10	7.50	11.70	10.00	6.80	15.00	9.80	11.30	4.50
IIIS	11.10	12.20	10.75	9.10	10.30	8.80	9.80	8.70	10.00	8.75	10.00	14.75	8.40	9.80	15.00	10.25	4.50
IVS	8.90	10.70	8.70	10.30	10.00	11.00	9.80	8.10	10.30	8.80	12.80	12.20	8.70	11.30	10.25	15.00	5.50
VS	4.30	6.80	5.80	5.50	4.30	4.70	3.80	2.50	4.30	2.30	5.50	4.80	3.80	4.50	4.50	5.50	15.00

Table 6

	IP	IIP	IIIP	IVIP	IV2P	IV3P	IV4P	IV5P	IIS	I2S	I3S	I4S	I5S	IIS	IIIS	IVS	VS
IP	1.00	0.50	0.60	0.34	0.26	0.24	0.46	0.35	0.10	0.05	0.12	0.20	0.20	0.26	0.36	0.32	0.29
IIP	0.50	1.00	0.10	0.60	0.54	0.48	0.66	0.60	0.28	0.30	0.36	0.40	0.50	0.44	0.24	0.20	0.24
IIIP	0.60	0.10	1.00	0.14	0.16	0.04	0.06	0.35	0.04	0.05	0.05	0.20	0.20	0.06	0.36	0.32	0.50
IVIP	0.34	0.50	0.14	1.00	0.94	0.78	0.80	0.76	0.66	0.64	0.44	0.62	0.66	0.52	0.34	0.32	0.24
IV2P	0.26	0.54	0.16	0.94	1.00	0.82	0.66	0.80	0.66	0.70	0.64	0.58	0.64	0.60	0.24	0.26	0.22
IV3P	0.24	0.48	0.04	0.78	0.82	1.00	0.72	0.86	0.72	0.76	0.70	0.58	0.58	0.52	0.22	0.26	0.26
IV4P	0.46	0.66	0.06	0.80	0.66	0.72	1.00	0.85	0.52	0.55	0.55	0.62	0.70	0.40	0.35	0.28	0.15
IV5P	0.35	0.60	0.35	0.76	0.80	0.86	0.85	1.00	0.60	0.70	0.74	0.70	0.70	0.36	0.32	0.28	0.22
IIS	0.10	0.28	0.04	0.66	0.66	0.72	0.52	0.60	1.00	0.90	0.96	0.74	0.74	0.46	0.18	0.26	0.32
I2S	0.05	0.30	0.05	0.64	0.70	0.76	0.55	0.70	0.90	1.00	0.94	0.76	0.74	0.50	0.25	0.22	0.25
I3S	0.12	0.36	0.05	0.44	0.64	0.70	0.55	0.74	0.96	0.94	1.00	0.75	0.75	0.36	0.20	0.28	0.25
I4S	0.20	0.40	0.20	0.62	0.58	0.58	0.62	0.70	0.74	0.76	0.75	1.00	0.90	0.30	0.34	0.76	0.20
I5S	0.20	0.50	0.20	0.66	0.64	0.58	0.70	0.70	0.74	0.74	0.75	0.90	1.00	0.44	0.34	0.26	0.20
IIS	0.26	0.44	0.06	0.52	0.60	0.52	0.40	0.36	0.46	0.50	0.36	0.30	0.44	1.00	0.20	0.20	0.25
IIIS	0.36	0.24	0.36	0.34	0.24	0.22	0.35	0.32	0.18	0.25	0.20	0.34	0.34	0.20	1.00	0.54	0.45
IVS	0.32	0.20	0.32	0.32	0.26	0.26	0.28	0.28	0.26	0.22	0.28	0.26	0.26	0.20	0.54	1.00	0.50
VS	0.29	0.24	0.50	0.24	0.22	0.26	0.15	0.22	0.32	0.25	0.25	0.20	0.20	0.25	0.45	0.50	1.00

FOR OFF-DIAGONAL SIMILARITY COEFFICIENTS,MEAN = 0.438 VARIANCE = 5.633E-02 STD DEV =0.2373

Table 7

TEKINER -- MORPHOLOGICAL TRAITS 27 9/74 13:32:54 PAGE 4

	IP	IIP	IIIP	IV1P	IV2P	IV3P	IV4P	IV5P	I1S	I2S	I3S	I4S	I5S	IIS	IIIS	IVS	VS
IP	1.00	0.70	0.63	0.69	0.65	0.53	0.63	0.55	0.65	0.47	0.59	0.80	0.59	0.50	0.74	0.59	0.29
IIP	0.70	1.00	0.77	0.62	0.69	0.67	0.67	0.57	0.65	0.60	0.79	0.83	0.59	0.63	0.81	0.71	0.45
IIIP	0.63	0.77	1.00	0.48	0.59	0.53	0.53	0.51	0.65	0.53	0.62	0.70	0.45	0.63	0.72	0.58	0.39
IV1P	0.69	0.62	0.48	1.00	0.77	0.65	0.71	0.59	0.53	0.53	0.67	0.62	0.63	0.51	0.61	0.69	0.37
IV2P	0.65	0.69	0.59	0.77	1.00	0.65	0.65	0.72	0.53	0.45	0.67	0.60	0.41	0.59	0.69	0.67	0.29
IV3P	0.53	0.67	0.53	0.65	0.65	1.00	0.67	0.55	0.65	0.37	0.88	0.63	0.52	0.77	0.59	0.73	0.31
IV4P	0.63	0.67	0.53	0.71	0.65	0.67	1.00	0.61	0.71	0.60	0.65	0.70	0.65	0.47	0.65	0.65	0.25
IV5P	0.55	0.57	0.51	0.59	0.72	0.55	0.61	1.00	0.45	0.40	0.55	0.55	0.55	0.51	0.58	0.54	0.17
I1S	0.65	0.65	0.65	0.53	0.53	0.65	0.71	0.45	1.00	0.48	0.67	0.74	0.55	0.61	0.67	0.69	0.29
I2S	0.47	0.60	0.53	0.53	0.45	0.37	0.60	0.40	0.48	1.00	0.52	0.63	0.45	0.50	0.58	0.59	0.15
I3S	0.59	0.79	0.62	0.67	0.67	0.88	0.65	0.55	0.67	0.52	1.00	0.75	0.57	0.78	0.67	0.85	0.37
I4S	0.80	0.83	0.70	0.62	0.60	0.63	0.70	0.55	0.74	0.63	0.75	1.00	0.69	0.67	0.98	0.81	0.32
I5S	0.59	0.59	0.45	0.63	0.41	0.52	0.65	0.55	0.55	0.45	0.57	0.69	1.00	0.45	0.56	0.58	0.25
IIS	0.50	0.63	0.63	0.51	0.59	0.77	0.47	0.51	0.61	0.50	0.78	0.67	0.45	1.00	0.65	0.75	0.30
IIIS	0.74	0.81	0.72	0.61	0.69	0.59	0.65	0.58	0.67	0.58	0.67	0.98	0.56	0.65	1.00	0.68	0.30
IVS	0.59	0.71	0.58	0.69	0.67	0.73	0.65	0.54	0.69	0.59	0.85	0.81	0.58	0.75	0.68	1.00	0.37
VS	0.29	0.45	0.39	0.37	0.29	0.31	0.25	0.17	0.29	0.15	0.37	0.32	0.25	0.30	0.30	0.37	1.00

FOR OFF-DIAGONAL SIMILARITY COEFFICIENTS, MEAN = 0.586 VARIANCE = 2.111E-02 STD DEV = 0.1453

Table 8

COLLECTIONS ARRANGED IN ORDER OF SIMILARITY

IIIP	IP	IIP	IV4P	IV1P	IV5P	IV2P	IV3P	I2S	I1S	I3S	I4S	I5S	IIS	IVS	IIIS	VS
	0.60	0.50	0.66	0.90	0.76	0.80	0.82	0.76	0.90	0.96	0.75	0.90	0.44	0.20	0.54	0.45
		0.10	0.46	0.60	0.85	0.94	0.86	0.70	0.72	0.94	0.74	0.75	0.30	0.26	0.20	0.50
			0.06	0.34	0.60	0.66	0.78	0.70	0.66	0.70	0.76	0.74	0.36	0.26	0.34	0.25
				0.14	0.35	0.54	0.72	0.64	0.60	0.64	0.58	0.74	0.46	0.28	0.34	0.20
					0.35	0.26	0.48	0.55	0.66	0.74	0.58	0.58	0.50	0.26	0.20	0.20
						0.16	0.24	0.30	0.52	0.44	0.70	0.64	0.52	0.22	0.18	0.25
							0.04	0.05	0.28	0.55	0.62	0.70	0.60	0.26	0.25	0.32
								0.05	0.10	0.36	0.62	0.66	0.36	0.26	0.22	0.25
									0.04	0.12	0.40	0.70	0.52	0.28	0.24	0.26
										0.05	0.20	0.50	0.40	0.32	0.32	0.22
											0.20	0.20	0.44	0.28	0.34	0.22
												0.20	0.26	0.20	0.35	0.24
													0.06	0.32	0.24	0.15
														0.32	0.36	0.24
															0.36	0.29
																0.50

RMS ERROR = 0.5088F-01

Table 9

TEKINER — MORPHOLOGICAL TRAITS 2/10/74 16:21:19 PAGE 6

COLLECTIONS ARRANGED IN ORDER OF SIMILARITY

I2S	IV5P	IV2P	IV1P	IV4P	IP	IIS	IIIP	IIIS	I4S	IIP	IVS	I3S	IV3P	IIS	I5S	VS
	0.40	0.72	0.77	0.71	0.63	0.65	0.65	0.72	0.98	0.83	0.71	0.85	0.88	0.77	0.45	0.25
		0.45	0.59	0.65	0.69	0.71	0.63	0.67	0.70	0.81	0.81	0.79	0.73	0.78	0.52	0.30
			0.53	0.61	0.65	0.53	0.53	0.74	0.74	0.77	0.68	0.75	0.67	0.75	0.57	0.31
				0.60	0.55	0.53	0.48	0.65	0.80	0.65	0.58	0.67	0.63	0.63	0.58	0.37
					0.47	0.45	0.59	0.61	0.70	0.70	0.69	0.62	0.59	0.67	0.59	0.37
						0.48	0.51	0.69	0.62	0.67	0.59	0.67	0.53	0.65	0.69	0.45
							0.53	0.58	0.60	0.62	0.65	0.59	0.65	0.63	0.56	0.32
								0.58	0.55	0.69	0.69	0.65	0.53	0.61	0.45	0.30
									0.63	0.57	0.67	0.67	0.67	0.50	0.55	0.39
										0.60	0.54	0.67	0.65	0.47	0.59	0.29
											0.59	0.55	0.65	0.51	0.65	0.29
												0.52	0.55	0.59	0.63	0.25
													0.37	0.51	0.41	0.37
														0.50	0.55	0.29
															0.45	0.17
																0.15

RMS ERROR = 0.4268E-01

Table 10

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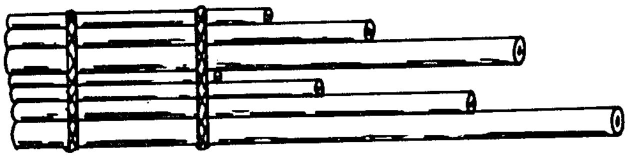


Fig. 4

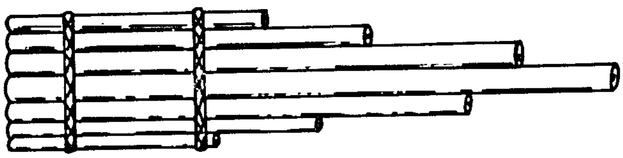


Fig. 3

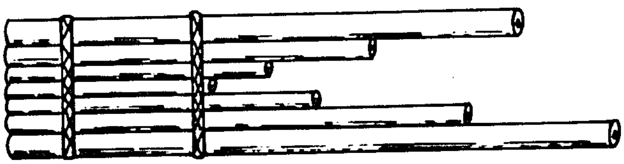


Fig. 2

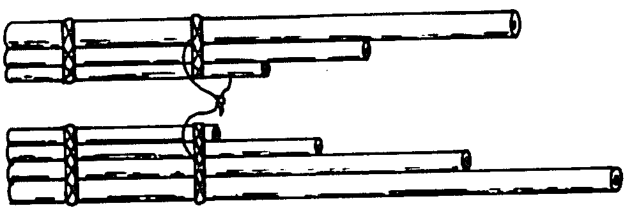
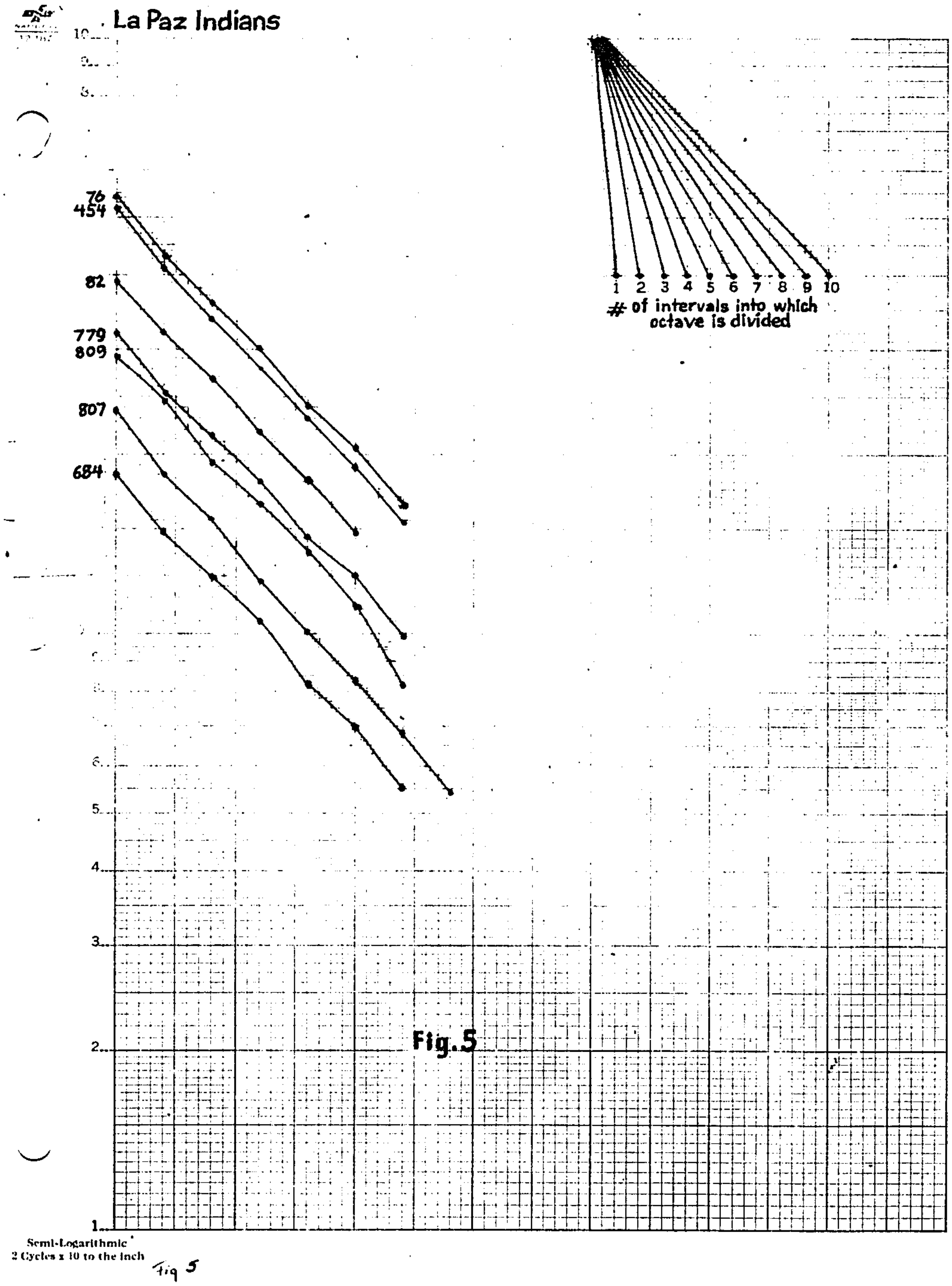
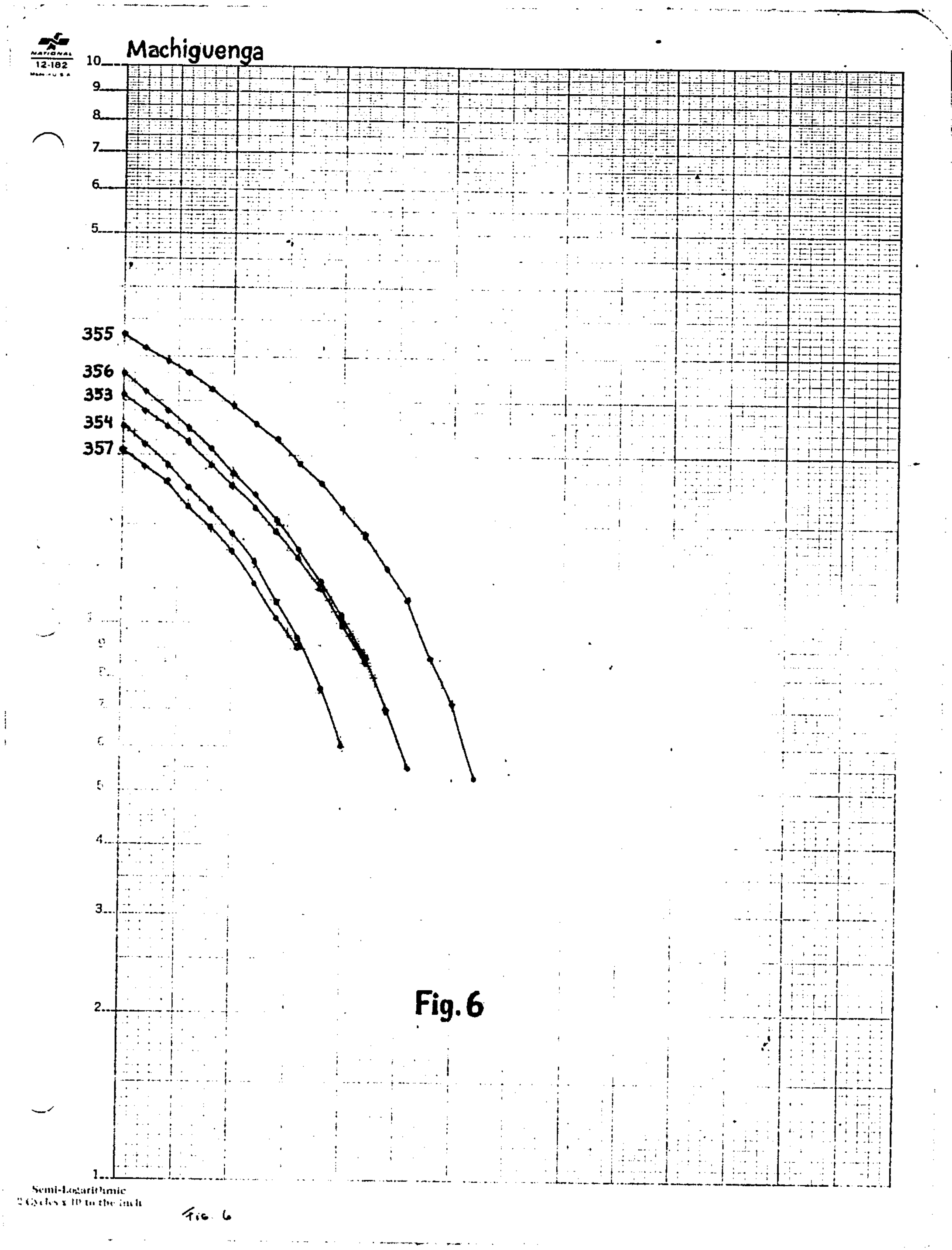


Fig. 1

Doubly graduated panpipes



Graph of Panpipes of La Paz



Graph of Machiguenga Panpipes

Solomon Islands

Fig. 7 Card with individual pitch pattern

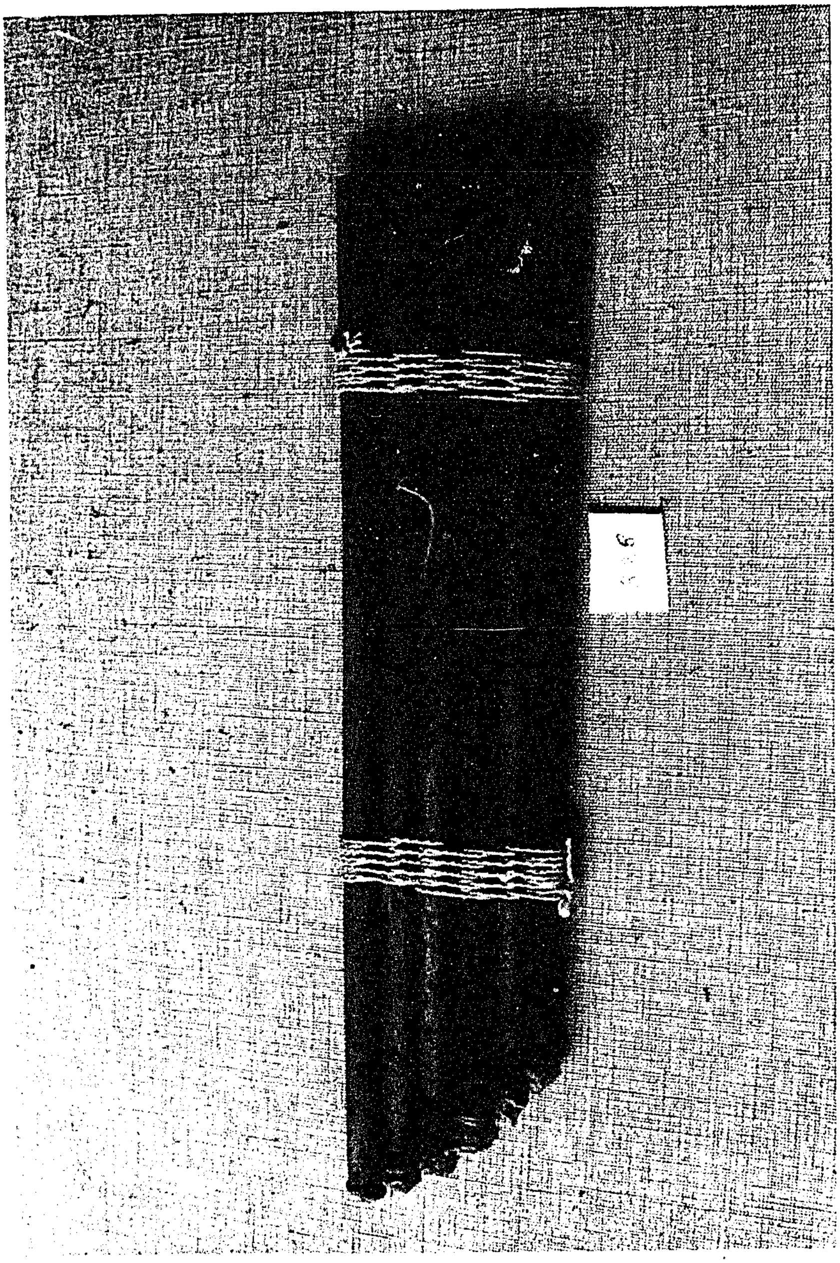


Figure 8. Cayabí Panpipe

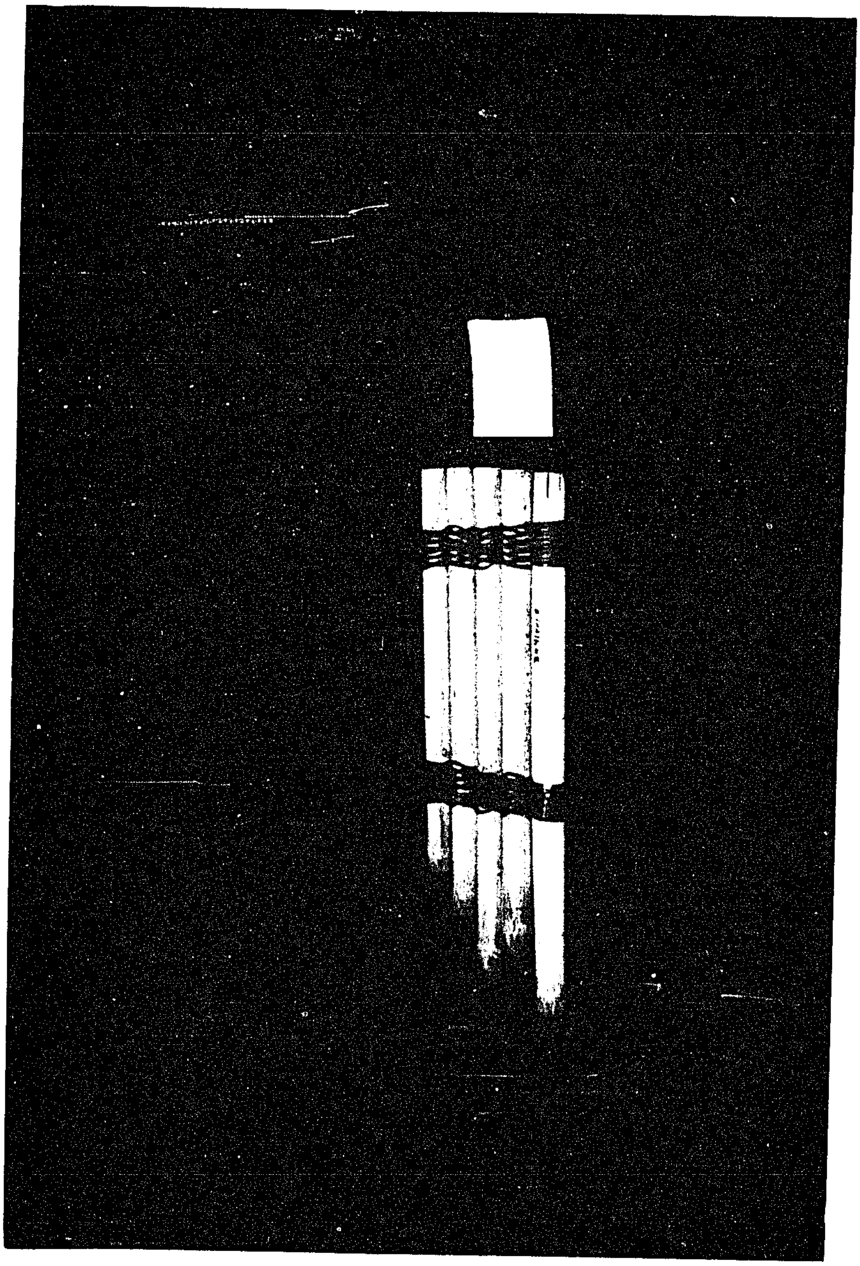


Figure 9. Melanesian Panpipes

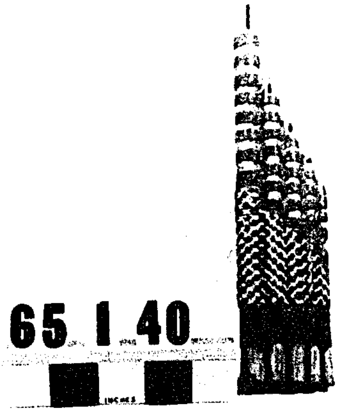


Figure 10. Panpipe of Archaeological Andean Area
(photograph from San Diego Museum of Man)

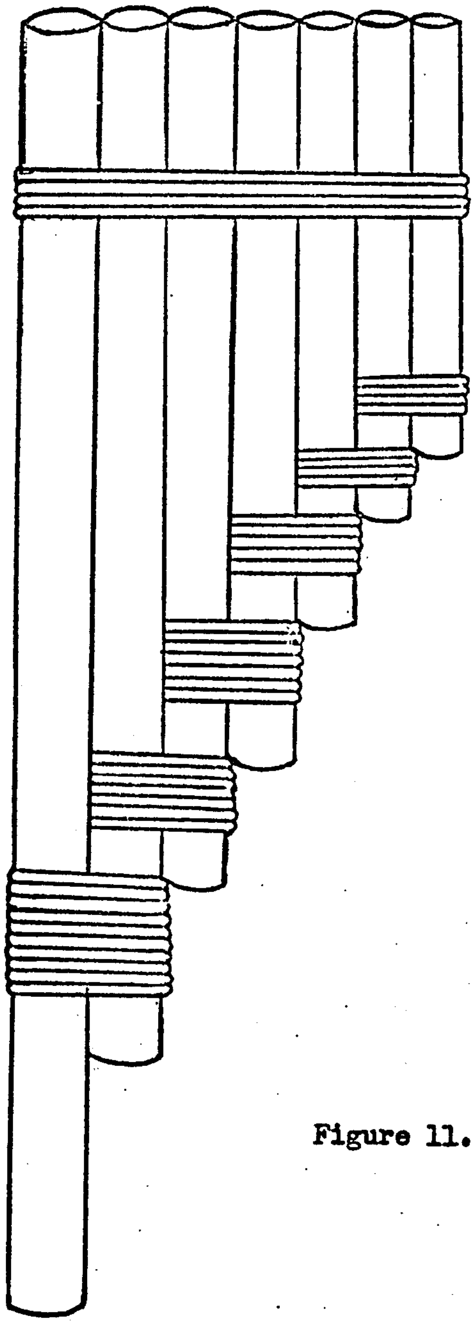


Figure 11. Step ligature, Melanesia

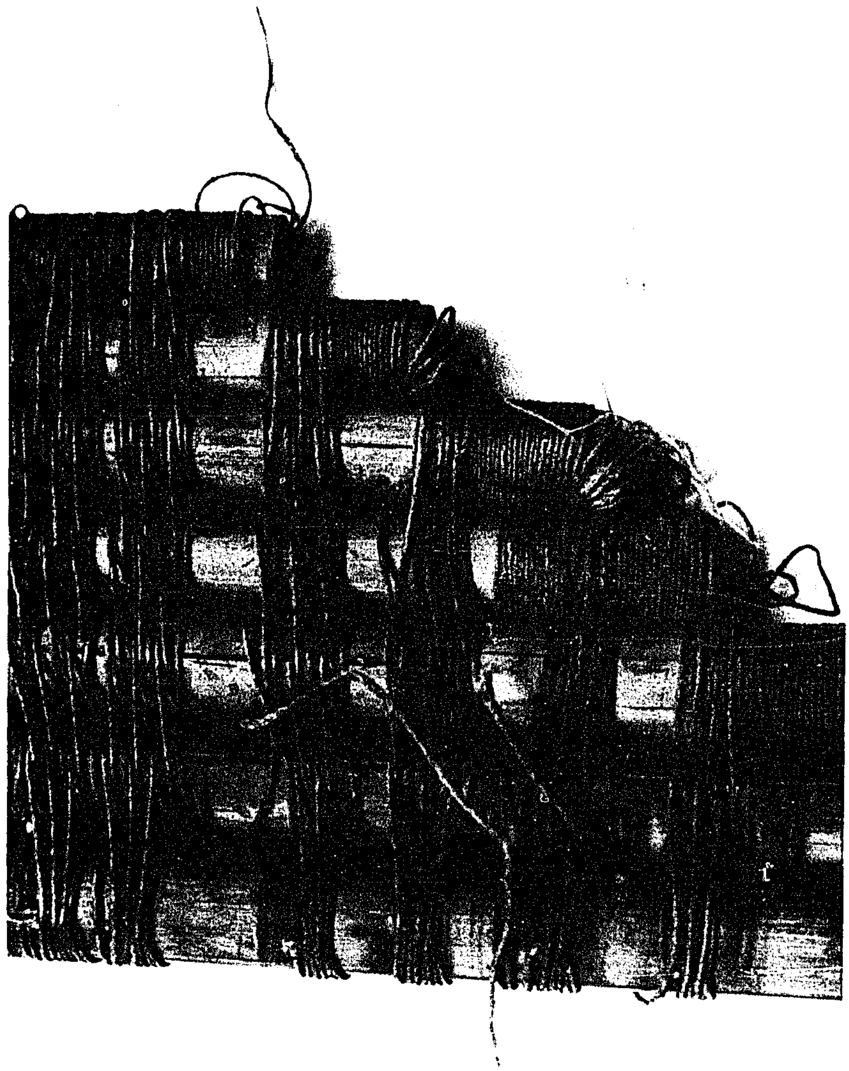


Figure 12. Panpipe of Prehistoric Peru (Ica)

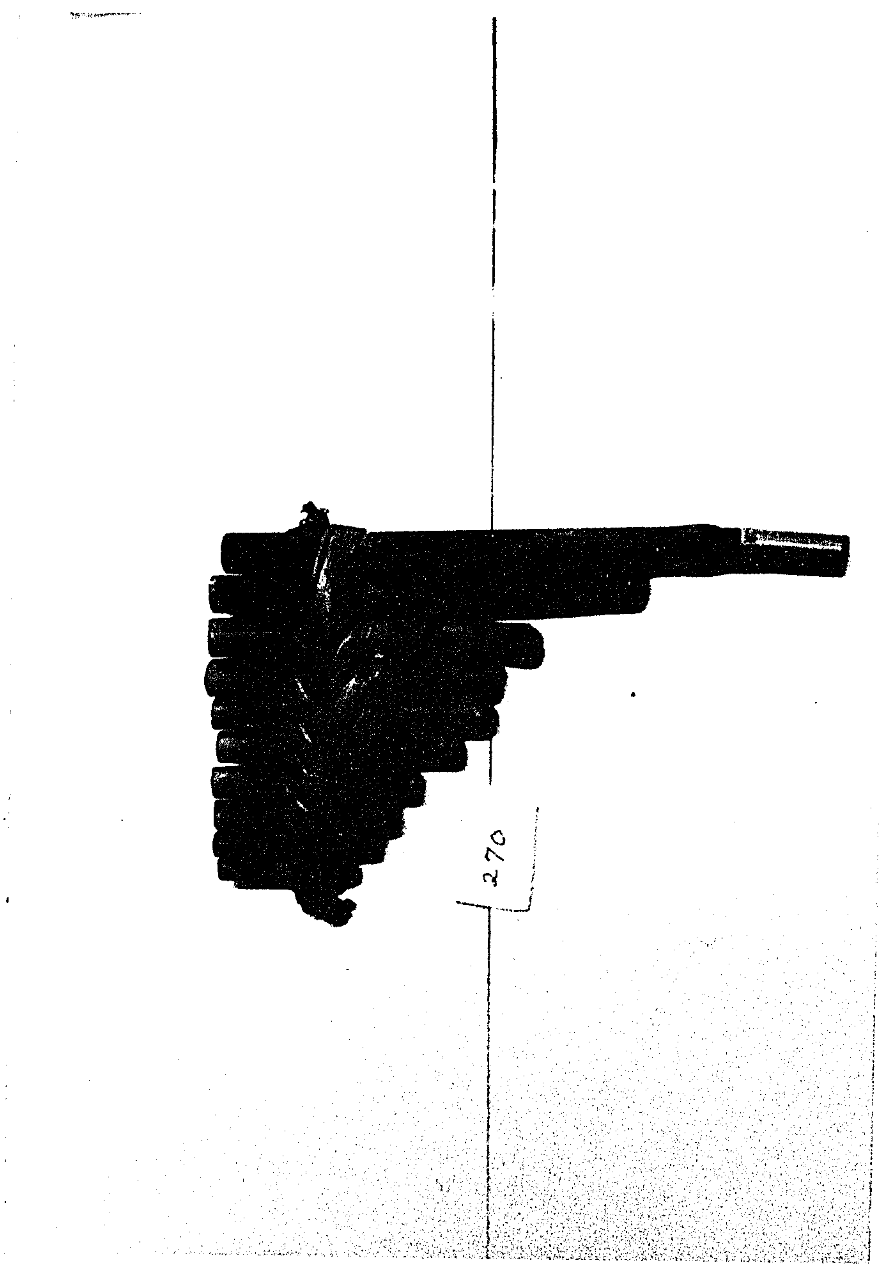


Figure 13. New Hebrides Panpipe

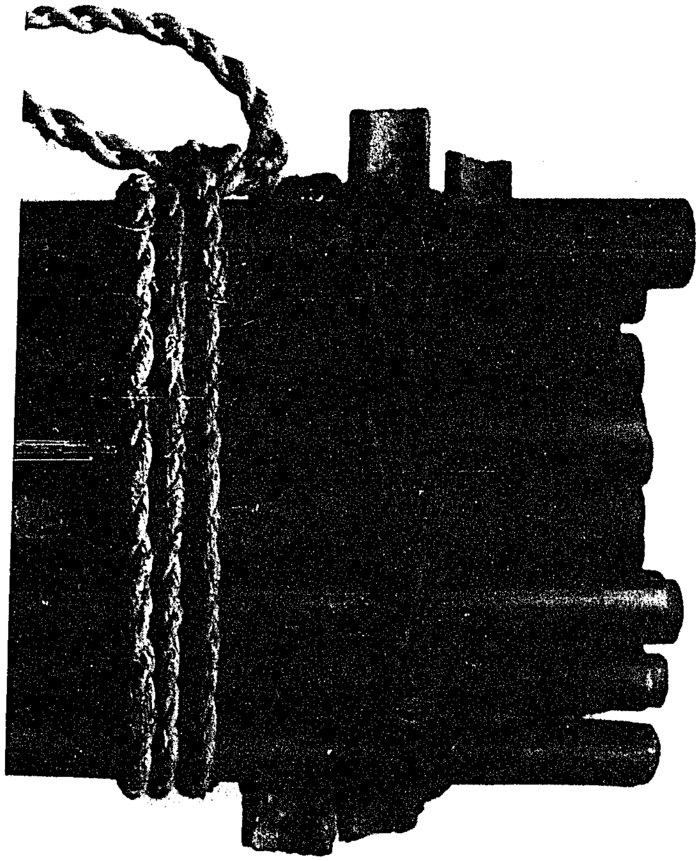


Figure 14

Panpipe of Prehistoric Peru (Huacho)

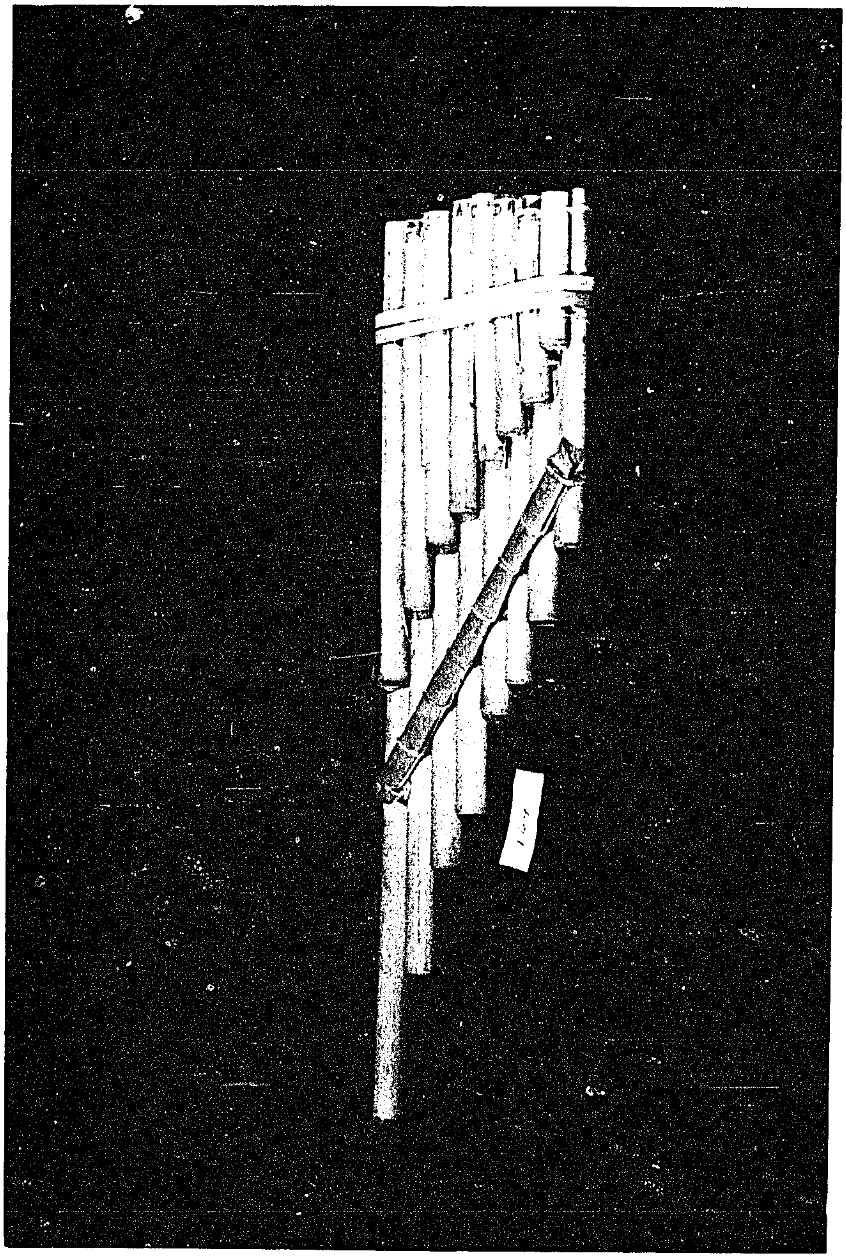


Figure 15. Bolivian Panpipe from La Paz

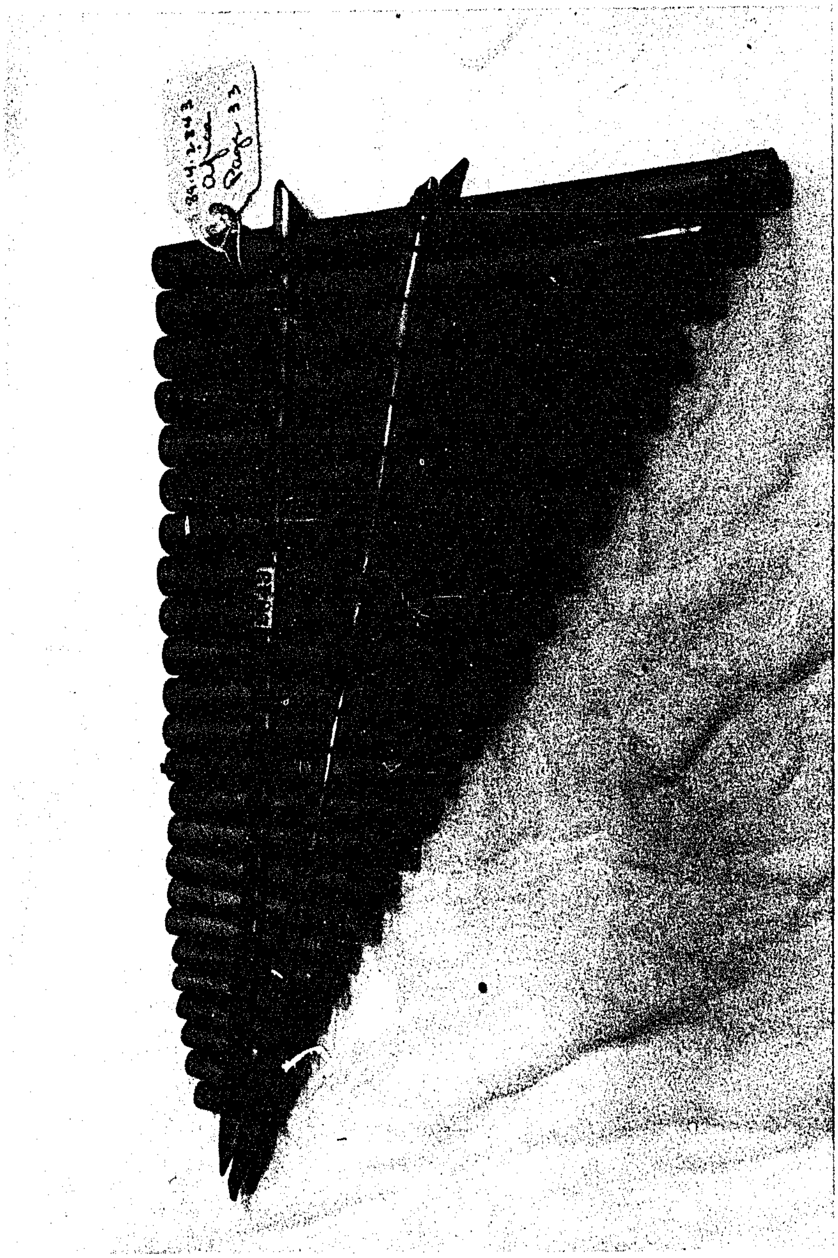


Figure 16. Egyptian Panpipe

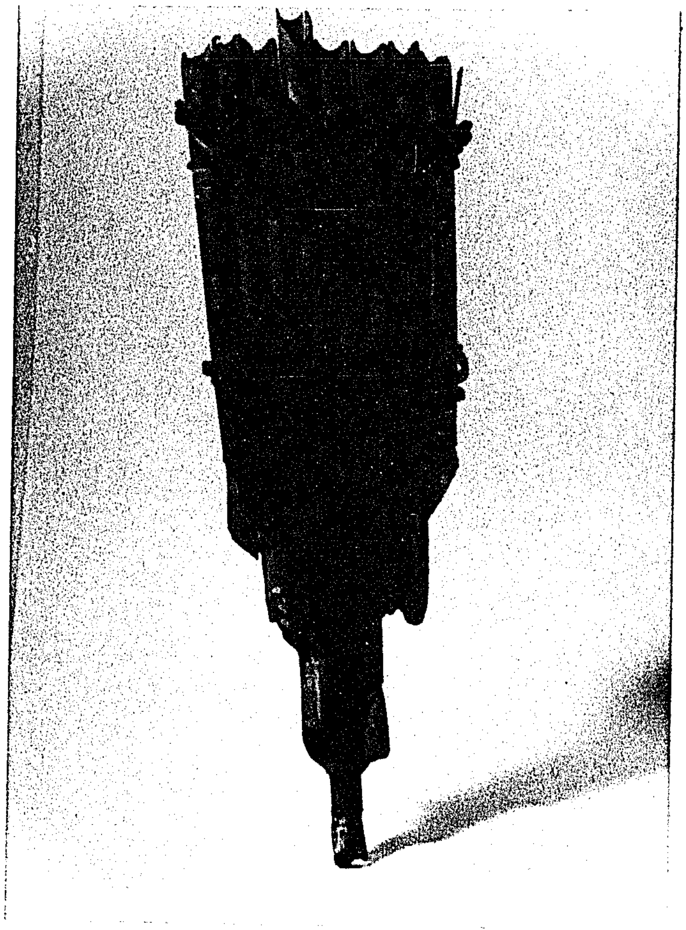


Figure 17. Panpipe of Tonga

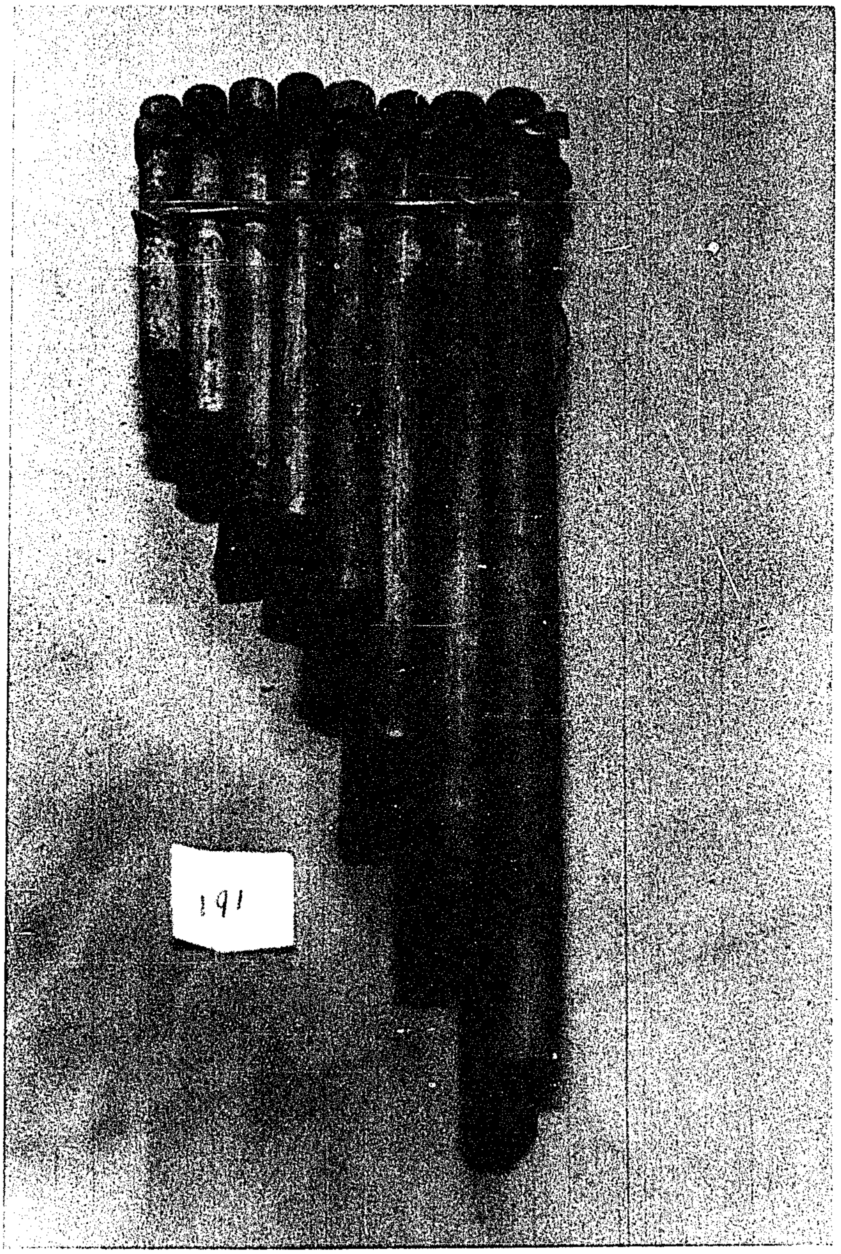


Figure 18. Panpipe of the Solomon Islands

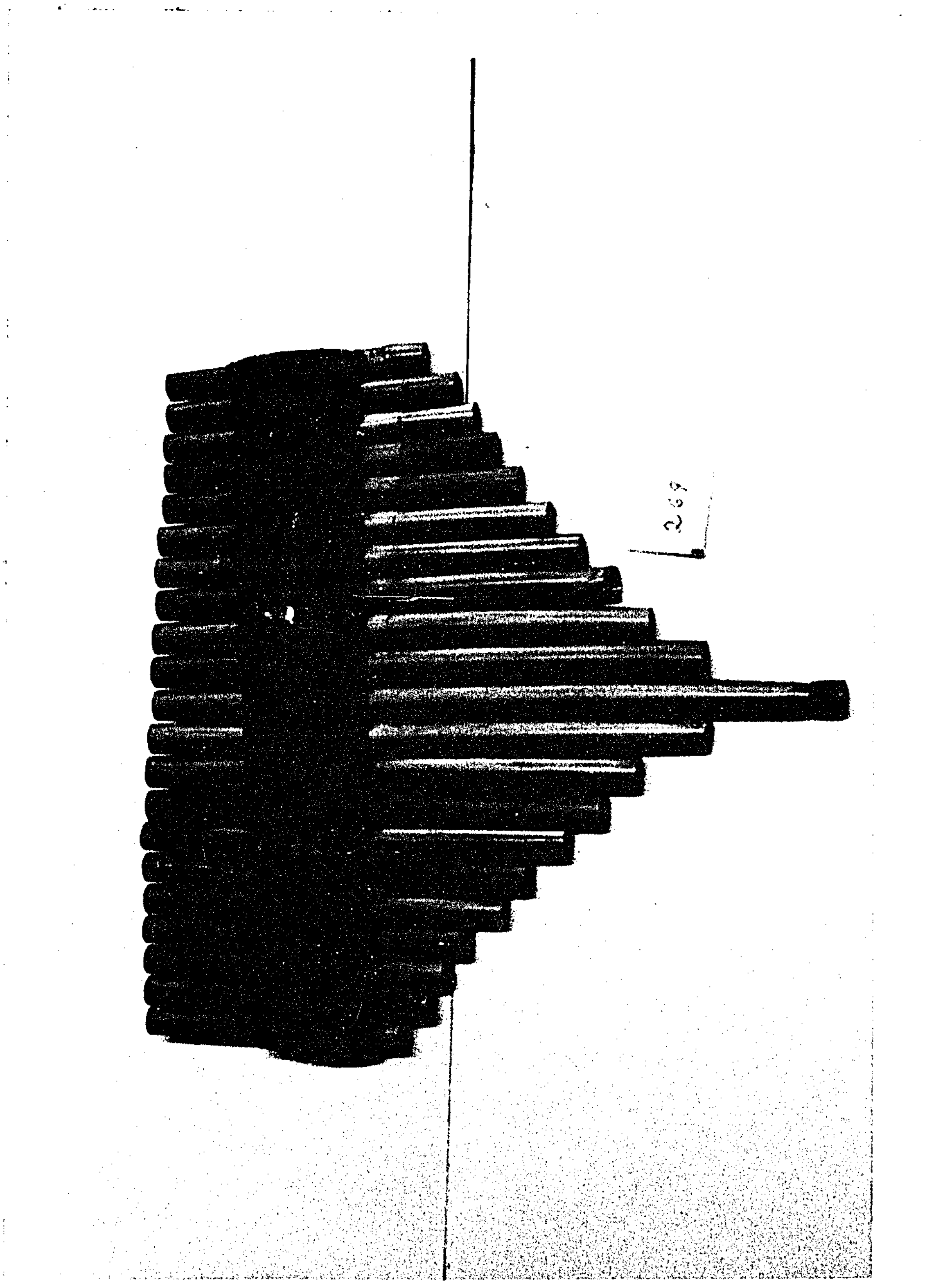


Figure 19. Panpipe of Ecuador

Figure 20. Panpipe of Oceania

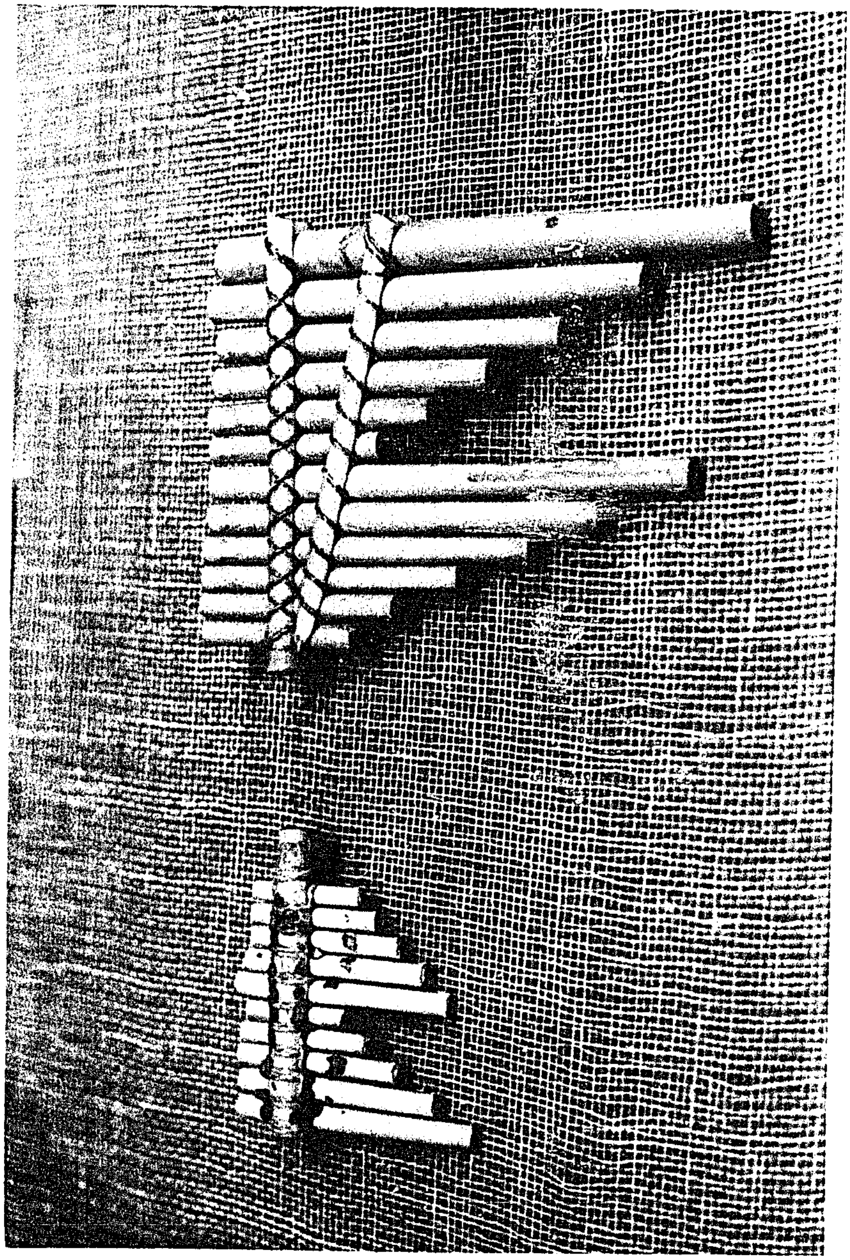


Figure 21. Panpipes of Colombia

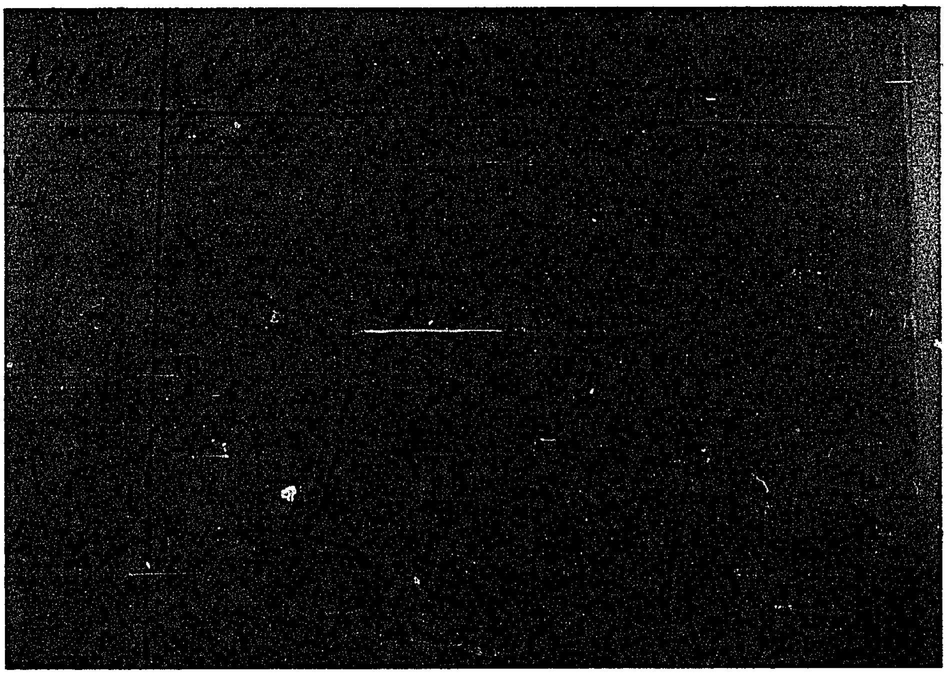


Figure 22. Panpipe of Solomon Islands

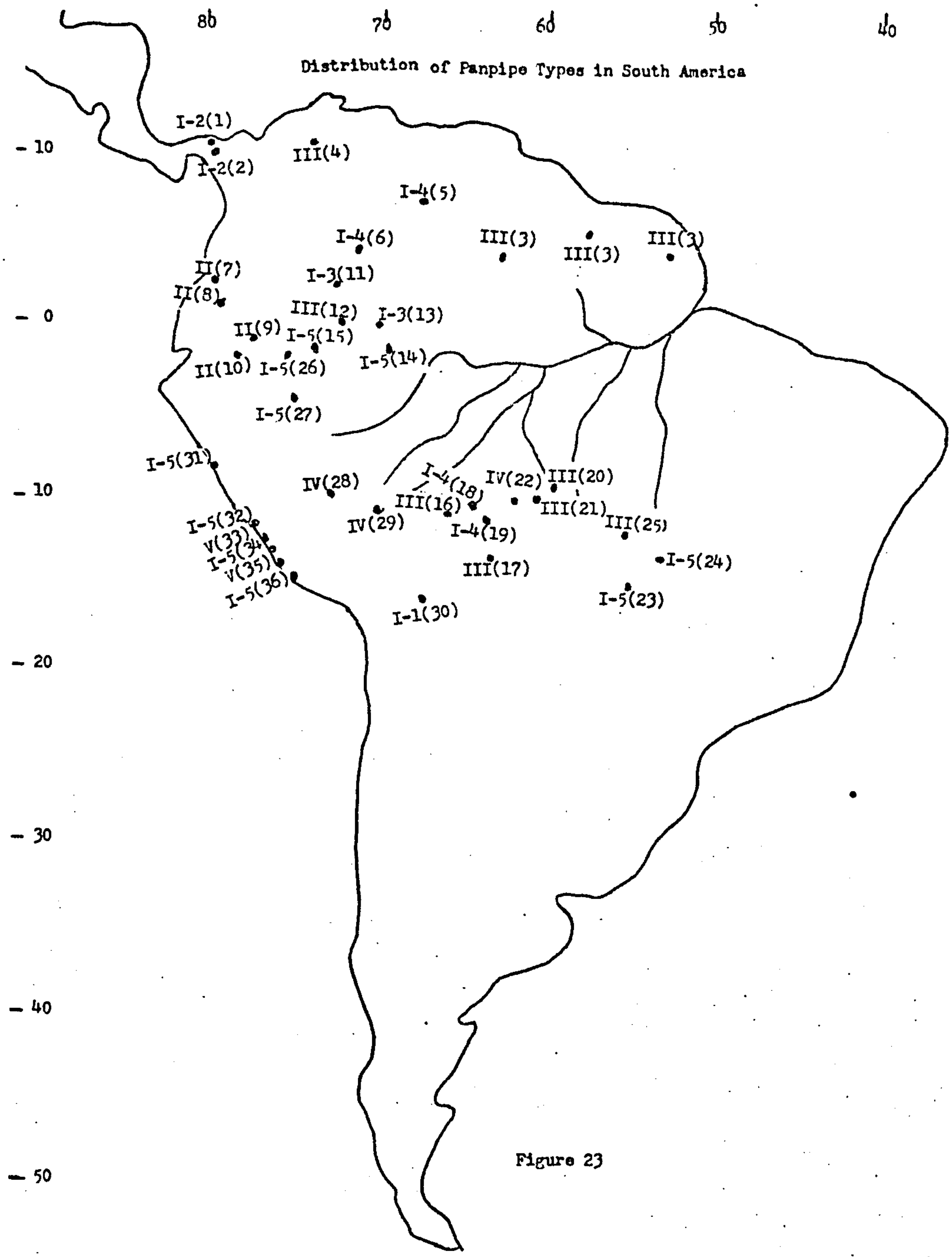

Distribution of Panpipe Types in South America
80
70
60
50
40
10
0
10
20
30
40
50
I-2(1)
I-2(2)
III(4)
I-4(5)
I-4(6)
III(3)
III(3)
III(3)
II(7)
II(8)
I-3(11)
III(12)
I-3(13)
II(9)
I-5(15)
II(10)
I-5(26)
I-5(14)
I-5(27)
I-5(31)
IV(28)
I-4(18)
IV(22)
III(20)
III(16)
III(21)
IV(29)
I-4(19)
III(25)
I-5(32)
V(33)
I-5(34)
V(35)
I-5(36)
I-5(24)
III(17)
I-5(23)
I-1(30)

Figure 23

Key to Distribution Map (Figure 23)

	Ethnic or Linguistic Group or Locality
I-2 (1)	Cuna (eth)
I-2 (2)	Tupi (ling)
III (3)	Wayana (eth)
III (4)	Noaname (eth)
I-4 (5)	Makiritaré (eth)
I-4 (6)	Piapoco (eth)
II (7)	Esmeraldas (loc)
II (8)	Cayapa (eth)
II (9)	Payamino (loc)
II (10)	Jivaro (eth)
I-3 (11)	Uaupés (eth)
III (12)	Bora (eth)
I-3 (13)	Tucano (eth)
I-5 (14)	Omagua (eth)
I-5 (15)	Upper Amazon (loc)
III (16)	Chacobo (eth)
III (17)	Chiquito (eth)
I-4 (18)	Huanyam (eth)
I-4 (19)	Amniapé (eth)
III (20)	Nambicuara (eth)
III (21)	Tupari (eth)
IV (22)	Moré (eth)
I-5 (23)	Paressi (eth)
I-5 (24)	Cayabí (eth)
III (25)	Trumaí (eth)
I-5 (26)	Iquitos (loc)
I-5 (27)	Ucayali River (loc)
IV (28)	Campa (eth)
IV (29)	Machiguenga (eth)
I-1 (30)	La Paz (loc), Aymara (ling), Quechua (ling)
I-5 (31)	Huacho (loc)
I-5 (32)	Pachacamac (loc)
V (33)	Paracas (loc)
I-5 (34)	Ica (loc)
V (35)	Nazca (loc)
I-5 (36	Ocucaje (loc)

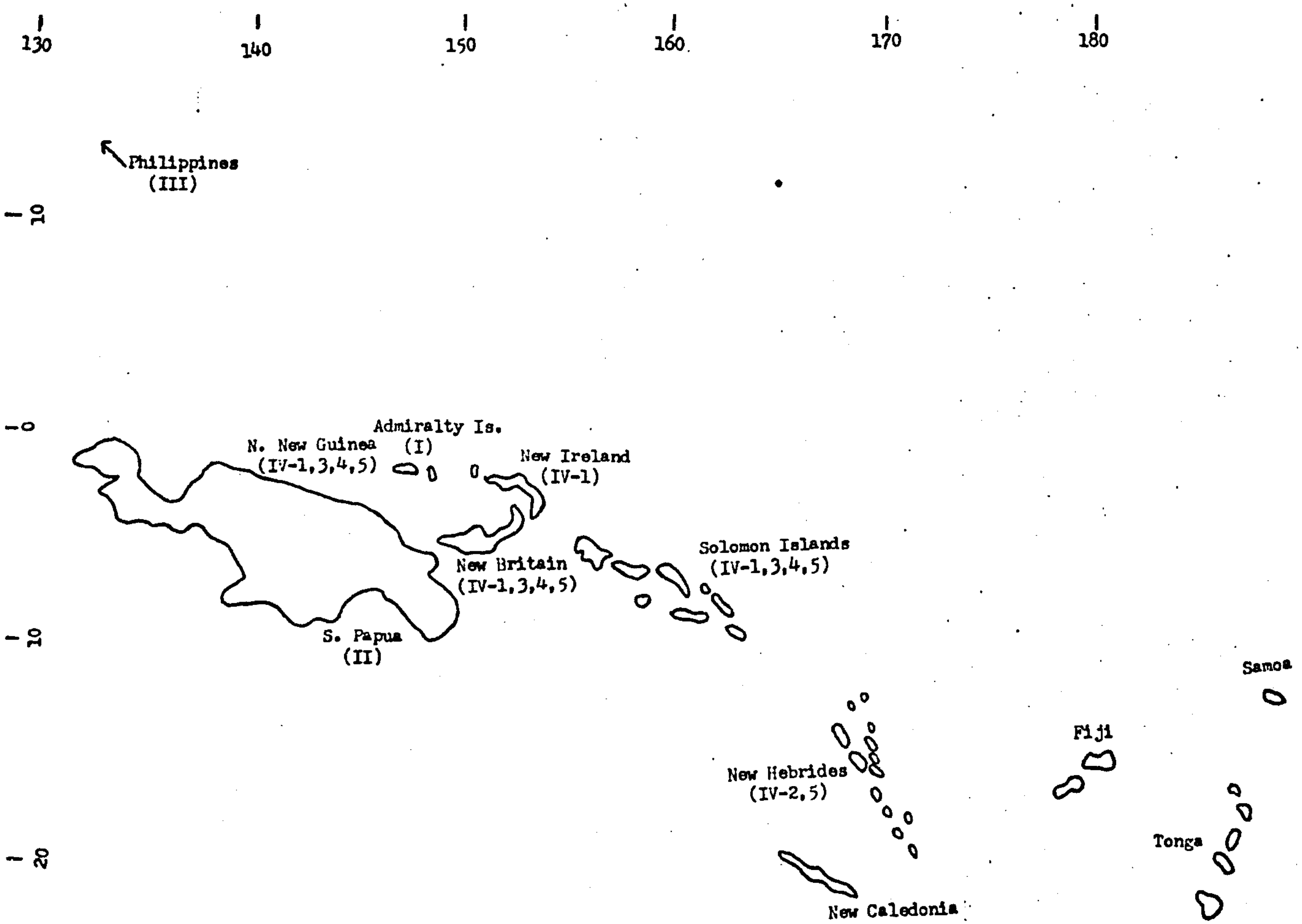


Figure 24 Distribution of panpipe types in the Pacific

Musical Traits - Strong Clusters

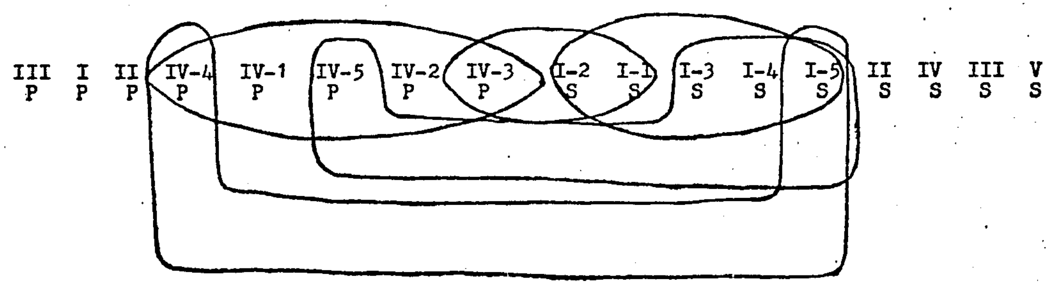


Figure 25

Musical Traits - Weak Clusters

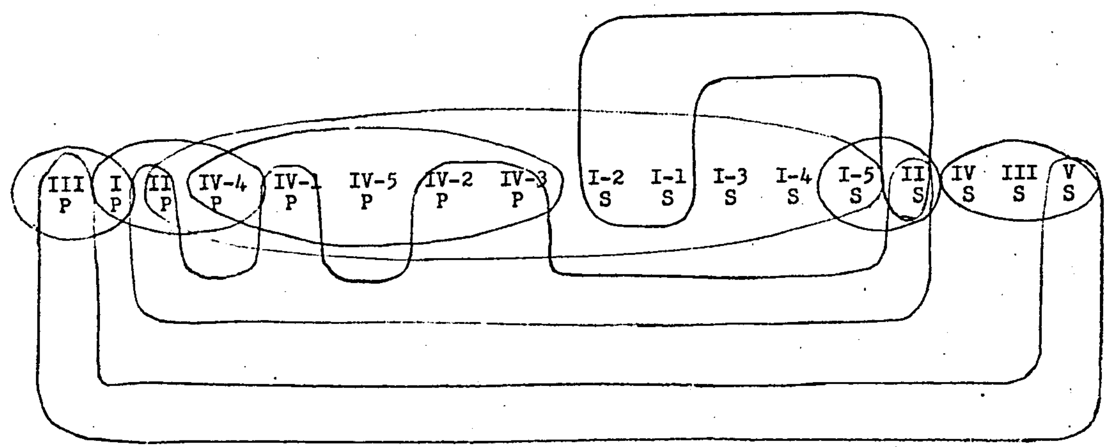


Figure 26

Morphological Traits - Strong Clusters

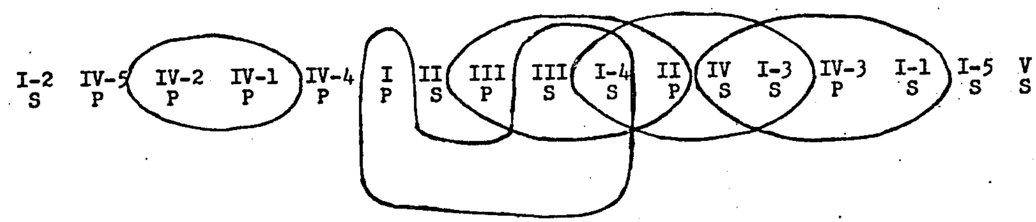


Figure 27

Morphological Traits - Weak Clusters

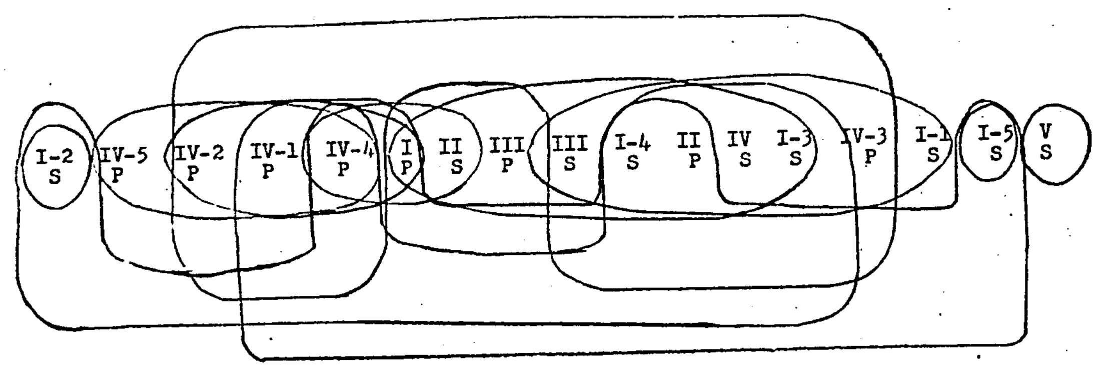


Figure 28