A FUNCTIONAL ANALYSIS OF NORTHWEST COAST SPINDLE WHORLS

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MASTER'S THESIS

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ABSTRACT

The rich legacy of Northwest Coast textile art has attracted the attention of people from a wide range of interests and disciplines. Current research has focused on the history and construction of Chilkat and Salish textile fabrics, but does not offer much information regarding spinning tools or techniques. Early ethnographic accounts offer only limited details about spinning technology on the Northwest Coast.

This study is a descriptive, functional analysis of 100 spindle whorls from the Gulf of Georgia region. Using a paradigmatic classification system to sort shape combinations, whorls are compared within and between material types in order to determine possible functional motives for shape modification. It is suggested that modifications to the edge of whorls may serve the purpose of redistributing weight so that whorl efficiency is increased. Whorls displaying a raised collar around the central perforation may have been modifed to provide more surface area in contact with the spindle shaft, increasing stability. It is shown that, in the sample, material type affects whorl design and that certain shape characteristics are associated with certain material types. This study discusses the problems with current classification schemes and suggests the use of the physical principle of Moment of Inertia as an index of performance that would take both whorl weight and diameter into account while providing a single figure to be used in analysing the effects of shape modifications.

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Special thanks is due also to the staff members of the museums I visited to gather data for this research. Every person I worked with during my fieldwork took an interest in what I was doing and devoted a great deal of time and effort to helping locate artifacts and finding background information about them. I was welcomed into already cramped workspaces and helped at every step of the process.

Lastly I want to thank my husband Charles for his expertise in answering mathematical questions and his ability to argue all sides of a point; and my sons, Zephyr, Yeshe, and Tristan, for their good humor and patience for the duration of the writing period.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1- INTRODUCTION

Northwest Coast textile art has captured the attention of people from a wide range of interests and disciplines. The intricate fabrics of both the Salish and Chilkat weaving traditions blend sophisticated technical knowledge and the distinctive art forms developed in this area to create the rich legacy first noted by early explorers. The history of Northwest Coast weaving is a source of information about textile technology, prehistoric and historic cultural change, and interaction among the early peoples of the area.

This study focuses on spindle whorls, which are one component of the technology used to manufacture yarns from prepared fiber. Previous research has emphasized either technical analysis of woven goods from the Northwest Coast or ethnohistoric reconstruction of the post-contact development of Salish or Chilkat weaving. Spindle whorls themselves have received little direct attention in the literature. They are viewed primarily as art objects, with the more decorative wooden Salish whorls selected out for discussion. Their role as tools used in the production of yarn is treated as secondary.

This research focuses on spindle whorls as functional objects, and addresses some basic questions about design choices related to the task of spinning. Going beyond the general description of whorls as round or slightly squared flattish discs with a central perforation, the variation in material types is looked at, as well as variation in shape within material types. The benefit of using a functional approach to study these whorls is that artifacts can be analysed on their own merit, based on relevant standards of performance dictated by natural physical laws. The results of different shaping techniques can be measured in quantitative terms, giving a better understanding of the design trade-offs in Northwest Coast spinning technology.

I had two overall purposes for undertaking this project. First, I hoped to bring together information about spindle whorl artifacts from the Northwest Coast. Textiles from this area have their place in the literature, but spindle whorls have been largely ignored. Research specifically concerning spindle whorls has either noted ethnographic references to certain diameter whorls and their products (Vanderberg 1953, Marr 1979, Gustafsen 1980, Samuel 1982 and 1987) or addressed carving techniques and design elements employed on whorls (Suttles 1976, Kew 1979 and 1980). Neither type of study begins to address the variation in form of whorls, nor the effect of material choice on their form and use, and in no study is there given detailed metric data on the whorls or information on where they may be found for further study. This work begins to compile such information.

My second purpose was to apply what we know about the physical principles of spinning to data from Northwest Coast spindle whorls and try to explain variation in form in terms of functional variability. It is easy to see that there is great variation in how whorls were made and that some features of construction commonly co-occur. The question is which of these characteristics are related to the performance of the task of making yarn, and which were chosen for other reasons. Shape may also be related to style or decorative detail, and the personal preferences of the spinner regarding weight or diameter would certainly have dictated fine tuning of whorl design.

Early ethnohistoric accounts from this area are very limited in specific details of textile technology. Drucker (1950) pointed out the double problem of textile production being a specialized task that everyone knew a little bit about, but only a specialist would be able to explain in detail, as well as the fact that textiles were in the women's realm on the Northwest Coast, and that males had less access to this type of information. Drucker felt that if he had employed more female informants his work would have benefited greatly (Drucker 1950).

The best ethnographic information on spinning and whorls has been collected in the context of descriptions or analyses of the indigenous weaving traditions in the Northwest. While rare in archaeological context, enough spindle whorls have been found to add to our view of the extent and variation of this technology. The ethnographic and archaeological literature concerning spinning and weaving on the Northwest Coast are discussed in Chapter 2.

In order to understand the importance of functional design variation in spinning tools it is necessary to understand the spinning process and factors which can affect it. Chapter 3 explains the basic mechanical aspects and terminology of spinning. After a brief discussion of fibers it moves into an explanation of the devices and tools used for handspinning and some of the physical principles that motivate design variation in these tools. The functional requirements for handspinning devices and the physical principles underlying these requirements are explained. The interaction of various factors in the spinning process is discussed as well as the effect of these factors on the yarn produced. The chapter closes with a description of traditional Northwest Coast spinning tools and techniques.

Chapters 4 and 5 deal directly with research data. Chapter 4 details my research goals and the methods I used to work toward them. Data collection procedures are explained and the paradigmatic classification scheme used to analyze functional attributes is presented. Chapter 5 discusses the whorls in detail, presenting metric data on each classifiable whorl and shape comparisons within and among materials types. I have concentrated primarily on descriptive and comparative analysis of the spindle whorls in my sample because the literature is devoid of this type of information. These artifacts have not previously been the subject of critical analysis, and basic descriptive data is not available for more than a handful of whorls. As I point out in my conclusions, Chapter 6, any subsequent analysis of spindle whorl artifacts will benefit from such a groundwork of descriptive and comparative data. Before more complex research questions can be addressed these simpler issues of shape combination and variation must be explored.

CHAPTER 2- CONTEXT

Most research on the textile traditions of the Northwest Coast has focused on descriptions of textile products. It is natural that much of the work done would be of this nature, for Salish and Chilkat woven goods are eyecatching, with striking designs and fine workmanship. Previous work of this type has ranged from very general explanations of how textiles were produced and their function in Northwest Coast culture to detailed technical analyses of the materials and woven structure of various types of textiles.

Although the descriptive theme is the major one in the literature, other aspects of Northwest Coast weaving have also been addressed. One area of discussion is the origin and development of Northwest Coast weaving. Two major lines of thought address this point. Archaeological data come into play in this aspect of the discussion, providing physical evidence of the antiquity of textile arts.

Early ethnographic sources include Boas' (1890) description of spinning and fiber processing in his report on the Indians of British Columbia, and Emmons' (1907) exhaustive monograph on the Chilkat weaving complex; followed closely by Hill-Tout (1978), Willoughby (1910), Howay (1918), and Kissell (1928), who each detailed some particular culture area or type of Northwest Coast weaving technology. Each of these works contains references to the spinning of yarn for weaving.

Early research specifically on spinning began with Kissel (1916). In a short article in *American Anthropologist* she points out that a type of spinning practised by the Salish of Vancouver Island is unique in the world (Kissel 1916:264). Incredibly, for the next few decades there was only occasional mention of spinning or textiles (Barnett 1938, and Drucker 1950) as a part of the cultural complexes of the area as a whole. In the 1950s interest in Northwest Coast weaving was renewed briefly, beginning with Vanderberg's M.A. thesis (1953) on Chilkat and Salish weaving.

Although Vanderberg's main focus was the analysis of the two types of woven cloth unique to the Pacific Northwest, she gave the first summation of the various techniques of producing yarn employed in the area. She drew from early ethnographic accounts the first coherent description of the several methods of spinning and types of spindles, as well as the presumed distribution of each type. It is also to Vanderberg that we owe the first clear technical delineation between Salish and Chilkat weaving.

After another gap of over twenty-five years, Carolyn Marr (1979) produced an M.A. thesis on Salish weaving. Hers remains by far the most detailed and exhaustive account of historical sources on Salish weaving and spinning. Marr included observations made by early explorers in the 1700-1800's as well as the ethnographic accounts used by Vanderberg. She drew an inclusive picture of weaving as observed at contact. Marr devoted seven pages (of 348) to an exacting description of the five types of spindles described in the literature and how each was observed to have been used.

Where Marr's purpose was to present as accurate and detailed an account as possible of the state of Salish weaving at the time of European contact, Gustafson (1980) extended further back and included the archaeological past. Her analysis combined archaeological evidence for weaving and spinning with the ethnographic record, backed up by a technical analysis of the textiles themselves. Gustafson ended her account with interviews and observations of Salish textile manufacture as practised now by the Salish Weavers Guild in Sardis, B.C..

Other recent works on Northwest Coast textile traditions that touch on spinning technology are Samuel (1982, 1987), Hirabayashi (1987), and Holm (1987). Samuel and Hirabayashi both present detailed analysis of the textiles themselves, while Holm focuses on the early historic record of the Chilkat blankets.

Most writers are in agreement that both the Salish and Chilkat weaving traditions were well established by the time early Europeans arrived to describe them. Holm believed that the early geometric Chilkat predated European contact, but that the classic Chilkat Style, reproducing on cloth the complex painted images of the Northern style of art, developed after the contact period. (Holm 1982:35) This opinion is not general among other sources, although the case he made is a good one.

Marr stated that the use of spindles for the production of yarn was the factor distinguishing the Salish weaving complex from the Chilkat weaving tradition of the northern coast (Marr 1979:66). Vanderberg (1953) discussed this factor at some length, speculating on the direction of diffusion of different spinning techniques. She was critical of Kissell's interpretation of the unique nature of Salish style spinning, and maintained that Kissell had viewed this trait in isolation rather than as part of the Salish weaving complex (Vanderberg 1953:92). Vanderberg believed that Kissell had overlooked the significance of the fact that the smaller Salish spindle was used by rolling it along the thigh or shin, and as such was only a step away from the technique of spinning yarn on the thigh used by more northern groups. She saw this as an indication that the small spindle had diffused down from the north (Vanderberg 1953:91-92). Vanderberg also pointed out that Salish spinning of the type observed by Kissell was a "distortion of suspension spinning" (Vanderberg 1953:92) and was in fact, very similar to the type of spinning practised in the Southwestern United States and Mesoamerica. Olson (1929) and Kissell (1916) both represented the extreme version of this opinion, placing the origin of the Salish weaving complex in South America.

Marr (1979) best voiced the other major line of thinking on the origin of the Salish weaving complex. She believed that the Salish weaving complex was a product of independent invention which grew from a textile complex that was once widespread throughout the Plains and Plateau culture areas (Marr 1979:2-3). Marr based her opinion on the similarity of Salish weaving techniques to those used to manufacture buffalo and rabbit hair blankets in these areas.

At the present time it is not possible to state with certainty the origin of Northwest Coast weaving. We can, however, discuss the antiquity of this technology within the area by looking at the archaeological record. Gustafson (1980) used this approach in her book on Salish weaving. She points to two well-known archaeological sites as providing evidence of pre-contact weaving: Milliken, in British Columbia, and Ozette, in Washington State.

The Milliken site is near Yale, on the Fraser River. Gustafson (1980:18) gives the date for a steatite spindle whorl found at this site as between 500-1200A.D. Duff (1975) gives the date for this artifact as about 800 A.D, however the artifact may be considerably later. Borden (1976) points out that the whorl in question came from a deposit of material which had sloughed off a wall in the excavation, and may have been part of a later grave inclusion. Although Borden initially assigned this whorl to the Emery Phase (500A.D.-1300A.D.), he later decided that it was more likely a nineteenth century intrusion into the earlier deposits (Borden 1976:161). This reassignment was based largely on the intricate nature of the designs incised on both faces of the whorl. The Emery Phase had few stone carvings and Borden also mentions that the complexity of the designs is similar to later styles.

The Ozette site is on the westernmost shore of the Olympic Peninsula of Washington State. One component of the site, dated about three to five hundred years ago, yielded spindle whorls of wood and bone as well as a whole range of textile tools and materials (Gustafson 1980). McKenzie (1974) gave an initial classification of bone spindle whorls from Ozette, and Gustafson has analysed the remains of a folded woolen blanket preserved in a box, but beyond this little work has been published about textile technology found at the site.

Several other archaeological sites in the Northwest have yielded spindle whorl artifacts. All of the whorls found so far date from around 1200 years ago or later (King 1950, Siemens 1968, Borden 1970, Carlson 1971, and Thompson 1978), well before the contact period. This information, combined with the accounts and woven goods collected in the 1700s by early explorerers, supports the view that textile technology had been extant and developing on the Northwest for a long time before European influence.

The functional analysis of spindle whorls as tools rather than as art objects can result in the unification of existing ethnohistoric and archaeological information. Ethnohistoric accounts seem to be consistent with each other, and so are likely to be accurate in the general. Archaeology gives us the particulars in terms of location and a better idea of the age of artifacts. By using a functionally derived set of standards for looking at spindle whorls it may be possible to note connections and changes in form and use through time and space.

CHAPTER 3- THE MECHANICS OF SPINNING

A fiber is defined as the fundamental unit in the fabrication of textile yarns and fabrics (Forbes 1956:187). Fibers are found in two forms: filament and staple (Miller 1968:10). A filament fiber is a fiber of long continuous length which may be used in fabric construction without further alteration. Staple fibers have a limited length, from 10mm to many centimeters, and they must be twisted together to make a useful element for fabric construction (Miller 1968:10). Fibers can be rough, with many scaly barbs which aid in the spinning process (wool is a good example); or smooth and slick, like hair or various vegetable fibers (Fannin 1970 discusses this at length).

Fibers are typically combined in order to produce elements of varying thickness, according to the work to be performed with them. These assemblages of fibers or filaments, twisted or laid together to form a continuous strand, are called yarns (Forbes 1956:187). Sometimes the terms thread or cordage are used to describe these assemblages. Thread implies a small element, cordage is formally defined as two or more plys of yarn twisted together (after Forbes 1956 and Miller 1968). Note that a yarn is fundamentally different from a kelp rope, for example, because the yarn is composed of several elements, while the kelp rope is a single strand, used as is. Since filament fibers were not in use on the Northwest Coast, the term fiber will denote staple fibers for the duration of this paper.

The spinning process

The process of combining fibers or filaments into yarns is called spinning. No matter what the raw materials or resulting yarn, the spinning process consists of three parts: arranging the fibers, drawing out the fibers, and twisting the fibers (Davenport 1964:17). Depending on the material being spun and the many variations in technique, a spinner can produce a wide range of yarns from the same fiber, depending on what her project requires. Spinning may be carried out using nothing more than the fingers or by the use of devices to increase the speed of the operation. We will consider the three processes of spinning -arranging the fibers, drawing out, and twisting- below.

Arranging the fibers is the first step in making yarns. This step often includes cleaning the fiber in some way, and can involve separating coarse outer hairs from the softer undercoat fibers. There are many methods for effecting the same final result: fibers arranged in a roughly parallel fashion, with no knots, lumps or foreign material to hinder the spinning. At this point the spinner may choose to spin the prepared fibers as they are or further process them by forming them into a thick, loose, continuous cord called roving. The advantage of roving is that the spinner can further refine the consistency of fibers moving into the yarn, thus better controlling the evenness of the final product by eliminating thick and thin areas within the fiber mass. There is also less time wasted picking up separate bundles of fiber while spinning, as the roving unrolls from a loose ball or coil placed close beside the worker.

Drawing out the fibers is more formally known as drafting. Drafting is the attenuation of an amount of fibers from a larger supply through interfiber slippage, the end result being some fibers moving out of the main group and some remaining in place. Draft can be quantified as the drafting factor, or the numerical relationship between the length of the fibers to the length of the spun yarn section they form. This is expressed as a ratio (Fannin 1970:28). Fibers with microscopic barbs (such as wool) actually lock themselves together during the attenuation process. In hair or vegetable fibers this effect is not so pronounced, but the drawing out still serves the inportant function of distributing fibers evenly and consistently in the yarn produced.

From the spinner's eye view, the control of draft is accomplished by observing the fibers as they pass through the fingers and enter the area where drafting is taking place. This triangularly shaped area occurs between the fiber supply and the finished yarn, where fibers are attenuated but not yet twisted. By maintaining a consistent quantity of fiber in this drafting zone, and a triangle of consistent size and shape, the spinner creates yarn the same size and type throughout its entire length. The drafting zone is sometimes referred to as the "golden triangle" of spinning (after Fannin 1970).

The final process involved in spinning is twisting the fibers. Twisting is turning the group of fibers that has been attenuated from the fiber supply. This adds the friction necessary for attenuated fibers to hold together in a continuous strand. Twist is quantifiable. The friction of prepared fibers is effectively zero; the twist and subsequent adding to the friction of these fibers can be measured by counting the number of times a unit length of drafted fiber is twisted 360 degrees. This figure is expressed as turns per inch. Twist is optimal when friction is sufficient to prevent no slippage of fibers when the yarn is under the tension of use. Too much twist ruptures the individual fibers, causing overall weakness of the yarn; too little results in a weak yarn that disintegrates under tension. Less twist is required to make a strong, heavy yarn than a thin one, due to the fact that the heavy yarn has more fibers in contact with each other, resulting in more friction overall (after Davenport 1964 and Fannin 1970).

Twist is also described directionally, as either "S" or "Z" twist. The direction of twist is an important diagnostic characteristic in textile analysis (Forbes 1956). The direction of twist in a yarn is determined by holding a sample in a vertical position. If the spiraling of the fibers conforms to the central part of the letter "S" (that is, slants up to the left) the yarn is denoted as "S" twist. If the spiraling runs up to the right, after the manner of the central part of the letter "Z", the yarn is "Z" twist (Forbes 1956, Fannin 1970). Figure 1 illustrates the concept of "S" versus "Z" twist.

Figure 1- Direction of twist in yarn (after Samuel 1987)

Plying and cabling are further optional techniques used in the manufacture of yarns. These terms refer to the act of twisting two or more yarns together to make a single, larger yarn. Individual yarns, called singles, may be combined for greater strength or greater diameter. Plying and cabling utilize only the final step of spinning, twisting the yarns together, with no drafting involved. A controlled tension on all yarns being combined is the only requirement. Strictly speaking, plying means combining singles by twisting them together in the direction opposite the direction in which they were originally spun. Cabling means combining singles by spinning them in the same direction they were originally spun (Fannin 1970). Cabling adds twist to yarns, plying subtracts it. It is common practise for a spinner to anticipate later cabling or plying by adjusting the amount of twist in singles yarn accordingly. In common use plying is used as a general term meaning the combining of yarns by spinning them together, without reference to direction of twist. Hereafter this useage will be followed.

Tools for Spinning

Spinning can be done with only the fingers and perhaps the surface of the spinner's thigh. This method has several drawbacks, however, including slow speed and the problem of containing the yarn in an acceptable fashion after its length reaches beyond the spinner's arm length. Yarn left to its own devices will promptly tangle up and/or untwist, leaving nothing to show for one's effort. World wide, the solution for this is the use of a spindle, or smoothed stick, which solves both problems at once (Barber 1991:42). The use of a spindle stick increases the speed at which twist can be introduced into the fibers as well as giving a place to wind up the finished yarn. It is a short step from here to noticing that as a larger amount of yarn accumulates on the spindle shaft the spinning action tends to last longer (Barber 1991:43), amounting, in effect, to a spindle with a weight or whorl added.

A spindle whorl is a weight that is attached to the shaft of a spindle; its mass both prolongs rotation, and by increasing tension, assists in the attenuation of fibers from the fiber supply. Within this broad definition there is a world of variation possible, as shown by the tremendous variety of documented ethnographic and archaeological spindles and whorls (Barber 1991) For the remainder of this paper I will refer to the combination of spindle plus whorl as a spindle, as is customary.

The critical difference between spinning with a stick and spinning with a stick plus whorl is that the whorl increases the duration of the spin and gives a more constant spinning speed. Two factors influence whorl performance: the weight (mass) of the whorl and the distance of that mass from the axis (radius). The best measurement of a whorl's efficiency is the Moment of Inertia, which is a measure of the tendency of a body to keep moving at a constant speed, neither slowing down nor speeding up. (Flywheels, for example, have a very high Moment of Inertia.) Inertia is calculated for a spinning disc of constant thickness by the following formula: $I=1/2MR^2$, where I is the Moment of Inertia, M is the mass of the disc, and R is the radius of the disc (Tipler 1982:268). I varies as the mass, and I varies as the square of the radius. For example, if you double the weight and keep the radius constant, I doubles. If you double the radius and keep the weight constant, I quadruples (2 squared). Tripling the weight, with a constant radius, triples I. Tripling the radius, with a constant weight, increases I nine times (3 squared). As you can see, varying the radius of the disc has a much greater effect on Inertia than varying the weight. For the purpose of spinning yarn, higher Inertia is better because the spindle tends to maintain a constant speed for a longer time, increasing the efficiency of the work.

Inertia may be calculated for discs of varying thickness. In general, the effect of adding thickness (mass) at the edge of a disc has substantially more effect on the Inertia than adding it at the center of the disc. Figure 2 illustrates this point. The diameter of the whorl also affects the speed at which it turns. Hochberg (1980) uses the analogy of an ice skater to illustrate this point. When

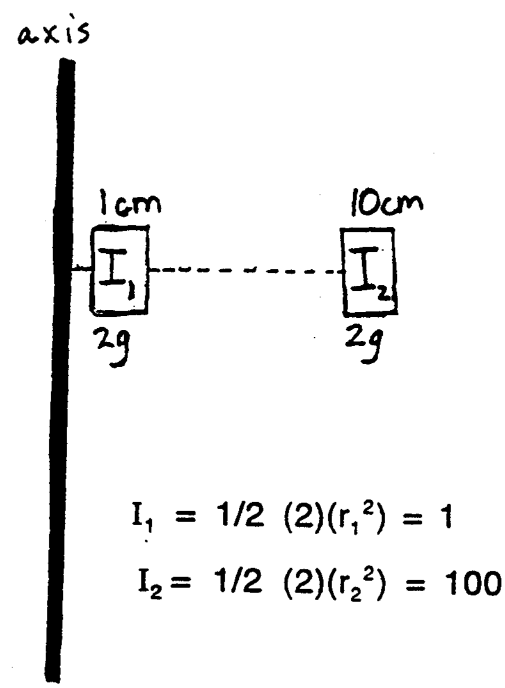

Figure 2- Effect of adding weight at different points on a spinning disc.

performing twirls a skater can increase the speed of her rotation by tucking her arms in and concentrating her weight closer to the axis of rotation. To slow down she extends her arms, redistributing her weight further from the axis. So it is with spindle whorls: a broad whorl produces a long, slow spin, a whorl of smaller diameter spins faster but stops sooner (Hochberg 1980:40).

Spinning can be carried out in two ways, either with the spindle supported somehow or with the spindle hanging from the yarn in process. In the latter case the weight of the whorl is brought more directly into play as a factor in what fiber and yarn types can be processed. Even when the whorl is supported, its weight is still a factor, and a general rule of thumb is that a smaller, lighter spindle is capable of producing a finer yarn and a heavier, larger one a bigger yarn (Barber 1991:52). For supported spinning the angle formed between the yarn and the tip of the spindle shaft affects the amount of the weight transfer from the spindle-plus-whorl to the fiber being drafted (Figure 3). We will discuss this point more fully when we look at the different ways spinners manipulated their spindles on the Northwest Coast.

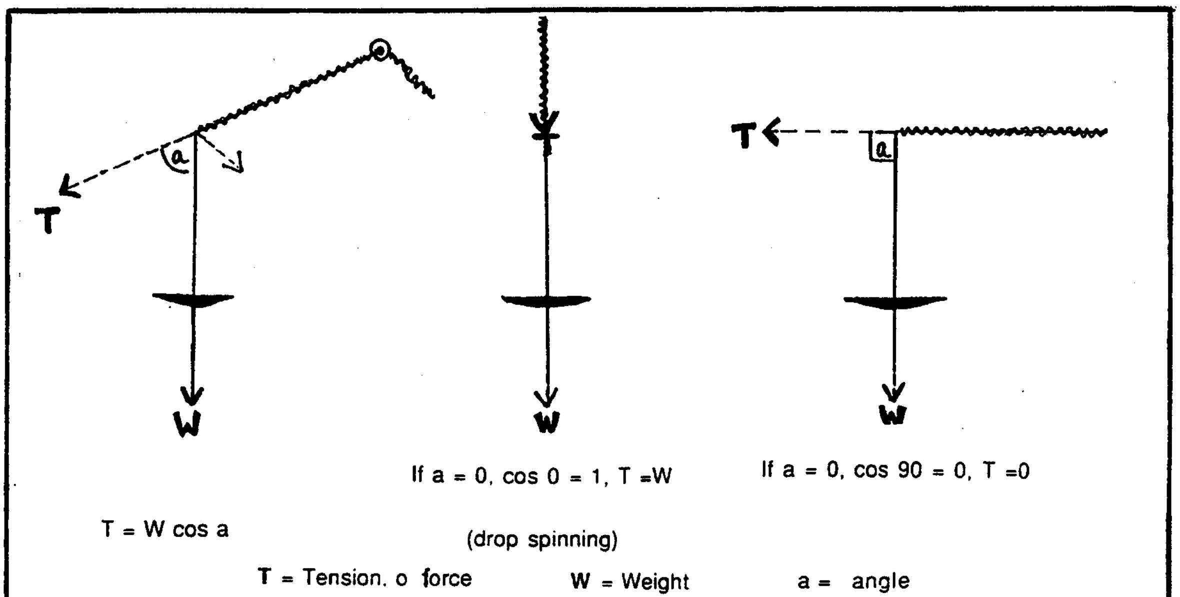

Figure 3- Angles of tension in spinning.

Barber's (1991) study covers the research on spindle whorls in great detail. She quotes a 1978 study as her source for the following minimum and maximum weights of spindle whorls across cultures: minimum weight = <1gram (used in the Middle East during

Islamic times); maximum weight =140-150 grams. Whorls must fall within particular weight ranges to perform specific jobs. The tension introduced by the weight of a whorl has a tremendous effect on the fibers being spun. Short light fibers cannot be processed using a heavy whorl. They are drawn out too fast and the yarn constantly breaks. On the other hand, when spinning heavier, long staple fibers a heavy spindle whorl assists greatly in the task.

Spinning technology on the Northwest Coast

Three authors, Kissel (1916), Vanderberg (1953) and Marr (1979), provide the most specific information on Northwest Coast spinning technology, and each summarizes the literature of her time. Marr (1979) provides the most comprehensive summary of all sources, emcompassing the work of both Vanderberg (1953) and Kissel (1916) as well as the other ethnographic records. The first part of this discussion is based primarily on her work, with additional information from Vanderberg (1953) following.

Traditional Salish-style spinning used a variety of spindle sizes and types. These spindles were used to make yarns for weaving (both single ply and two-ply) and sometimes were employed for spinning nettle fiber into twine. The distribution of the spindle types and their uses had quite a bit of overlap (Marr 1979:71-72). Additionally, in some areas all yarns were initially manufactured by hand, with no spindle used at all, or with a spindle used only in the plying step of the process (Vanderberg 1953:56).

Although they varied in form and use, all Salish spindles were supported spindles, and being supported, shared the same drafting method. In Salish spinning, fibers were drawn continuously down toward the spindle shaft as a result of its turning. Tension resulted from this pulling of the fibers as the twist was added. This type of supported spinning differs fundamentally from European drop spinning, where the weight of the spindle serves to provide the tension on the fibers as they are drawn out and into the twist. Spindle weight has an effect on drafting in supported spinning, but as Figure 3 showed, this effect is not as directly related to tension on the yarn. Instead, spindle weight has more effect in terms of a greater or lesser Moment of Inertia of the spindle in supported spinning.

Table 1 shows Marr's breakdown of the five different types of spindles used in the Salish spinning tradition. This information was summarized from historic sources.

Each of the five spindle types Marr details was manipulated in a different fashion. Type I was rolled down the right leg by a seated spinner, with legs outstretched and slightly bent. The shaft was rolled using the right hand, with the left holding the fiber supply. Yarn was made as the spindle rolled down, then wound onto the shaft on the return up the leg. Plying was carried out in the same fashion (Marr 1979:67). Note that it is only possible to have produced an "S" twisted yarn or plyed yarn with this motion. Also of interest is the fact that this is the smallest of the five types, and the only one noted by Marr to have been specifically used for making nettle cordage.

Table 1- Marr's Salish spindle types (after Marr 1979).

Type	Diameter (cm)	Shaft Length (cm)	Material	Used By	Used For
I	7-8	13.6	Whale bone	Northern Salish of Vancouver Island, Kwakiutl	Mostly nettle, also wool
II	10-16	13.6	Hardwood	Nootka, Makah	Wool
III	20	90	Wood	Puget Sound area	Wool
IV	30	over 90	Whale bone	Lillooet	Wool
V	20+	120	Wood (Maple)	Cowichan on Vancouver Island, Musqueam Fraser River to Yale and Spuzzum	2 ply Wool

Type II, used by the Nootka and Makah, was held and used in a completely different manner. The spinner turned it in mid-air, with one hand (Marr 1979:68). No further information is given, so it is not possible to say what the twist might have been for yarn produced from this spindle.

Type III was used in a manner somewhat similar to Type I. The spinner sat on a slightly elevated surface and rested the end of the spindle shaft on the ground, with the upper end resting on her thigh. The shaft was rolled down the right thigh to spin and up again to wind the yarn on. The fiber supply was held in the left hand. A variation of this method was for the spinner to roll the spindle in her lap, though this seems to have been a much later development (Marr 1979:69). This spinning method would likewise produce an "S" twist yarn.

The Lillooet spindle, Type IV, was used by resting the butt end on the ground and turning the shaft by hitting the whorl from below with the right hand. The left hand controlled the fiber supply (Marr 1979:69). Resulting yarn might have been either "S" twist or "Z" twist, depending on which way the whorl was turned.

The last type, Type V, was employed in a spinning method used nowhere else in the world (Kissel 1916:264). Two variants of the method are described by Marr. The first has the spinner resting the butt of the shaft (its length was about 120cm) on her palm and turning it by hitting the underside of the whorl with the right hand so that it lifted up slightly from the hand holding it. The second is for the left hand to hold the spindle on the side of the shaft while the right hand patted the shaft just below the whorl with a circular motion which lifted it slightly with each pat. In both methods the spinner is actually looking up at the convex face of the whorl as she works. Tension is maintained by threading the roving through a tension ring anchored to a beam or merely passing it over a high point, and then manipulating the height of the top of the spindle shaft to spin or wind on, as needed. (Marr 1979:70-71) Marr gives no indication of the direction of spin employed.

Vanderberg (1953) presented a slightly different distribution of Northwest Coast spindles. Table 2 shows Vanderberg's breakdown of spindle types and usage.

Table 2- Vanderberg's Salish spindle types (after Vanderberg 1953).

Type	Diameter (cm)	Shaft Length (cm)	Material	Used By	Used For
I	6.25	<45	Wood, stone or bone	Northern Salish, Nootka, Kwakiutl, Bella Coola, Tsimsian	Wool, dog hair, nettle or other materials
II	20	90-120	Wood	Southern Salish	Wool- 1 or 2 ply

Like Marr, Vanderberg described the methods of spinning used with each type of spindle. Type I was rolled down the right shin or thigh of the seated spinner. The left hand controlled the fiber supply. Vanderberg went into more detail about the construction of this small whorl, noting that the size of the whorl varied depending on what type of yarn was being made, and that the whorl was wedged tightly to the shaft nearer to one end than the other. This description was taken mostly from Barnett's at that time unpublished work on the Coast Salish of British Columbia and his *Coast Salish of Canada* (1938).

Vanderberg's description of the spinning method employed with her Type II spindle is virtually identical to that outlined by Marr for her Type V spindle. (Both Marr and Vanderberg quoted this method almost verbatim from Kissell (1916)). According to Vanderberg this large spindle was used in a nearly vertical position (Vanderberg 1953:57).

CHAPTER 4- RESEARCH GOALS AND METHODS

Leaving aside the issue of personal preference, specific modifications of the basic flat disc shape of a spindle whorl were made for either functional or stylistic reasons. These modifications can include thinning of the edges, hollowing out the underside of the whorl to form a concave surface, or leaving a raised collar around the central perforation. All of these modifications appear in Northwest Coast whorls, in various combinations, and some, like thinning of the edges of the whorl, are very common. Using specific analytic techniques it is possible to determine the effect of these modifications on the balance and performance of a whorl and thereby see what effect particular combinations of modifications would have on spinning efficiency.

Classification and functional analysis

Classification for the purpose of a specific analysis is a central feature of most archaeological research (Redman 1978:160). Properly used, classifcation systems can help to highlight patterns in data and provide a framework for comparison of artifacts within assemblages and among assemblages. Change over time can be noted and variation between geographical areas can be examined. Poorly constructed classification systems become difficult to use when new data comes to light.

Paradigmatic, or dimensional classification is a method of organizing information about a set of data. Unlike taxonomic classification, paradigmatic classification develops a nonhierarchical picture of the relationships of mutually exclusive attributes to each other. No attribute is given more weight than any other attribute, and all possible combinations of attributes are allowed (Dunnell 1971:70-71). This type of classification has been explained in detail by Dunnell (1971), and is particularly suited to functional analysis of artifacts because dimensions may be selected on the basis of well-defined, relevant criteria (Thompson 1978:71). The resulting combinations of modes, or classes, can be treated equally for the purpose of analysis, because there is no inherent order in their classification.

Functional analysis has been performed extensively on archaeological materials. Attributes typically examined are those relating to the shape of the artifact and to manufacture and use wear (Thompson 1978:71). Although we now view spindle whorls more as art objects than tools, originally they were made to perform the specific task of acting as a flywheel on a spindle shaft. The techniques used to shape them were fundamentally reductive techniques, that is material was removed from a blank to form a specific shape the maker had in mind. This being the case, any curvature introduced, any beveling of the edge, or any projections rising above the surface of the whorl were made intentionally. As I showed in Chapter 3, diameter and weight are critical factors in the performance of a spindle whorl. By applying a paradigmatic classification system to my sample I was able to separate out shape attributes of whorls so that attribute combinations could then be compared with the weight and diameter of the whorls to see if there were functional reasons for variation in shape.

Data selection

Data for this research was gathered from a variety of sources. I made a thorough search of ethnographic, archaeological and Native American artistic literature for references to Northwest Coast spindle whorls. I compiled initial lists of artifacts and their locations. Then I contacted curators and arranged for access to artifacts for the purpose of analysing them. In the course of my fieldwork I found many more whorls than were on my initial list. Conversely, I was not able to gain access to some of the ones on my original list. Most whorls included in this study are from the collections of three institutions: Thomas Burke Memorial Washington State Museum, in Seattle, Washington; British Columbia Royal Provincial Museum, in Victoria, B.C.; and Museum of Anthropology at the University of British Columbia, in Vancouver, B.C., all major repositories of artifacts from the Northwest Coast.

Several biases were introduced because of my reliance on data from museum collections. First, there is a distinct bias toward whole artifacts. Museums are often the recipients of artifacts from personal collections, and these most often are whole or nearly whole items. Second, there is a bias in favor of decorative or artistic objects in museum collections. Ordinary utilitarian items are often passed over by collectors. Third, there is a bias toward historic period artifacts in museum collections. Few archaeological specimens have made their way to museum collections, especially those resulting from recent work in the field. There are few spindle whorls from archaeological contexts, and they are spread thinly through museum collections. Another difficulty I encountered was the lack of exact provenience for many museum artifacts. Only general location, date and collector information is given.

Offsetting these biases is the fact that I was able to thoroughly examine each artifact from the museums collections, and to weigh, measure and record to the limits of my imagination. The biases toward whole or decorative whorls have also worked to my advantage in that I was able to limit estimated measurements to a handful, which would not have been the case had I used many fragmentary objects.

I also included specimens from the literature that I had not personally seen and analysed if there was sufficiently detailed information given. The decision to include all specimens, even if complete information was not available, was made on the basis that the type of analysis performed can be successfully applied to partial as well as full data sets. I have been careful to include specific details about the nature of the sample with each section of my analysis, and to compare only equivalent data.

Appendix C contains brief descriptions, location and citations in the literature for each whorl included in this study. Additionally this appendix lists of other known whorls which were not included in the present work.

Field data recording and coding sheets

A two page field data sheet was developed for recording information on each whorl (see sample, Appendix A.). This sheet also contains citations in the literature pertaining to the artifact in question and any notes collected through research. In addition to recording metric and qualitative data in the field, a graphic image of each artifact was obtained. For some, this is a xeroxed copy from either the literature or museum accession records. For others I made my own drawing. All artifacts were photographed in black and white and color for detailed and accurate field records.

Raw data was coded for computer entry, allowing convenient summary of quantitative and qualitative information. Appendix B contains coding sheets for all artifacts in the sample. The variables and coding are discussed in detail below.

To begin I will present terminology pertaining to the geography of spindle whorl artifacts and explain measurement landmarks. A brief description of Northwest Coast spindle whorls in general will be helpful. Whorls are round, flat discs with a central perforation. They can be slightly squared or ovate, but if the shape strays too far from a balanced roundness the whorl will not spin correctly. Some whorls are truly flat, others have one or both surfaces curved. These curves may be convex or concave, or some combination of the two. When there is a concave curve on the surface of the bottom of the whorl there is often a marked concavity of this side of the whorl. The central perforation must be very nearly in the center of the whorl or it will not spin evenly. This perforation may be straight or have a simple taper or double taper. Whorl edges may be rounded, flat or beveled. Whorls are sometimes plain and sometimes decorated with painting or carving or both, on one or both surfaces.

For the purpose of this analysis, "top" means the surface of the whorl that would face the spinner. This is typically the surface with the most decoration and the most carefully finished surface. If the whorl has one convex face and one concave face, the convex face was considered to be the top, based on historic accounts of Salish spinning practises. For bone whorls the surface with the least evident grain was considered the top. In cases where there was no clear difference between faces a top face was arbitrarily assigned. "Bottom" means the face opposite the top face. The "edge" is the outer circumference of the whorl.

"Neck", refers to the flattened area around the perforation of some types of whorls. A "collar" is considered present if the neck area protrudes above the surface of the whorl. Its height is the maximum vertical distance from the top flattened edge to the face of the whorl. Some whorls have a "rim", or undercut edging on the collar. This rim is measured along the side, from the top of the neck surface to the bottom edge of the rim. Figure 4 illustrates these and other spindle whorl landmarks.

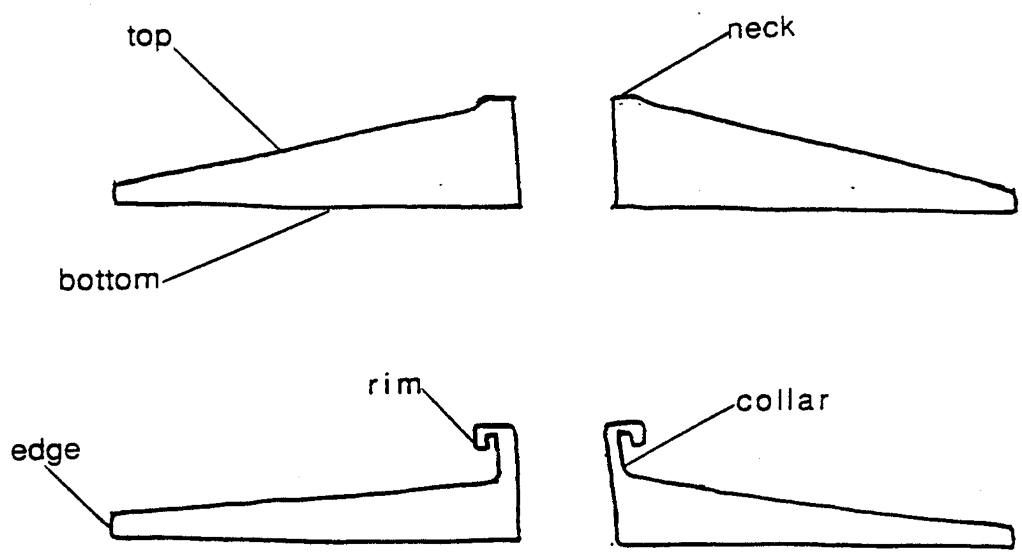

Figure 4- Spindle whorl landmarks.

Columns 1-10: Metric Data

1: Specimen #- All specimens were assigned a number for the purpose of this research and all data is keyed to this reference number.

2: Edge Thickness- Greatest thickness at outer edge of whorl; measured in centimeters.

3: Thickness at Hole- Thickness measured on inside of central perforation; measured in centimeters.

4: Diameter-Maximum diameter measured across the top of the whorl. In the case of varying diameter, the largest figure is used. Measured in centimeters.

5: Maximum Height- Measured from top of whorl at the center through the hole to the top of the surface upon which whorl rests; given in centimeters.

6: Weight- Given in grams. In the case of partial whorl weight is estimated for whole whorl based on the percentage of completeness.

7: Hole Diameter- Measured across opening, from the top view, measured in centimeters. If the hole was asymmetrical, the greatest measurement is given. In cases where the whorl was not available for handling but the circumference was known and a photograph was available this measurement was calculated mathematically using the following formula: $(X_i)(Y_o)/X_o = Y_i$. X_i is the diameter of the hole in the photograph, X_o is the diameter of the whorl in the photograph, Y_i is the actual diameter of the hole and Y_o is the given actual diameter of the whorl.

8: Neck Thickness- Measured at top of whorl from edge of hole to edge of the flattened surface defining the neck; given in centimeters This measurement was also in some cases mathematically derived from photographs. I used the same formula as I used to calculate hole diameter.

9: Collar Height- Distance from top of whorl proper to top edge of collar; in centimeters.

10: Rim Height- Measured between top and bottom edges of the rim; in centimeters.

Columns 11-17: Qualitative Data

11: Material Type- Coded as wood, stone, bone or antler.

12: Date- Whorls were considered historic if they were collected since the contact period. This includes contemporary works. Archaeological specimens were indicated as such, without including specific age.

13: Location- Since locational data was vague for most of these artifacts, I sorted them by only three categories. Washington State, Mainland British Columbia, or Vancouver Island.

14: Shape- Overall shape of the whorl as viewed from the top. Listed as round, square with round corners, or ovate.

15: Shape of Hole- Described as round, square or ovate.

16: Type of Perforation- This is a description pertaining to the way that the hole was drilled, expressed as straight; conical with widest part toward the top surface of the whorl; conical with the widest part toward the bottom surface of the whorl; or biconical.

Columns 17-19: Decoration

17: Location of Decoration- Recorded as none; one side only; two sides; or edge.

18: Style of Decoration- Plain; geometric; zoomorophic; geometric and zoomorphic.

19: How Decorated- Refers to the way design was applied. Carved; painted; carved and painted; none; other method of decoration.

Columns 20-26: Wear and Breakage

20: Completeness- Expressed as a percent and coded as follows: 100%- no visible pieces missing. 99% complete except for chipping at the edges (considered complete for the purposes of weight calculation). Other percentages estimated as required.

21: Edge Wear- None; chipping; or checking (small cracks extending along the grain lines a short distance into the whorl).

22: Surface Wear- Surface wear reflects use, to some extent. Recorded as: polish near center of top surface, overall wear of top surface (paint worn off, patina present); polish near the edge of top surface; identical categories in reference to the bottom surface; none.

23: Breakage- Categories are: none present; partially split along grainline; fully split along grainline; broken across grain; breakage near hole.

24: Degree of Warping- Expressed in four categories: none; minor; moderate; heavy.

25: Direction of Warping- With or against grain.

Column 26-28/: Other Information

26: Collector- Many whorls analysed came from the collections of two people: C.F. Newcombe and G.T. Emmons. I was curious to see if there might have been a preference for certain types of whorls by either one. Artifacts are coded as Newcombe, Emmons, or other.

27: Estimated dimensions- Any artifact for which data was figured with the aid of a mathematical calculation rather than by direct measurement or as described in the literature is identified by a "x" in this column. I wanted to be able to quickly isolate any potential problems due to estimation.

28: Class- Class number assigned through application of the dimensional classification system proposed.

Dimensional Classification System

The following classification was applied to all artifacts. Artifacts were also coded according to material type (S=stone, B=bone, W=wood), making it possible to look at classes as units or to compare different materials within a class.

Dimension 1: Top Profile

This dimension refers to the shape of the top surface of the whorl as seen in plan view.

Modes:

1. Flat- No curvature of this surface.
2. Concave- Surface displays a concave curve between the hole and the edge.
3. Convex- Surface displays a convex curve between the hole and the edge.

Dimension 2: Bottom Profile

This dimension refers to the shape of the bottom surface of the whorl as seen in plan view.

Modes:

1. Flat- No curvature of this surface.

2. Concave- Surface displays a concave curve between the hole and the edge.

3. Convex- Surface displays a convex curve between the hole and the edge.

Dimension 3: Collar

This dimension denotes the presence or absence of a collar raised from the top surface of the whorl around the central perforation of the whorl.

Modes:

1. Present- Whorl has a raised collar.

2. Absent- No raised collar.

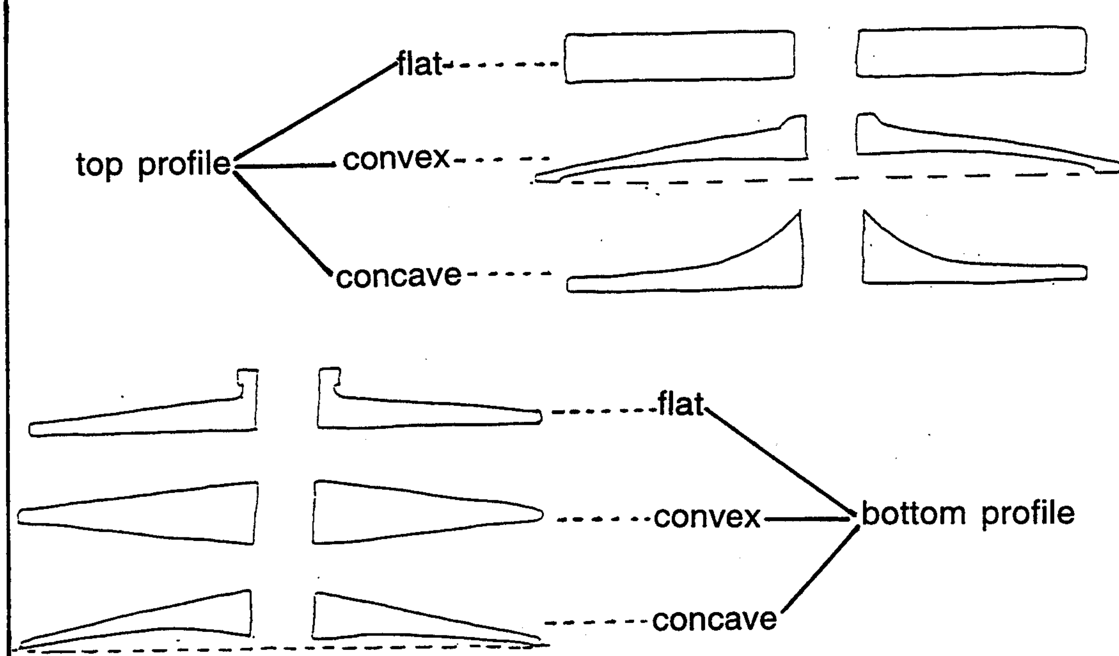

Figure 5- Shape attributes for dimensional classification system.

CHAPTER 5- RESULTS

I have metric data for 66 of 100 whorls in my sample. This information comes either from my field analysis of the artifacts or from published information. Of these 66 whorls, almost half (48%) were collected on Vancouver Island. Nine (14%) came from mainland British Columbia, and 8 (12%) from Washington State. The remainder (26%) are from unknown locations. Wooden whorls make up 68% of the classifiable sample. Bone and stone whorls are respectively 22% and 10% of the sample (Table 3). The high proportion of whorls from Vancouver Island is probably the result of collection bias.

Table 3- Whorl frequency by location and material type.

	Wood	Bone	Stone	Total N	Total %
VCI	22	6	4	32	48%
B.C.	4	4	1	9	14%
WA	4	3	1	8	12%
Unknown	15	2	0	17	26%
Total N	45	15	6	66	
%	68%	22%	10%		100%

Material Type

A central question in this analysis is the effect of material choice on the design of spindle whorls. Bone, stone and wood behave differently and have different strengths and weaknesses as raw materials. Each requires different manufacturing techniques and there is a great deal of difference in density between these three materials. If material choice for whorl manufacture was deliberate we would expect to see allowance made in the design of finished artifacts for the strengths and constraints of the material. This would be exhibited most clearly in the clustering of materials in one or more of the proposed shape types.

In order to test this theory artifacts were classified using an alphanumeric designation indicating material type as well as shape type. ("S" for stone, "B" for bone and antler, "W" for wood.) In this analysis no distinction was made between types of material within these categories. Table 4 shows class members by material type.

In this sample shape and material type are not equally distributed. Stone whorls all occupy one shape class (112); most bone whorls are members of this same class, with three examples in two other classes (312, 332). Wooden whorls have the most diverse distribution, appearing in each of the eight classes represented in the sample, but most concentrated in four shape classes (311, 312, 321, and 322). Stone and almost all bone whorls are flat on both faces, and no stone or bone whorls appear in any class with the collar attribute. This is an indication that material choice affects the finished shape of spindle whorls in the sample, either because of the properties of the material or its limitations.

Material useage may have changed over time. There is insufficient information on the age of artifacts in this sample to determine whether or not this is the case. The fact that all stone whorls in the sample are from archaeological contexts might suggest the use of stone for whorls predates the use of other materials. Given the dual problems of poor dates and preservation bias, this issue is beyond the scope of this analysis and can only be raised as a question for further inquiry.

Table 4- Class members by material type.

Class	Stone	Bone	Wood	Total
112	6	11	3	21
211	--	--	1	1
222	--	--	2	2
311	--	--	8	8
312	--	2	11	12
321	--	--	10	10
322	--	--	9	9
332	--	1	1	2
Total	6	14	45	65

Shape Types

The purpose of applying a shape based classification system to the sample is to identify combinations of attributes which might have their roots in the function of the whorl as a spinning tool. The shape categories sorted for with this classification have direct bearing on modifications made during manufacture which may be functional in nature. Using the classification categories it was possible to quickly isolate attributes and combinations of attributes and compare them.

Regardless of material, spindle whorls were made from a flat blank, with shaping accomplished by a reductive process. In terms of the shape classification system used in this analysis, the profile of the basic blank corresponds to class 112 (flat top, flat bottom, no collar). Modifications to this basic shape are the result of deliberate removal of material from the blank. Using the classification system we can describe these modifications as they appear in the finished product, that is as overall curvature of the top of bottom surfaces or the formation of a collar at the center of the whorl. However, it is important to keep in mind that while the shape profile of the artifact is the result of modifications which were made, it was not necessarily the primary intent of those modifications. For example, a concave bottom surface is the result of material having been removed from the bottom surface of the whorl. This might have been done for decorative or stylistic purposes. It might have been the result of thinning the whorl to remove excess weight. Because the bottom of the whorl is the side that yarn was wound against, it might have been done to provide a firmer seat for the accumulated yarn. The question then becomes what functional advantages there might be to the modifications commonly made to Northwest Coast type spindle whorls, and how functional and stylistic modifications can be separated.

Leaving aside modifications which seem to be primarily decorative (surface carvings, for example), there are two main types of modification present in the whorls in the sample. The first, and most common, is the selective removal of material with the end result of modifying the overall weight of the whorl and/or the placement of weight on the whorl. Edge modifications would be included in this category. The second type of modification is the creation of a raised collar around the central hole. Both of these types of modifications are expressed as changes in the shape of the whorls, in various combinations.

Of all the possible shape combinations, eight were filled by the classifiable whorls in the sample. These eight are as follows:

112- flat top flat bottom, no collar.
211- concave top, flat bottom, collar
222- concave top, concave bottom, no collar
311- convex top, flat bottom, collar
312- convex top, flat bottom, no collar
321- convex top, concave bottm, collar
322- convex top, concave bottom, no collar
332- convex top, convex bottom, no collar

The members of each class occuring in each material type will be discussed in detail.

Stone whorls

All six stone whorls are members of class S112. The members of this class are relatively thin, flat stone discs with a central perforation. They have no collar. Their diameter varies from 4.10cm-11.25cm, with a mean diameter of 7.45cm (n=6). Mean thickness is 1.07cm (n=5). Included in this class are artifact numbers 1, 2, 3, 4, 76, 91. Of the six, only numbers 1, 76 and 91 had both dimensional and weight data, although information on other characteristics make it possible to make other types of comparisons.

Two of the whorls are made of sandstone, two of dark basaltic rock, one of brown steatite and one of green phyllite. Mean weight is

167.1g (n=3). One weight was estimated. When the one estimated weight is omitted the mean weight is 90.5g (n=2). Four of the six are round in shape, one is slightly ovate. The sixth is a whorl fragment with a projected circumference of 11 cm (Grabert 1983:36). All of the stone whorls are from archaeological contexts.

Bone and antler whorls

Bone whorls analysed fill three of the possible classes. The antler whorl in this sample was collected from the literature and not classifiable due to incomplete dimensional information. All of the bone whorls in the sample are made from flat bone, not vertebral epiphyses. No attempt was made to specify whether this is sea mammal bone or other, since it is all the same type of material from a manufacturing standpoint. Vertebral epiphyses would impose a shaping element on whorls using them as a blank.

<u>Class B112</u>- There are eleven artifacts in this class: artifact numbers 5, 34, 35, 37, 38, 52, 53, 55, 75, 80, and 93. Members of this class are all relatively thin, flat discs with no collar, with a mean weight of 49.5 (n=6) and a mean diameter of 10.56 (n=8). Mean thickness is 0.75cm (n=9). Six of the artifacts belonging to this class are circular in shape, seven are rounded squares. Only numbers 5 and 34 are decorated, 5 with a rough concentric groove midway between the perforation and the edge of the object, and 34 with incised geometric designs on both sides of the whorl.

<u>Class B312</u>- Two artifacts, number 81 and 92 are in this class. They are flat on the bottom with a convex top surface, with no collar. Mean edge thickness is 0.50cm, mean center thickness is 1.50cm.

Mean diameter is 5.38cm, mean weight is 62.1g. Both whorls are undecorated.

Class B332- Artifact number 57 is the sole member of this class. It is a small bone whorl, 5.63cm across, weighing 46g. Unlike other bone whorls in the sample, this artifact has two convex sides. No collar is present. The edge thickness is 0.5cm and each side slopes evenly toward the central perforation, where the whorl is 1cm thick. It is plain and highly polished.

Wooden whorls

A total of 45 wooden whorls were classifiable. They are all from the historic period and eight of the possible classes were filled. Most wooden whorls in the sample are of hardwood, usually alder or maple. A few are cedar, although these tend to be modern copies of older whorls or original contemporary carvings. Three whorls are made from modern milled or processed woods.

Class W112- Artifacts 56, 84 and 89 belong to this class. These whorls are all round and flat, of uniform thickness, with no collar. Mean weight of this class is 155.9g (n=3), mean diameter is 16.66cm (n=3), and mean thickness is 0.97cm (n=3). These whorls are all made from materials very different from each other and from the rest of the wooden whorls examined. Whorl 56 appears to be made from a three-ply plywood. Four small rust stains are evenly spaced around the perforation, suggesting small nails may have been used to attach the whorl to its shaft. The use of plywood indicates that this whorl is of fairly recent manufacture. Number 84 is made of very rough wood, with a slight bevel filed on the lower surface of the edge. Artifact 89 appears to have been made from the head of a keg or small barrel. A machined, double bevel is evident on the edge, and in two spots near the top edge there are what appear to be bits of tarnished metal (copper?). These may have been related to the attachment of the head to the body of the keg. The hole is slightly off center and the whole whorl is severely warped.

These three whorls all show indications of more recent manufacture. It may be significant that these are the only wooden whorls of this shape in the sample, possibly indicating a change in technology or the use of materials in a different way than previously practised.

<u>Class W211</u>- Artifact number 99 is the sole member of this class. It is 14cm in diameter and weighs 55.8g, with thickness varying from 0.5cm at the edge to 1.5cm at the hole. The bottom profile is flat, while the top surface sweeps up toward the edge of the center perforation. The convex curve formed by this sweep is not regular- it is more gentle at the edge and rises sharply in the inner third of the whorl, culminating in a raised area forming the collar.

<u>Class W222</u>-Two artifacts belong to this class: 70 and 83. They are both plain whorls with two concave faces and no collar. Mean weight of this group is 230.4g (n=2), mean diameter is 32.5cm (n=2). Thickness means for this class are 0.5cm (n=2) at the edge and 2.63cm (n=2) at the perforation. Number 83 has the largest diameter of all whorls in the sample; it is larger by 7.5cm than the next largest. Both 70 and 83 sweep up toward the center dramatically. Both have a flattened neck area around the perforation on the top.

Class W311- This class has eight members: artifacts number 9, 39, 42, 51, 67, 72, 90, and 96. Mean weight is 106.3g (n=8), mean diameter is 20.1cm (n=8), mean edge thickness is 0.38cm (n=8), mean thickness at hole is 1.72cm (n=8). All whorls in this class have a flat bottom, while the top is convex to some degree. Each whorl has a collar.

Each of these eight whorls has a carved design in which the raised collar is incorporated. Number 9 has incised rays extending outward from the collar to the edge. Number 39 has a geometric carved design of concentric rings, the innermost of which forms the collar. Numbers 72 and 90 are stylized wagon wheels with cutouts removed between the spokes. The hub of the wheel forms the collar. Artifact 67 has a compact owl carved on the top whose open mouth is the central collar and perforation. Artifact 51 is a creature that appears to be an angel. A five-sided house-like structure forms its body and also serves as the raised collar. On number 42, two animals chase each other around the top of the whorl. The collar is formed by two carved concentric rings. Number 96 is a partial whorl, with a raised star forming the central collar. This whorl is unusual in that it has a collar on the bottom, a mirror image of the top collar. The bottom collar is circular rather than carved into a star shape.

Class W312- The greatest number of members were assigned to this class: numbers 12, 14, 49, 61, 64, 68, 71, 73, 74, 85, and 100. Mean weight is 134.3g (n=10), mean diameter is 22.55cm (n=11), mean edge thickness is 0.47cm (n=11), and mean thickness at hole is 1.61

(n=11). All the whorls in this class are flat on the bottom and display varying degrees of convexity on the top surface. They do not have collars. Numbers 49, 61, 64, 68, and 85 all have a flattened neck area around the central perforation. This area varies in width from 0.2cm on number 49 to 0.75cm on number 68.

Six whorls in this class have intricately carved designs on them (12, 14, 49, 71, 73, 74, 85, 100). All are zoomorphic, except for the geometric design on number 100. Numbers 64 and 85 have very similar incised, painted designs, and number 61 is like these two in the manner of decoration (incised and painted) but the motif is different. Number 73 has a crudely incised and painted design.

Class W321- This class has ten members: numbers 25, 44, 50, 59, 60, 62, 63, 65, 94, and 98. Mean weight of this class is 122.17g (n=10), mean diameter is 21.5cm (n=10), mean edge thickness is o.40cm (n=10), and mean thickness at hole is 1.85cm (n=10). The whorls in this class have a convex top surface, concave bottom surface, and a raised collar. Six of them are round, one is ovate and three are rounded squares. Numbers 25 and 59 have a raised area at the outer edge of the bottom surface that extends all the way around their circumference.

Six of the ten whorls have carved designs on them, of four different types. Numbers 25, 44, and 60 all have intricate, distinctively Salish style creatures worked in interlocking fashion. Number 62 has a finely done carving of what may be stylized feathers, which looks more European influenced than the previous three. Whorl 98 has a star design carved on it with a border design of small triangles around the edge. Artifact 59 has thick, deeply incised birds and plants evenly spaced around the top of the whorl. Of the other four whorls in this class, two are plain wood, one has a penciled drawing of what appear to be humans and whales, and the last has either a painted or penciled concentric ring near the edge of the whorl and painted or penciled rays extending outward from the center collar area.

Class W322- Artifacts 54, 58, 66, 69, 82, 86, 87, 88, and 95 are members of this class. Mean weight of the class is 110.9g (n=9), mean diameter is 21.58cm (n=9), mean edge thickness in 0.39cm (n=9), and mean thickness at hole is 1.64cm (n=9). Artifacts in this class have a convex top surface and a concave bottom surface, with no collar. Six of the nine whorls in this class are plain whorls, the other three have carvings. Seven of the nine have their greatest thickness at the center perforation, while the other two have a uniform taper from edge to hole. Numbers 66 and 86 have a raised area on the underside of the whorl similar to a tiny collar. Five whorls in this class are round, four are rounded squares.

Class W332- This class has one member: artifact number 97. Its weight is 31.1g, diameter is 11.5cm, edge thickness is .5cm, and thickness at hole is 1.5cm. Artifact 97 has a gentle convex curve on both surfaces, sloping equally out to the somewhat thinner edge. This whorl has no collar.

Comparison of whorls by material and class

There is a great deal of diversity in the whorls in the sample, yet some patterns are apparent. (Metric data for the following discussion is presented in summary at the end of the section, in Table 5.) Wooden whorls tend as a group to be biggest, bone the smallest, and stone in the middle but closer in overall size to the bone whorls. Wood and bone whorls tend to have about the same average edge thickness (0.50cm), but wooden whorls are much thicker at the center than bone (1.70cm mean thickness for wood, 0.37cm for bone). Stone whorls in the sample are thicker overall at the edge (0.98cm), but at the center tend to be between bone and wood in thickness (1.07cm). Stone and bone whorls are near each other in mean diameter (stone 7.45cm, bone 5.07cm), but wooden whorls have on average three times greater diameter than stone (21.3cm). Wooden whorls tend to be the heaviest, but the difference between them and stone whorls is not so marked (121.58g compared to 90.5g). This is probably due to the greater density of stone. Bone whorls are the lightest, weighing 31.97g.

As I showed in Chaper 3, overall size is an important consideration in spinning tools, but weight distribution is also important. Weight and its placement directly affects the efficiency and performance of the whorl. With this in mind, we can compare metric data for the classes and material types in the sample and look for patterns in modifications which may be functional in nature. In particular we will look at the thickness of the whorl profile and how it varies from edge to center. Varying the profile results from removing material from the whole, the effect being to redistribute weight placement.

With the exception of class 112, all shape classes exhibit some degree of modification in thickness between center and edge. In no class or material type do we find that any effort was made to thin the center portion and leave thickness at the edge. The reverse is always true. If thickness modification was made, its effect was to thin the edge and leave weight at the center of the whorl. Is this edge thinnning found with any regularity in the sample? Does it occurr more often in any material type or class? Is edge thinning associated with any other shape modifications?

Edge modification is very common in the sample. Forty five whorls (66.5%) show some degree of edge thinning. The greatest difference between edge and center thickness is found in two whorls, number 65 (class W321) and number 83 (class W222). In both these whorls thickness ranges from. 0.50cm at the edge to 3.00 cm at the center, a difference of 2.50cm. The least difference between edge and center thickness is 0.25cm. Whorls 59, 63 (both class W321), 71 (class W312), and 92 (class B312) all show this difference between edge and center thicknesses, but vary widely in overall thickness. In the sample wood whorls are much more likely to display shaping which produces this edge thinning effect. All but three of the forty-five whorls with this attribute are wood. While this may reflect a bias due to the relatively small proportion of bone whorls analysed, it is apparent that edge thinning in some form is an important shape characteristic of wood whorls. The only wooden whorls which do not display this shaping are the three in class 112, which seem to be unusual in material (plywood and milled lumber) and are probably of more recent manufacture..

The functional reasons for the use of edge thinning in wooden whorls may be related to their greater average diameter. As diameter increases weight increases as well, which has an effect on the size and quality of yarn produced. In order to manipulate weight and maintain diameter it would be necessary to remove material from the whorl. If the motive was to fine tune the whorl as a spinning tool, the most effect would be achieved for the least effort by thinning at the edges, where removal of weight has a much greater effect than near the center.

The other major shape modification found in the sample is the inclusion of a projecting collar around the central perforation of the whorl. These collars may be of functional value. By increasing the area of contact between the whorl and the spindle shaft the whorl might be made more stable. The addition (or more correctly, the leaving) of material in this area would make little difference to the weight distribution across the diameter. The overall weight of the whorl could be reduced while maintaining desired diameter, and whorl thickness could potentially be reduced without compromising the stability of the whorl.

When we look at the mean greatest thickness of the whorls proper (excluding the collar) in the three shape classes with collars present compared to all other wooden whorls it is apparent that the collared whorls in this sample tend to be thinner. Mean greatest thickness of whorls in classes 211, 311 and 321 is 1.38cm, while mean greatest thickness for all other wooden whorls is 1.60cm. This would seem to suggest a tendency for thinner whorls in the sample to have collars.

It is possible that the collar is merely a decorative device. Nineteen of the whorls analyzed (all wood) have collars. Of these 14 (72%) have a raised collar incorporated into a carved design on the top of the whorl. The remaining 5 (28%) are plain whorls, with no carving. This suggests that either the whorl was planned with a raised collar because the design required a raised area in the center, or that the collar affected the carved design in order to include it. It is worthwhile to note that the 19 whorls with collars are among the most heavily decorated of the whorls in the sample. It seems likely that the functional and decorative blend together in the case of the collar, and that while there may be a decorative motive for including a collar on some whorls, there is strong evidence to suggest a functional element as well.

This is not the case, however, for the other shape modifications we have discussed. There is little evidence for a direct link between style and whorl profile shaping, but very good evidence, based on the physical principles of spinning tools presented in Chapter 3, that material was removed from specific locations on whorls for reasons directly related to the performance of the whorl as a tool for making yarn.

Table 5- Summary of mean weight, diameter, edge and center thicknesses, by class and material type.

Class	Weight (g)			Diam. (cm)			Edge (cm)			Center (cm)		
	m	s	n	m	s	n	m	s	n	m	s	n
<u>112</u>												
S	90.50	80.9	2	7.45	2.6	6	1.07	0.85	5	1.07	0.85	6
B	49.51	32.6	6	10.22	5.7	8	0.75	0.55	8	0.75	0.55	8
W	155.89	85.7	3	16.66	9.1	3	0.97	0.55	3	0.97	0.55	3
<u>211</u>												
S	- -			- -			- -			- -		
B	- -			- -			- -			- -		
W	55.80	--	1	14.00	--	1	0.50	--	1	1.50	--	1
<u>222</u>												
S	- -			- -			- -			- -		
B	- -			- -			- -			- -		
W	230.35	91.0	2	32.50	10.6	2	0.50	0	2	2.63	1.41	2
<u>311</u>												
S	- -			- -			- -			- -		
B	- -			- -			- -			- -		
W	106.33	30.4	8	20.09	4.1	8	0.38	0.13	8	1.72	0.34	8
<u>312</u>												
S	- -			- -			- -			- -		
B	62.10	41.3	2	5.38	1.8	2	0.50	1.8	2	1.50	0.71	2
W	134.34	24.0	10	22.55	3.7	11	0.47	0.17	11	1.61	0.46	11
<u>321</u>												
S	- -			- -			- -			- -		
B	- -			- -			- -			- -		
W	122.17	49.5	10	21.50	2.6	10	0.40	0.16	10	1.85	0.49	10
<u>322</u>												
S	- -			- -			- -			- -		
B	- -			- -			- -			- -		
W	110.89	20.7	9	21.58	4.5	9	0.39	0.45	9	1.64	0.45	9
<u>332</u>												
S	- -			- -			- -			- -		
B	46.02	--	1	5.63	--	1	0.50	--	1	1.00	--	1
W	31.10	--	1	11.50	--	1	0.50	--	1	1.50	--	1

Diameter

Previous research on Northwest Coast spinning tools, based on observations from early ethnographers and explorers, has focused on diameter as the distinguishing factor between whorls used for different spinning tasks. The two major classification systems in use were discussed in Chapter 3. While this is understandable given the context of the work, it is not very useful. First, there are many inconsistencies in the original reports, making diameter ranges approximate at best. Second, when new data, such as the data from this sample, is compared to these diameter ranges, it becomes apparent that the whorls themselves do not break neatly into the diameter ranges used in these classifications. The diameter distribution of the sample is nearly continuous. These clusters do not correlate with the diameter ranges mentioned by Marr, Vanderberg and others in ethnographic accounts. (Figure 6).

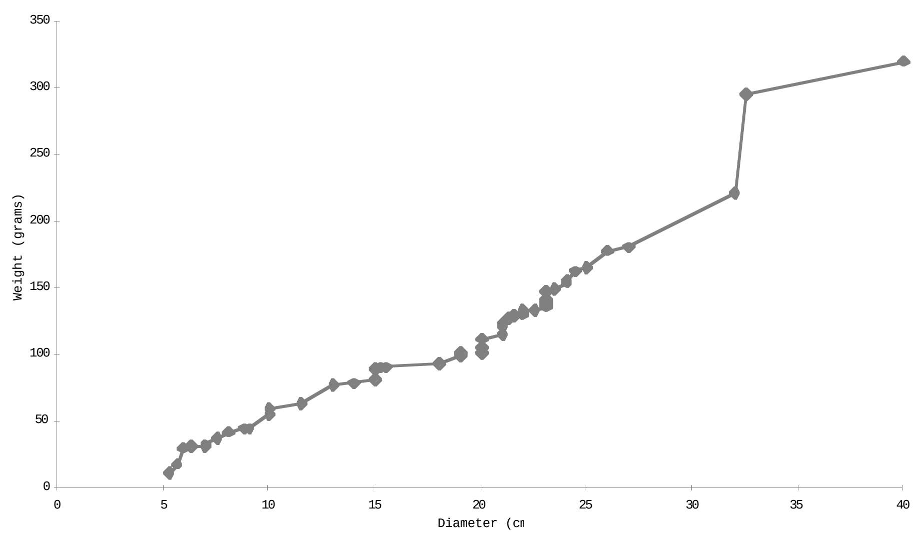

Figure 6- Weight and diameter distribution of whorls, all classes and material types.

Third, diameter is only one aspect of the design of a spinning tool. Weight is far more significant in determining the range of yarns which could possible be spun with a given spindle. While diameter alone is not a good diagnostic indicator of the specific use of a particular whorl, It is useful to look again at Marr's and Vanderberg's classifications systems for general clues to whorls use and possible motives for shape modifications found in the sample.

Spindles up through 20cm in diameter were mainly used while supported on the ground, by rolling up and down the shin or thigh (Vanderberg 1953, Marr 1979). Additionally, both Marr and Vanderberg note that the small spindles, with whorls less than 8cm in diameter, were used for wool or primarily nettle fibers. Typically nettle fiber was spun into a thin, tight two-ply yarn, suitable for netting and other tasks requiring a strong, thin line. Remembering the rules of thumb laid out by Barber (1991), it is logical that a small, light spindle would be used for this purpose. Its smaller diameter would promote rapid accumulation of twist and its lower weight would not break the finer yarn. Whorls with diameter of 9-16cm were reportedly used for spinning wool yarn, which would require a heavier spindle and slower spin than nettle.

Whorls over 16cm are those traditionally recognized as the large, Salish-style spindle. They were used supported in the air, for spinning either one or two ply wool yarn. The spinner would have held her spindle at almost arm's length for long periods of time. Single or two-ply wool yarn was produced with these spindles. In this group we may begin to see some functional reasons for the shaping which took place on these whorls and also in most all the whorls in the sample. A certain weight is required to be able to draft the fibers or pull the yarns up and through a tension ring for plying. Too much weight makes it tiring to spin for long periods, and too much weight placed far out toward the edge of the whorl makes manipulation of the whorl difficult. One solution would be to thin the edge of the whorl but keep it relatively thicker in the middle, where weight has less impact. The effect of this shaping would be to lower the overall weight to an acceptable level and maintain the diameter needed to promote a long, slow spin, while preserving enough weight to obtain the proper draft.

Eighty-two percent (37) of the wooden whorls in the sample have a diameter of 16cm or more, and of these all but one has some degree of edge thinning . (The one exception is a member of class W112, and is one of the three fairly recent whorls of odd materials mentioned above.) This suggests the use of edge modification to control overall weight by manipulating weight placement while retaining desired diameter. The eight remaining wooden whorls range from 9-15.5cm in diameter, and all of these except the other two whorls in class W112 show edge modification as well. This is consistent with Marr's and Vanderberg's data that whorls of this diameter were used for wool. Again, wool spinning requires a greater diameter (slower spin) and somewhat greater weight than nettle fiber. In order to fine tune the performance of the whorls in this group it appears that edge thinnng has been employed.

Stone and bone whorls in the sample show less shape modification than wood whorls. Ethnohistoric data suggests that bone and stone whorls were generally of smaller diameter than wooden whorls, which is borne out in the sample. (The exception to this is the 30+cm whalebone whorls made by the Lillooet.) Stone and bone whorls were used mostly for spinning nettle fiber (Marr 1979) Again, a smaller diameter equates with a faster spin, and tighter and thinner yarn. All of the stone and most of the bone whorls in the sample are flat discs with no difference in thickness from edge to center. This is consistent with the idea that small, supported spindles require less precise shaping to manipulate weight distribution and diameter. In the sample, only when spindles reach a diameter of 9 or 10cm does edge thinning become common.

Moment of Inertia

Weight ranges for the sample do not break into groupings either. Weight varies tremendously from whorl to whorl, with whorls of similar diameter, shape class and material type often having very different weights. This is probably due to the varying density of different materials within material types (i.e. maple vs. alder or cedar). Little weight data has been presented previously in the literature, making comparison by weight impossible. This is very unfortunate, since weight is a critical factor in whorl performance. What is needed to effectively compare whorls and evaluate their performance potential is a measure which combines weight and diameter. A measure like this would enable researchers to easily integrate new data as it becomes available and to begin to study the functional aspects of whorl shaping variation in terms of a fixed standard.

In Chapter 3 it was suggested that the Moment of Inertia might be applied in the functional analysis of spinning tools as an indication of the relative efficiency of a spindle in terms of its ability to maintain motion for longer duration. Since the Moment of Inertia combines the diameter and weight of a whorl into one number we can compare groups of whorls with varying shape characteristics and quickly note the effect of altering the shape of the basic disc blank. Inertia is easily calculated for discs of uniform thickness, and can also be calculated for discs of varying thickness. All whorls in class 112 are flat, and therefore the calculation of their Inertia is a straightforward application of the formula given in Chapter 3 ($I=1/2MR^2$). Tables 6, 7, and 8 shows the results of this calculation for each material type..

Table 6- Bone whorls, class B112,arranged by Moment of Inertia, highest to lowest.

Artifact	Diameter (cm)	Weight (grams)	Moment of Inertia
80	22.00	101.70	6,153
52	8.75	79.11	757
93	7.00	45.50	279
55	5.94	42.71	188
53	6.25	32.55	159
75	7.00	12.10	74

Table 7- Stone whorls, class S112, arranged by Moment of Inertia, highest to lowest.

Artifact	Diameter (cm)	Weight (grams)	Moment of Inertia
1	11.00	320.35	4,863
76	9.00	147.70	1,495
91	5.25	33.00	115

Table 8- Wooden whorls, class W112, arranged by Moment of Inertia, highest to lowest.

Artifact	Diameter (cm)	Weight (grams)	Moment of Inertia
84	27.00	180.84	16,479
89	13.00	150.40	3,177
56	10.00	19.52	98

Moment of Inertia can be calculated for whorls which are not flat but which have a regularly varying thickness. In order to account for varying thickness a slightly different formula is used: $I = 3/10\ MR^2\ \{(4t_o + t_i) / (2t_o + t_i)\}$, where t_o is the edge thickness and t_i is the thickness at the hole. This formula is not completely accurate because it does not account for curvature, but for our purposes this difference would be negligible. Using the variant formula we can calculate Moment of Inertia for all whorl classes with flat bottom profiles, convex top profiles and no neck (class 312). We can also use it to calculate Inertia for class 322, since it contains the same basic shapes as class 312. Table 9 and 10 show the results of this calculation for each material type with members in this shape class.

Table 9- Moment of Inertia for wooden whorls, class W312.

Artifact	Class	Diameter (cm)	Weight (grams)	Moment of Inertia
85	W312	32.50	115.70	12,832
68	W312	23.00	178.19	8,979
73	W312	24.00	141.00	8,101
12	W312	21.00	162.90	7,543
74	W312	22.00	148.10	7,526
64	W312	23.00	129.95	7,218
61	W312	23.00	123.39	6,854
71	W312	19.00	140.40	6,082
14	W312	21.50	102.40	4,580
49	W312	20.00	101.41	3,651

Table 10- Moment of Inertia for bone whorls, classes B312 and B322

Artifact	Class	Diameter (cm)	Weight (grams)	Moment of Inertia
81	B312	10.00	91.30	959
92	B312	7.50	32.90	208
57	B332	5.63	46.02	165

To illustrate the potential usefulness of the Moment of Inertia as an indicator of the effect of redistributing weight on the whorl, we can recalculate the Inertia for shape classes 312 and 322 to simulate what the whorl's Moment of Inertia would be if it were a flat disc, rather than a disc with more weight in the center, and the difference between this measurement and the figures given in Tables 9 and 10 represent the change produced by shaping (redistributing weight) for wooden and bone whorls, respectively. Since the the whorl is treated as if it were a flat disc, we can use the formula $I=1/2MR^2$. Tables 11 and 12 show the results of this new calculation compared to the original figures for classes W312, B312 and B322. Redistributing the weight through shaping has had the effect of lowering the Moment of Inertia of all these whorls.

Table -11 Comparison of actual Moment of Inertia with Moment of Inertia of comparable flat disc for wooden whorls, class W312.

Artifact	Moment of Inertia	Comparable Flat Disc	Actual / Comparable
85	12,832	15,276	0.84
68	8,979	11,784	0.76
73	8,101	10,152	0.79
12	7,543	8,980	0.84
74	7,526	8,960	0.84
64	7,218	8,594	0.84
61	6,854	8,160	0.84
71	6,082	6,336	0.96
14	4,580	5,917	0.77
49	3,651	5,070	0.72

Table 12- Comparison of actual Moment of Inertia with Moment of Inertia for comparable flat disc for bone whorls classes B312 and B322.

Artifact	Moment of Inertia	Comparable Flat Disc	Actual/ Comparable
81	959	1,141	0.84
92	208	231	0.90
57	165	182	0.91

In order to fully apply the physical principle of Moment of Inertia to the question of how shaping techniques affect weight distribution and performance of spindle whorls it would be necessary to calculate formulae for all the shape variants in the sample as well as identify materials with more accuracy. It might be found, for example, that wooden whorls with a certain shape characteristics were typically made from alder, while maple whorls required somewhat different shape characteristics to maximize efficiency.

My purpose in introducing Inertia in this study is to suggest it as an alternative measure by which we could look at whorl performance and shaping and consider both the critical factors of weight and diameter. The short example given shows the potential usefulness of the Moment of Inertia as an independent index of spindle whorl performance in yarn production and of the effects of modifying the shape of the whorl to alter its performance.

CHAPTER 6- CONCLUSIONS

One of my original motives for undertaking this research was to make more detailed information about Northwest Coast spindle whorls available for research purposes. Little published information is to be found, and details are often sketchy or absent. I searched the literature carefully and made several ventures into the field to collect detailed data on one hundred whorls. This information is contained in summary in Appendix C of this study, along with information about whorls I was not able to analyse personally and where they may be found.

My second goal was to try to determine what functional reasons might underlie the variation in form I noted among Northwest Coast spindle whorls. I used a paradigmatic, or dimensional classification system to look at how these variations occur in combination and to analyse metric data in terms of shape. Dimensional classification is particularly useful for this type of analysis, as each dimension has equal weight in the analysis and all possible combinations of attributes are allowed.

The classification system I developed had three dimensions: top profile in plan view, bottom profile in plan view, and presence or absence of a raised collar on the top surface of the whorl. Sixty-six of the hundred whorls in my sample had complete enough data to be classifiable (the remainder were either unavailable to me for analysis when I was in the field or were recorded from information in the literature). These sixty-six whorls filled eight of the possible classes in the classification. Each class was divided by material type.

Spindle whorls were very specially made tools which were used for one task: to act as a flywheel and prolong spin in a spindle to aid in the spinning of yarn. They were made by a reductive process, and any modification of shape from that of a thin, regularly shaped, flat disc was done deliberately. As I discussed in Chapter 3, spindles are made to produce a specific range of yarn sizes from a specific type of fiber. Whorl weight plays an important part in the efficiency of the tool for the purpose intended. A heavy spindle is well suited to spinning thick yarn from heavy, long staple fibers. How the spindle is held and used determined to some extent the minimum and maximum spindle weights that will be effective.

Diameter is also important. The greater the diameter of the spindle the slower and longer it spins. The smaller it is the faster it spins, but for a shorter time. A fast spin is more conducive to spinning light thin yarn, while a slower spin is necessary for spinning a heavier yarn.

My original question was whether or not the variation apparent in spindle whorls had a functional basis. I showed in Chapter 5 that edge thinning is a very common modification in the sample, particularly in wooden whorls. I demonstrated how edge thinning could be used to maintain desired whorl diameter while manipulating weight distribution on the whorl. I also showed that whorls in the sample with a raised collar seem to be thinner than whorls without the collar. This supports the idea that a raised collar may increase whorl stability on the shaft while allowing a thinner whorl overall.

Previous research has used diameter as the standard of description for Northwest Coast spindle whorls. Diameter ranges are used to define spindle use and to some extent to assign whorls to particular geographic areas or ethnic groups. In Chapter 5 I point out the deficiencies of diameter alone as an indicator of the potential use of a spindle for yarn production. Weight and diameter together offer much better information about how the spindle might have been used. The physical principle of Moment of Inertia is proposed as a potentially useful performance index of whorls, allowing comparisons to be made in terms of the effect of variation in shape and weight distribution for whorls of similar material types. I show that whorls in the sample exhibit no modalities in diameter distribution, and therefore the arbitrary breaks in existing whorl classification systems are suspect.

Suggestions for further research include following up the idea of using Moment of Inertia as an index for purposes of comparing whorls of different shapes and materials. Another avenue of research would be to make a study of the spindle shafts associated with spindle whorls. Many of the whorls I analysed had shafts, separately catalogued. It may be that spindle shaft length in combination with whorl diameter would prove a more reliable way to correlate artifacts with the functions or style of use described in ethnohistoric accounts. These approaches, used in combination, would create a bridge between the existing literature and the physical evidence of the artifacts.

The incredible variety exhibited in the whorls in this sample is a testimony to the extensive development of spinning technology and skillful use of materials by Northwest Coast artisans. Whether textile arts spread from the Southwest or the Great Plains to the Northwest Coast, or whether the Chilkat and Salish textile traditions developed independently, it is evident that this industry was brought to a refined stage by the time Europeans arrived. A quote from Peter Collingwood (1987) sums up my experience of working with these artifacts.

> Studying traditional objects in detail, not just admiring them, brings to light the ingenious ways in which their makers exploited the possibilities and overcame the limitations of both material and structure. ...Looking closely, I feel I have made journeys into the minds of these skilled anonymous makers; journeys which have greatly increased my respect for them. (Collingwood 1987:7)

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APPENDIX A:

FIELD DATA RECORDING FORM AND KEY

Key

Specimen number- Specimens are numbered consecutively, beginning with 1.

Site name- Popular name, if .any.

Site #- Smithsonian (U.S.) or Borden (Canada) number.

Date collected- Date of collection or excavation.

Who collected- Individual, institutuion excavating, private donor, finder.

Where housed- Permanent location of artifact.

Catalogue number- Refers to artifact number used by curators of artifact.

Citation- Reference from which artifact was found, other references pertinent in the literature.

Date assigned- Date given artifact by collector.

Method of dating- How date was determined.

What item was called- What the person collecting it thought it was.

Ethnic affiliation- Possible ethnic affiliation(s).

Archaeological context- How artifact was situated within the site.

Diameter- Maximum diameter, in cm.

Thickness- Greatest thickness in plan view. If varying thickness, express as "xxcm-xxcm".

Overall shape-

1. Round 2. Rounded square 3. Ovate 4. Other

Material- Name of material, eg wood, stone, bone.

Profile (plan view)- Draw plan view sketch.

Completeness- 100% means no missing pieces; partial specimens estimated completeness. 10% or less designates fragments, 99% means complete with minor chipping or edge damage.

Perforation- check yes or no, partial or complete.

Shape of perforation-

1. Straight 2. Biconical 3. Conical (specify orientation)

Decoration- Check one side or two sides. If no decoration, indicate by "-" in both spaces. If decorated, check geometric, zoomorphic, or both.

Narrative description- Describe overall shape, material, etc.; manufacturing details; wear from manufacture or use; breakage/repair; rounding or other marks. Describe ornamentation. List other features.

Bottom space on page 2 is for a measured drawing of the artifact. Include views of both faces and plan view.

SPECIMEN # ______

Site Name ______________ Site # ______________

Location of site

Date collected ______________ Who collected ______________

Where housed ______________ Catalogue # ______________

Citation

Date assigned ______________ Method of dating ______________

What item was called ______________ Ethnic affiliation ______________

Archaeological context:

Features-

Components-

Levels-

Other-

Diameter (mm) ________ Thickness (cm) ________ Weight (gm) ________

Overall Shape ______________ Material ______________

Profile (plan view) ______________ Completeness (%) ________

Perforated ______________ Shape of Perforation ______________

complete ______ incomplete ______

Decoration:

one side ______ two sides ______

geometric ______ zoomorphic ______

-1-

SPECIMEN # ____

Narrative Description

Overall shape, material, etc.-

Manufacture/wear/breakage/rounding-

Ornamentation-

Other-

-2-

APPENDIX B:

DATA SHEETS

Coding Sheet Key

Columns 1-10: Metric Data

1: Specimen #- All specimens have been assigned a number for the purpose of this research and all data has been keyed to this reference number.

2: Edge Thickness- Thickness at outer edge of whorl.

3: Thickness at Hole- Thickness measured on inside of central perforation.

4: Diameter-Maximum diameter measured across the top of the whorl. In the case of varying diameter, the largest figure is used.

5: Maximum Height- Measured from top of whorl at the center through the hole to the top of the surface upon whic whorl rests.

6: Weight- Given in grams. In the case of partial whorl weight is estimated for whole whorl based on the percentage of completeness.

7: Hole Diameter- Measured across opening from the top. In the case of asymmetrical hole, the greatest measurement is given. In cases where the whorl was not available for handling but the circumference was known and a photograph was available this measurement was calculated mathematically.

8: Neck Thickness- Measured at top of whorl.from edge of hole to edge of the flattened surface defining the neck. This measurement was also in some cases mathematically derived from photograghs.

9: Collar Height- Distance from top of whorl proper to top edge of collar.

10: Rim Height- Measured between top and bottom edges of the rim.

Columns 11-16: Qualitative Data

11: Material Type-
- 1-Wood
- 2-Stone
- 3-Bone
- 4-Antler

12: Date-
- 1-Historic
- 2-Archaeological

13: Location
- 1-Washington State (includes San Juan Islands)
- 2-Mainland British Columbia
- 3-Vancouver Island (or any other B.C. island)

14: Shape- Overall shape of the whorl as viewed from the top.
- 1-Round
- 2-Square with rounded corners
- 3-Ovate

15: Shape of Hole-
- 1-Round
- 2-Square
- 3-Ovate

16: Type of Perforation
- 1-Straight
- 2-Conical with wideness toward top of whorl
- 3-Conical with wideness toward bottom of whorl
- 4-Biconical

Columns 17-21: Decoration

17: Location of Decoration-
1-None
2-One side
3-Two sides
4-Edge

18: Style of Decoration
1-Plain
2-Geometric
3-Zoomorphic
4-Geometric and Zoomorphic

19: How Decorated- Refers to the way design was applied.
1-Carved
2-Painted
3-Painted and Carved
4-None
5-Other

Columns 20-25: Wear and Breakage

20: Completeness- Expressed as a percent.
100%-No visible pieces missing
99%-Complete except for chipping at the edges (considered complete for the purpose of calculating weight)
Other percentages estimated.

21: Edge Wear-
0-None
1-Chipping
2-Checking

22: Surface Wear-
0-None
1-Polish near center of top surface
2-Polish near edge of top surface
3-Overall wear of top surface (paint worn off, patina of some sort evident)
4-Polish near center of bottom surface
5-Polish near edge ot bottom surface
6-Overall wear of bottom surface (paint worn off, patina of some sort evident)

23: Breakage-
0-None
1-Partial split along grainline
2-Fully split along grainline
3-Broken across grain
4-Near hole

24: Degree of Warping-
1-None
2-Minor
3-Moderate
4-Heavy

25: Direction of Warping
1-Along grainline
2-Across grainline

Columns 26-28: Other Information

26: Collector-
1-Newcombe
2-Emmons
3-Other

27: Estimated- "x" in this column indicates some measurement estimated.

28: Class

Atrifact #	edge thkns	thkns at hole	midpoint thkns	diameter	max ht	weight	hole diam	neck thkns	collar ht	rim ht
1	1.00	1.00	2.00	8.00	1.00	320.35	1.50			
2				11.25			1.50	0.32		
3	2.50	2.50	2.50	7.10	2.50		2.90			
4	0.35	0.35	0.35	4.10	0.35		0.70			
5	2.00			11.50			1.80			
6	0.50					23.10				
7										
8				20.00			2.30			
9	0.50	1.75	1.13	26.00	1.75	154.70	1.50	1.00	0.25	
10				23.13			1.76	0.77		
11				21.25			1.55	0.79		
12	0.50	1.50	1.00	21.00	1.50	162.90	2.00			
13				20.00			1.55	0.53		
14	0.20	1.00	0.60	21.50	1.00	102.40	2.00			
15				19.00			1.75			
16				20.63			1.70			
17				18.75			1.87	0.94		
18				19.38			1.64	0.17		
19				22.50			1.60	0.15		
20										
21				23.75			1.77	0.50		
22										
23										
24										
25	0.50	2.00	1.25	23.00	2.25	130.20	1.50	0.50	0.50	
26	see # 67									
27	see data sheets-Koeye River find									
28				21.70	1.70		2.14	0.72		
29				21.00			2.04			

Atrifact #	edge thkns	thkns at hole	midpoint thkns	diameter	max ht	weight	hole diam	neck thkns	collar ht	rim ht
30				13.50						
31				20.63			1.32			
32				24.69			2.41	1.74		
33				18.75			1.66	0.42		
34	1.00	1.00	1.00	16.00	1.00		2.00			
35										
36										
37										
38										
39	0.50	1.75	1.13	19.00	1.75	105.50	1.80	0.25		
40										
41										
42	0.25	1.50	0.88	20.00	1.50	91.30	1.75	0.50	0.25	
43										
44	0.25	1.50	0.88	23.50	2.00	137.36	2.00	0.25	0.25	
45				19.38						
46				18.75						
47				24.38						
48				18.75						
49	0.25	2.00	1.30	20.00	2.00	101.41	2.00	0.20		
50	0.25	1.50	0.88	15.00	1.75	38.24	1.00	0.50	0.50	
51	0.25	1.75	1.00	15.00	1.75	78.25	1.25	0.50	0.50	
52	0.47	0.47	0.47	8.75	0.47	79.11	0.31			
53	0.47	0.47	0.47	6.25	0.47	32.55	0.31			
54	1.50	2.00	1.75	21.25	2.50	136.43	1.75	0.25		
55	0.78	0.78	0.78	5.94	0.78	42.71	1.10			
56	0.40	0.40	0.40	10.00	0.40	19.52	1.50			
57	0.50	1.00	0.75	5.63	1.00	46.02	1.00			
58	1.00	1.50	1.25	15.50	2.00	89.44	1.50			
59	0.75	2.00	1.38	21.00	2.50	155.25	2.00	3.00	0.25	

Atrifact #	edge thkns	thkns at hole	midpoint thkns	diameter	max ht	weight	hole diam	neck thkns	collar ht	rim ht
60	0.50	1.50	1.00	21.00	2.00	132.34	1.50	0.75	0.25	
61	0.50	1.50	1.00	23.00	1.50	123.39	2.25	0.50		
62	0.50	1.25	0.88	22.50	2.00	128.75	2.50	0.50	0.25	
63	0.25	1.75	0.25	21.00	2.50	115.60	2.50	0.25	1.50	
64	0.50	1.50	1.00	23.00	1.50	129.95	2.00	0.50		
65	0.50	3.00	1.75	24.00	3.50	221.20	1.75	0.75	0.50	
66	0.50	2.00	1.13	20.00	2.25	81.50	0.85			
67	0.25	2.00	1.13	18.00	2.00	101.60	1.75	0.25	0.50	0.20
68	0.50	2.75	1.63	23.00	2.75	178.19	1.75	0.75		
69	0.25	2.25	1.38	20.00	2.50	99.20	1.50	0.25		
70	0.50	1.00	0.88	25.00	2.50	166.00	2.50	0.75		
71	0.75	2.00	1.25	19.00	1.00	140.40	1.75			
72	0.50	2.00	1.25	24.50	2.00	134.63	2.00	1.00	0.50	
73	0.50	2.00	1.25	24.00	2.00	141.00	1.75			
74	0.75	1.50	0.63	22.00	1.50	148.10	2.00			
75	0.25	0.25	0.25	7.00	0.25	12.10	0.75			
76	1.00	1.00	1.00	9.00	1.00	147.70	1.00			
77										
78				21.88			2.43			
79										
80	0.50	0.50	0.50	22.00	0.50	101.70	1.50			
81	0.50	1.50	1.00	10.00	1.50	91.30	1.50			
82	0.25	1.75	1.00	21.50	2.25	122.10	2.75	0.25		
83	0.50	3.00	1.75	40.00	4.30	294.70	1.75	0.50		
84	1.50	1.50	1.50	27.00	1.50	180.78	3.00			
85	0.50	1.50	1.00	32.50	1.60	115.70	2.25	0.75		
86	0.25	1.50	0.88	32.00	2.00	112.11	2.50			
87	0.25	1.00	0.63	23.00	1.80	129.10	1.75			
88	0.25	1.00	0.63	19.00	1.25	93.60	1.75			

Atrifact #	edge thkns	thkns at hole	midpoint thkns	diameter	max ht	weight	hole diam	neck thkns	collar ht	rim ht
89	1.00	1.00	1.00	13.00	1.00	150.40	2.25			
90	0.50	2.00	1.25	23.00	2.00	121.50	2.75	1.75	0.25	
91	0.50	0.50	0.50	5.25	0.50	33.30	1.00			
92	0.25	0.50	0.38	7.50	0.50	32.90	1.25			
93	0.75	0.75	0.75	7.00	0.75	45.50	1.50			
94	0.50	2.00	1.25	21.00	2.60	63.30	2.00	1.00	1.25	
95	0.25	2.00	1.13	22.00	3.00	134.50	2.00			
96	0.25	1.00	0.25	15.25	1.00	61.17	1.00	3.50	0.25	
97	0.50	1.50	1.00	11.50	1.50	31.10	1.50			
98	0.50	2.00	1.25	23.00	2.50	138.90	2.25	3.00	1.00	
99	0.50	2.00	1.25	14.00	2.00	55.80	1.50			
100	0.50	1.50	1.00	19.00	1.50		2.25			

Atrifact #	mat type	Date	Loc	Shape	Hole Shape	Perf Type	Loc of dec	Style dec	How dec	completeness	Edge wear	Surface wear
1	2	2	1	1			1	2	1	20	1	0
2	2	2	2	1	1	1	3	4	1	100		
3	2	2	3	1	1	4	1	1	4	90	1	0
4	2	2	3	1	1	4	1	1	4	80	1	0
5	3	2	3	1	1	1	2	2	1	75	1	
6	2	2	1				3	3	1	25		
7	3											
8	1	1	2	1	1	1	2	4	2	100		
9	1	1	3	1	1	1	2	2	3	100	0	3
10	1	1	3	1	1	1	2	2	1	100		
11	1	1	3	2	1	1	2	3	1	100	0	
12	1	1		2	1	1	2	3	3	100	0	1
13	1	1	3	2	1	1	2	3	2	100		
14	1	1	3	1	1	1	2	3	1	100	0	0
15	1	1	2	2	1	1	2	3	1	100		
16	1	1	3	1	1	1	2	3	3	100		
17	1	1	3	1	1	1	2	3	1	99	1	
18	1	1		1	1	1	2	3	1	100		
19	1	1		1	1	1	2	3	1	99		
20	1		2	1	1	1	2	3	1	100		
21	1	1		1	1	1	2	2	1	100		
22	1	1	3	1	1	1	2	3	1	100		
23	1			1	1	1	2	3	1	100		
24	1			1	1	1	2	3	1	100		
25	1	1	3	1	1	1	2	3	1	100	0	0
26												
27												
28	1	1	3	1	1	1	2	3	1	100		
29	1	1		1	1	1	2	3	1	99		

Atrifact #	mat type	Date	Loc	Shape	Hole Shape	Perf Type	Loc of dec	Style dec	How dec	completeness	Edge wear	Surface wear
30	1	1	1	1	1	1	1	0	4	100		
31	1			1	1	1	2	3	1	100		
32	1	1	3	1	1	1	2	3	1	100		
33	1	1	3	1	1	1	2	4	1	100		
34	3	2		2	1	1	3	2	1	80	1	
35	4		2	2	1	1	1	1	4	100		
36	3		2	2	1	1	1	1	4	99	1	
37	3		3	1	1	1				99	1	
38	3		2	1	1	1				100		
39	1	1	3	2	1	1	2	2	1	100	0	1
40	1			2	1	1	2	2	1	100		
41	1			2	1	1	2	2	1	90	1	
42	1	1	3	3	1	1	2	3	1	100	0	0
43	1			1	1	1	2	3	1	100		
44	1	1	3	1	1	1	2	3	1	100	0	3
45	1	1	2	1	1	1	2	3	1	100		
46	1	1	3	1	1	1	2	3	1	100		
47	1	1	3	2	1	1	2	3	1	100		
48	1	1	3	2	1	1	2	3	1	100		
49	1	1	3	2	1	1	2	3	1	100	0	0
50	1	1	3	1	1	1	2	3	5	100	1	0
51	1	1	3	2	1	1	2	3	3	95	1	0
52	3	1	3	2	1	1	1	1	4	99	1	0
53	3			1	1	1	1	1	4	100	0	0
54	1		3	1	1	1	1	1	4	90	1	0
55	3	1	2	2	1	1	1	1	4	100	0	0
56	1	1	3	1	1	1	1	1	4	99	0	0
57	3			1	1	1	1	1	4	100	0	0
58	1			2	1	1	2	3	3	100	0	0
59	1			1	3	1	2	4	3	100	0	0

Atrifact #	mat type	Date	Loc	Shape	Hole Shape	Perf Type	Loc of dec	Style dec	How dec	completeness	Edge wear	Surface wear
60	1			2	1	1	2	3	1	100	0	0
61	1	1		1	1	1	2	2	3	100	0	0
62	1	1	3	2	1	1	2	2	3	100	0	0
63	1	1		2	1	1	1	1	4	100	0	0
64	1	1	3	1	1	1	2	2	3	100	0	0
65	1	1	3	1	1	1	2	2	2	100	0	0
66	1	1		1	1	1	2	2	3	100	0	0
67	1	1	2	2	1	1	2	2	3	99	0	0
68	1	1		3	1	1	2	2	2	100	0	1
69	1	1	2	2	1	1	1	1	4	100	0	0
70	1	1		1	1	1	1	1	4	90	1	0
71	1	1		1	1	1	2	3	1	100	0	0
72	1	1	3	1	1	1	4	2	1	100	0	0
73	1	1	3	1	1	1	2	2	3	100	0	0
74	1	1		2	1	1	2	3	1	100	0	0
75	3	2	3	3	1	4	1	1	4	100	0	0
76	2	2	3	3	1	1	2	1	4	100	1	0
77	1			2	1	1	2	2	1	100		
78	1	1	3	1	1	1	2	2	1	100		
79	1	1		1	1	1	2	3	1	100		
80	3	1	1	2	1	1	2	2	1	100	1	0
81	3	2	3	1	1	1	1	1	4	100	1	0
82	1	1	2	1	3	1	2	1	2	100	0	1
83	1	1	2	1	1	1	1	1	4	100	0	0
84	1	1	3	1	1	1	1	1	4	100	0	0
85	1	1	3	2	1	1	2	2	3	100	0	0
86	1			1	1	1	2	1	2	90	1	1
87	1	1	3	1	1	1	2	1	2	100	0	0
88	1	1	3	2	1	1	2	2	1	100	0	0

Atrifact #	mat type	Date	Loc	Shape	Hole Shape	Perf Type	Loc of dec	Style dec	How dec	completeness	Edge wear	Surface wear
89	1	1		1	1	1	1	1	4	100	0	0
90	1	1	3	1	1	1	1	1	3	100	0	1
91	2	1	3	1	1	1	1	1	4	100	0	0
92	3	1	3	1	1	1	1	1	4	100	0	0
93	3	1	3	2	1	1	1	1	4	100	0	0
94	1	1		1	1	1	1	1	4	60	1	0
95	1	1	1	1	1	1	1	1	4	99	1	0
96	1	1	1	1	1	1	2	2	3	60	0	0
97	1	1	1	1	1	1	2	1	2	100	0	0
98	1	1	3	1	1	1	2	2	3	100	0	0
99	1	1	1	1	1	1	1	1	4	100	0	0
100	1	1		1	1	1	2	2	1	100	0	0

Artifact #	Breakage	Degree warping	Dir of warp	Collector	Estimated	Class
1	5	1	0	3	x	112
2				3	x	112
3	0	1	0	3	x	112
4				3		112
5				3		112
6				3		
7						
8				1	x	
9	0	1	0	1		311
10		1	0	1	x	
11				1	x	
12	0	0	0	3		312
13				3	x	
14	0	0	0	1		312
15				3	x	
16				3	x	
17					x	
18					x	
19	2			1	x	
20						
21				1	x	
22						
23				3		
24						
25	0	1	0	3		321
26						
27						
28				3	x	
29	2			3	x	

Atrifact #	Breakage	Degree warping	Dir of warp	Collector	Estimated	Class
30				3		
31					x	
32				2	x	
33				2	x	
34	2				x	112
35				3		
36						
37	1					
38						
39	0			1		311
40						
41	2					
42	0	3	1	1		311
43						
44	2	1	1	3		321
45				1		
46				1		
47				1		
48				1		
49	0	1	0	1		312
50	0	1	0	3		321
51	1	1	0	3		311
52	0	1	0			112
53	0	1	0			112
54	2	1	0			322
55	0	2	1	3		112
56	1	1	0	3		112
57	0	1	0		x	332
58	0	1	0			322
59	0	1	0			321

Atrifact #	Breakage	Degree warping	Dir of warp	Collector	Estimated	Class
60	0	1	0			321
61	0	1	0	1		312
62	0	1	0	1		321
63	2	1	0	1		321
64	0	1	0	1		312
65	0	4	1	1		321
66	1	1	1			322
67	4	3	1	1		311
68	0	1	0	1		312
69	0	1	0	1		322
70	2	1	0	1		222
71	0	1	0			312
72	0	1	0	3		311
73	0	1	0	1		312
74	0	1	0	1		312
75	2	1	0	3		112
76	0	1	0	3		112
77						
78				1	x	
79						
80	0	1	0	3		112
81	1	1	0	3		312
82	0	1	0	3		322
83	0	1	0	3		222
84	0	1	0	3		112
85	1	1	0	2		312
86	2	1	0			322
87	0	1	0	3		322
88	0	1	0	2		322

Atrifact #	Breakage	Degree warping	Dir of warp	Collector	Estimated	Class
89	0	3	1	3		112
90	0	1	0	2		311
91	0	1	0	3		112
92	0	1	0	2		332
93	0	1	0	2		112
94	2	1	0	3		321
95	0	1	0	3		322
96	2	1	0	3		311
97	0	1	0	3		332
98	0	1	0	3		321
99	0	1	0	3		211
100	1	1	0			312

APPENDIX C:

SUMMARY DESCRIPTIONS OF ARTIFACTS

This appendix contains the location and catalogue number of each specimen, as well as its age, who collected it and any references to it from the literature. Metric data and decorative information are omitted here, but are available on the data coding sheets in Appendix B. Abbreviations used in this appendix are as follows.

BCPM- British Columbia Royal Provincial Museum, Victoria, B.C.
Burke Museum- Thomas Burke Memorial Washington State Museum, Seattle, Washington
UBC Museum- Museum of Anthropology at the University of British Columbia, Vancouver, B.C.
CNM- Canadian National Museum, Ottowa.
SFU- Simon Fraser University, Burnaby, B.C.
PAM- Portland Art Museum, Portland, Oregon

The data in this appendix is compiled from my field notes, which were taken for the most part from collections records of the institutions holding the artifacts. This information is often vague, particularly with reference to dates, places of collection, and ethnic affiliations. For example, the term "Cowichan" is used variously to denote a location on Vancouver Island, an ethnic group, or an artifact collected from Cowichan Indians living on the mainland of B.C. Age of artifacts is often confused with date collected, or date accessioned into the collection of the institution. Abbreviations are often used with confusing effect, such as "C. Salish", denoting either Central or Coast Salish. Where possible I have noted specifically which useage is in effect for each artifact, although some information remains unclear at this time. . For location data I used

"B.C." to denote mainland B.C. and "Vancouver Island " for locations anywhere on the Island. U.S. sites are identified by state name.

Artifacts Analysed

Number 1
Location WWU
Catalogue number 439
Age ca. 1,000 B.P
Ethnic affiliation Nooksack?/Coast Salish
Collector Dr. Garland F. Grabert, WWU
Where collected Site 45-WH-34, near Ferndale, Washington
References Grabert (1983)
Comments Fragment of a whorl, broken into seven pieces and reassembled.

Number 6
Location Burke Museum
Catalogue number SJ25/118,137,179. National Park Service number is SAJH 136033, 136037, 136085
Age ca. 1000 A.D.
Ethnic affiliation Central Coast Salish
Collector Treganza
Where collected Site 45-SJ-25, The Garrison Site, on San Juan Island, Washington
References Daugherty and Friedman (1976); Thompson (1978)(date for site).
Comments This is probably not a spindle whorl, so I didn't include it in the analysis in the end. It is most likely part of a slate plaque.

Number 9
Location BCPM
Catalogue number 10354a
Age Collected 1884
Ethnic affiliation Salish
Collector C.F. Newcombe
Where collected Nanaimo, B.C.
References Inverarity (1950:#28); Kew (1979:plate 2).

Number 12
Location BCPM
Catalogue number 2906
Age Historic
Ethnic Affiliation Salish
Collector Edgar Dewdney collection
Where Collected ?
References Inverarity (1950:#31), Kew (1979:plate 6).

Number 14
Location BCPM
Catalogue number 2454
Age Collected 1912
Ethnic Affiliation Salish (Suttles 1976) or Cowichan
Collector C.F. Newcombe
Where Collected Cowichan, B.C.
References Inverarity (1950:#33); Borden (1976);Suttles (1976); Kew (1979:plate 13)

Number 25
Location BCPM
Catalogue number 10504
Age Historic
Ethnic Affiliation Salish/Cowichan
Collector C.F. Newcombe
Where Collected Cowichan, B.C.
References Suttles (1976); Kew (1979:plate 8).

Number 39
Location BCPM
Catalogue number 10693
Age Historic
Ethnic Affiliation Cowichan/Coast Salish
Collector C.F. Newcombe
Where Collected ?
References Kew (1979:plate 1)

Number 42
Location BCPM
Catalogue number 10271a
Age Historic
Ethnic Affiliation Cowichan
Collector C.F. Newcombe
Where Collected ?
References Kew (1979:plate 9)

Number 44
Location UBC Museum
Catalogue number A4323
Age Historic
Ethnic Affiliation Coast Salish/Cowichan
Collector Mrs. F.L. Beecher
Where Collected ?
References Kew (1979:plate 14)

Number 49
Location BCPM
Catalogue number 10270
Age Historic
Ethnic Affiliation Cowichan
Collector C.F. Newcombe
Where Collected ?
References Kew (1979:plate 7)

Number 50
Location UBC Museum
Catalogue number A17028 A-B
Age Collected 1893
Ethnic Affiliation Salish
Collector Dr. G.H. Raley
Where Collected Koksilah, Vancouver Island

Number 51
Location UBC Museum
Catalogue number A8079
Age Historic
Ethnic Affiliation Coast Salish/Cowichan
Collector Edith Bevan Cross
Where Collected Westholme, Vancouver Island

Number 52
Location UBC Museum
Catalogue number A1792
Age Historic
Ethnic Affiliation ?
Collector ?
Where Collected Vancouver Island (?)

Number 53
Location UBC Museum
Catalogue number A2290
Age Historic
Ethnic Affiliation ?
Collector ?
Where Collected ?

Number 54
Location UBC Museum
Catalogue number A1796
Age Historic
Ethnic Affiliation Kwagiutl
Collector ?
Where Collected Shushartie Bay, Vancouver Island

Number 55
Location UBC Nuseum
Catalogue number A8389
Age Collected 1870 (?)
Ethnic Affiliation Tsaxxis (Kwakwaka'wakw)
Collector Cadwallader Family, Prince Rupert
Where Collected Fort Rupert, B.C.

Number 56
Location UBC Museum
Catalogue number A4368
Age Collected 1893 (?)
Ethnic Affiliation Coast Salish/Cowichan
Collector Dr. G.H. Riley
Where Collected Koksilah, Vancouver Island

Number 57
Location UBC Museum
Catalogue number A2291
Age Historic
Ethnic Affiliation Coast Salish
Collector ?
Where Collected ?

Number 58
Location CNM (UBC Museum has it at present)
Catalogue number VIIG3
Age Historic
Ethnic Affiliation ?
Collector ?
Where Collected ?

Number 59
Location CNM (UBC Museum has it at present)
Catalogue number VIIG5
Age Historic
Ethnic Affiliation ?
Collector ?
Where Collected ?

Number 60
Location CNM (UBC Museum has it at present)
Catalogue number VIIG8
Age Historic
Ethnic Affiliation ?
Collector ?
Where Collected ?

Number 61
Location BCPM
Catalogue number 10781
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected ?

Number 62
Location BCPM
Catalogue number 10353
Age Historic
Ethnic Affiliation Cowichan (?)
Collector C.F. Newcombe
Where Collected ?

Number 63
Location BCPM
Catalogue number 9659
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected ?

Number 64
Location BCPM
Catalogue number 10115
Age Collected 1917
Ethnic Affiliation Union Bay Saanich
Collector C.F. Newcombe
Where Collected Union Bay, Tsekum Reserve, Vancouver Island

Number 65
Location BCPM
Catalogue number 10354
Age Historic
Ethnic Affiliation Cowichan
Collector C.F. Newcombe
Where Collected ?

Number 66
Location BCPM
Catalogue number 16521
Age Made in 1979
Ethnic Affiliation ?
Collector Made by Rod Modeste
Where Collected N.A.
References none
Comments This whorl is a copy of an old whorl housed at the BCPM, catalogue number 10692.

Number 67
Location BCPM
Catalogue number 9657
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected Port Hammond, B.C.

Number 68
Location BCPM
Catalogue number 11127
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected ?

Number 69
Location BCPM
Catalogue number 2455
Age Collected 1911
Ethnic Affiliation Salishan (Sul-sultin?)
Collector C.F. Newcombe
Where Collected Lower Fraser, B.C.

Number 70
Location BCPM
Catalogue number 11126
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected ?

Number 71
Location BCPM
Catalogue number 14986a
Age Made in 1976
Ethnic Affiliation Coast Salish
Collector Made by Charles Elliott
Where Collected N.A.

Number 72
Location BCPM
Catalogue number 13376
Age Collected in 1919
Ethnic Affiliation Coast Salish
Collector Pitt collection
Where Collected Tsartlip (Saanichton), Vancouver Island

Number 73
Location BCPM
Catalogue number 10139
Age Historic
Ethnic Affiliation Coast Salish/Chemainus
Collector Humphrey collection/ C.F. Newcombe
Where Collected ?

Number 74
Location BCPM
Catalogue Number 11425
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected ?

Number 75
Location BCPM
Catalogue Number DcRv1
Age Archaeological
Ethnic Affiliation Coast Salish
Collector ?
Where Collected Site DcRv1, Peddar Bay, Vancouver Island

Number 76
Location BCPM
Catalogue Number DeRv-y
Age Archaeological
Ethnic Affiliation Cowichan (Halkomelem speakers)
Collector ?
Where Collected Duncan area, Vancouver Island

Number 80
Location Burke Museum
Catalogue Number 1965-8
Age Collected Sept. 1954
Ethnic Affiliation Makah?
Collector Douglas McCallum
Where Collected Cape Alava, Washington. (Found along the beach trail to the Ozette site.)

Number 81
Location Burke Museum
Catalogue Number 47/1j; National Park Service number 132696, permanent location 33/02/A13
Age ?
Ethnic Affiliation Coast Salish
Collector Arden King
Where Collected Cattle Point site on San Juan Island, Washington.
References King (1950); Thompson (1978) (both give dates for site).
Comments Dating not clear. This whorl was found quite near the surface of the site.

Number 82
Location Burke Museum
Catalogue Number 1-274
Age Collected 1944
Ethnic Affiliation Coast Salish
Collector Mr. F.W. Shelly
Where Collected North Vancouver, B.C.

Number 83
Location Burke Museum
Catalogue Number I-1478
Age Collected 1920
Ethnic Affiliation Coast Salish
Collector Mr. and Mrs. Walter C. Walters
Where Collected Fraser River, B.C.

Number 84
Location Burke Museum
Catalogue Number 1-199
Age Collected 1949
Ethnic Affiliation Coast Salish
Collector Barbara S. Lane
Where Collected Cowichan,Vancouver Island (?)

Number 85
Location Burke Museum
Catalogue Number 1-10569
Age Collected 1929
Ethnic Affiliation Coast Salish
Collector G.T. Emmons
Where Collected Cowichan, near Duncan, Vancouver Island

Number 86
Location Burke Museum
Catalogue Number 1995-1/3
Age ?
Ethnic Affiliation Coast Salish
Collector ?
Where Collected ?

Number 87
Location Burke Museum
Catalogue Number 6944
Age Collected 1920
Ethnic Affiliation Cowichan (Coast Salish)
Collector F. Landsberg
Where Collected Cowichan, Vancouver Island

Number 88
Location Burke Museum
Catalogue Number 1-10577
Age Collected 1929
Ethnic Affiliation Cowichan
Collector G.T. Emmons
Where Collected Duncan, Vancouver Island

Number 89
Location Burke Museum
Catalogue Number 1-10609
Age Collected 1930
Ethnic Affiliation Coast Salish
Collector Erna Gunther Spier
Where Collected Patricia Bay Reserve, B.C. (not sure whether Vancouver Island or mainland B.C.)

Number 90
Location Burke Museum
Catalogue Number 1-10570
Age Collected 1929
Ethnic Affiliation Coast Salish
Collector G.T. Emmons
Where Collected Cowichan, near Duncan, Vancouver Island

Number 91
Location Burke Museum
Catalogue Number 6942
Age Collected 1920
Ethnic Affiliation Coast Salish
Collector F. Landsberg
Where Collected Cowichan, Victoria, B.C.(Vancouver Island)

Number 92
Location Burke Museum
Catalogue Number 1574
Age Collected 1909
Ethnic Affiliation Coast Salish
Collector G.T. Emmons
Where Collected Vancouver Island

Number 93
Location Burke Museum
Catalogue Number 1573
Age Collected 1909
Ethnic Affiliation Coast Salish
Collector G.T. Emmons
Where Collected Vancouver Island

Number 94
Location Burke Museum
Catalogue Number 1-10610
Age Collected 1930
Ethnic Affiliation Coast Salish
Collector Erna Gunther Spier
Where Collected Patricia Bay Reserve, B.C.(not sure whether Vancouver Island or mainland B.C.)

Number 95
Location Burke Museum
Catalogue Number 2.5E1313
Age Historic (?)
Ethnic Affiliation Coast Salish
Collector Mrs. J.I. Colwell
Where Collected Western Washington

Number 96
Location Burke Museum
Catalogue Number 99
Age Made in 1892
Ethnic Affiliation Skokomish
Collector Myron Eells
Where Collected Skokomish
References none
Comments Commissioned for the Washington World's Fair.

Number 97
Location Burke Museum
Catalogue Number 7994
Age Collected 1916
Ethnic Affiliation Swinomish
Collector J.S. Church
Where Collected Swinomish Indian Reservation at La Conner, Washington
References none
Comments Collected from elderly woman on the reservation.

Number 98
Location Burke Museum
Catalogue Number 6943
Age Collected 1920
Ethnic Affiliation Coast Salish
Collector F. Landsberg
Where Collected Cowichan, Vancouver Island

Number 99
Location Burke Museum
Catalogue Number 8684
Age Made in 1923
Ethnic Affiliation Tulalip
Collector Erna Gunther Spier/ Mary Davis
Where Collected Tulalip Reservation; made by Johnson of Snoqualmie tribe, residing at Tulalip, Washington

Number 100
Location Burke Museum
Catalogue Number 1989-26
Age Made 1989
Ethnic Affiliation Quinault tribe
Collector Made by Martin Oliver
Where Collected N.A.

Artifacts included in the study but not examined

Number 2
Location UBC Museum
Catalogue Number DjRi3:11142
Age ca. 800 A.D. (Emery Phase)
Ethnic Affiliation ?
Collector C.E. Borden
Where Collected Milliken site, in the Fraser Canyon above Yale, B.C.
References Borden (1976:160-161); Duff (1975:31 and 168).
Comments Unavailable during my visit.

Number 3
Location Alberni Valley Museum, Port Alberni, Vancouver Island
Catalogue Number ?
Age 910B.C.-220 A.D., Radiocarbon on associated charcoal
Ethnic Affiliation Opechetsaht (Nootkan speaking group that was possibly Salish in origin.)
Collector Alan D. MacMillan and Denis St. Claire
Where Collected Site DhSe2, Shoemaker Bay,B.C.
References MacMillan and St. Claire (1982)
Comments Dates may not be accurate for the site. Whorl may be a stone gaming disc (these discs are discussed in Culins 1902-1903).

Number 4
Location Alberni Valley Museum, Port Alberni, Vancouver Island
Catalogue Number ?
Age A.D. 500 (+/- 80)-A.D. 820 (+/- 85), Radiocarbon on asociated charcoal.
Ethnic Affiliation Opetchesaht
Collector Alan D. MacMillan and Denis St. Claire
Where Collected Site DhSe2, Shoemaker Bay, B.C.
References MacMillan and St. Claire (1982)
Comments May be a whorl or may be some sort of ornament.

Number 5
Location Alberni Valley Museum, Port Alberni, B.C.
Catalogue Number ?
Age A.D. 500 (+/- 80)-A.D. 820 (+/- 85), Radiocarbon on associated charcoal
Ethnic Affiliation Opetchesaht
Collector Alan D. MacMillan and Denis St. Claire
Where Collected Site DhSe2, Shoemaker Bay, B.C.
References MacMillan and St. Claire (1982)
Comments

Artifacts known but not examined or included in the study

Number 7
Location ? May be at U.B.C.
Catalogue Number ?
Age Early historic
Ethnic Affiliation ?
Collector ?
Where Collected
References Borden (1976)
Comments This small fragment is believed to be part of a spindle whorl.

Number 8
Location BCPM
Catalogue Number 9658
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected Port Hammond, B.C.
References Suttles (1976:84); Kew (1979:plate 11)
Comments Unavailable for examination when I went to this location.

Number 10
Location BCPM
Catalogue Number 1180
Age Collected 1908
Ethnic Affiliation Salish
Collector C.F. Newcombe
Where Collected Beecher Bay,Vancouver Island
References Inverarity (1950:#29)
Comments Unavailable for examination when I visited this location.

Number 11
Location BCPM
Catalogue Number 2389
Age Collected 1912
Ethnic Affiliation Salish
Collector C.F. Newcombe
Where Collected Nanaimo, Vancouver Island
References Inverarity (1950:#30)
Comments Unavailable for examination when I visited this location.

Number 13
Location Burke Museum
Catalogue Number I-276
Age Historic
Ethnic Affiliation Salish
Collector W.F. Shelley
Where Collected Vancouver Island
References Inverarity (1950:#32)
Comments Unavailable for examination when I visited this location.

Number 15
Location Burke Museum
Catalogue Number I-275
Age Collected ca. 1910
Ethnic Affiliation Salish
Collector W.F. Shelley
Where Collected North Vancouver, B.C.
References Feder (1983:54); Holm (1987:56-57)
Comments Unavailable for examination when I visited this location.

Number 16
Location National Museum of Man, Ottowa
Catalogue Number ?
Age Collected 1884 (Kew n.d)
Ethnic Affiliation Cowichan
Collector Tolmi
Where Collected Cowichan, Vancouver Island
References Feder (1971:30-31); Kew (1979:plate 19)
Comments Didn't visit.

Number 17
Location Smithsonian Institution (National Museum of Natural History)
Catalogue Number ?
Age Historic (?)
Ethnic Affiliation Cowichan
Collector ?
Where Collected ?
References Feder (1971:30-31); Suttles (1976:85)
Comments Didn't visit.

Number 18
Location Smithsonian Institution (National Museum of Natural History)
Catalogue Number ?
Age Historic (?)
Ethnic Affiliation Cowichan
Collector ?
Where Collected ?
References Feder (1971:30-31); Suttles (1976:85)
Comments Didn't visit.

Number 19
Location BCPM
Catalogue Number 9654
Age Historic
Ethnic Affiliation Salish
Collector C.F. Newcombe
Where Collected ?
References none
Comments Unavailable for examination when I visited this location.

Number 20
Location BCPM
Catalogue Number ?
Age ?
Ethnic Affiliation Salish
Collector ?
Where Collected Sardis, B.C.
References Suttles (1976:85)
Comments Unavailable for examination when I visited.

Number 21
Location BCPM
Catalogue Number 1179
Age Collected 1908
Ethnic Affiliation Salish
Collector C.F. Newcombe
Where Collected Beecher Bay, Vancouver Island
References Suttles (1967:85); Kew (1979:plate 4)
Comments Unavailable for examination when I visited.

Number 22
Location Brooklyn Museum
Catalogue Number ?
Age Historic (?)
Ethnic Affiliation Salish
Collector ?
Where Collected Chemainus, Vancouver Island
References Suttles (1976:85); Kew (1979:plate 10)
Comments Didn't visit.

Number 23
Location deMenlil Collection (Texas?)
Catalogue Number ?
Age ?
Ethnic Affiliation Salish
Collector ?
Where Collected ?
References Holm and Reid (1975:56-57); Suttles (1976:85); Kew (1979:Plate 20).
Comments Didn't visit.

Number 24
Location ?
Catalogue Number ?
Age Historic (?)
Ethnic Affiliation Salish (?)
Collector ?
Where Collected ?
References Suttles (1976:85)
Comments Couldn't locate

Number 27
Location SFU
Catalogue Number ?
Age Quite recent
Ethnic Affiliation Interior (?)
Collector Found by a logger.
Where Collected Koeye River, in Central B.C.
References Carlson (1976:128-129)
Comments Controversial, so I didn't include this in the study. Didn't visit SFU.

Number 28
Location Buffalo Museum of Science (formerly the Museum of the American Indian)
Catalogue Number C13426
Age Accessioned in 1939
Ethnic Affiliation Central Coast Salish
Collector George G. Heye
Where Collected Westholme Reserve, Vancouver Island
References Feder (1983:46-47)
Comments Didn't visit.

Number 29
Location British Museum
Catalogue Number 1861.3-12.62
Age Collected early 1800s
Ethnic Affiliation ?
Collector British naval captain
Where Collected ?
References
Comments Didn't visit.

Number 30
Location Burke Museun
Catalogue Number 8683
Age Historic
Ethnic Affiliation Salish
Collector Erna Gunther Spier
Where Collected ?
References none
Comments Unavailable for examination when I visited this location.

Number 31
Location PAM (Rasmussen Collection)
Catalogue Number ?
Age ?
Ethnic Affiliation Salish (?)
Collector ?
Where Collected ?
References Davis (1949:134-135)
Comments Didn't visit.

Number 32
Location PAM (Rasmussen Collection)
Catalogue Number ?
Age Historic
Ethnic Affiliation Salish
Collector G.T. Emmons
Where Collected Cowichan, Vancouver Island
References Davis (1949:135-136)
Comments Didn't visit.

Number 33
Location PAM (Rasmussen Collection)
Catalogue Number ?
Age Historic
Ethnic Affiliation Salish
Collector G.T. Emmons
Where Collected Duncan, Vancouver Island
References Davis (1949:151-152)
Comments Didn't visit.

Number 34
Location BCPM
Catalogue Number Dr-Rt-y:41 (location unknown)
Age Archaeological
Ethnic Affiliation Coast Salish
Collector ?
Where Collected Site Dr-Rt-y
References Stewart (1973:124)
Comments Unavailable for examination when I visited this location.

Number 35
Location SFU
Catalogue Number ?
Age ?
Ethnic Affiliation ?
Collector Carlson (?)
Where Collected Kwatna Inlet, on Burke Channel, B.C.
References Stewart (1973:124)
Comments Didn't visit.

Number 36
Location UBC Museum
Catalogue Number ?
Age Archaeological
Ethnic Affiliation ?
Collector ?
Where Collected Yale area on Fraser River, near Hope, B.C.
References Stewart (1973:124)
Comments Unavailable for examination when I visited this location.

Number 37
Location BCPM
Catalogue Number ?
Age ?
Ethnic Affiliation Salish (?)
Collector ?
Where Collected Sooke, south end of Vancouver Island
References Stewart (1973:124)
Comments Unavailable for examination when I visited this location.

Number 38
Location SFU
Catalogue Number ?
Age ?
Ethnic Affiliation ?
Collector ?
Where Collected Kimsquit, head of Dean Channel, B.C.
References Stewart (1973:124)
Comments Didn't visit.

Number 40
Location ?
Catalogue Number ?
Age ?
Ethnic Affiliation Salish (?)
Collector ?
Where Collected ?
References Kew (1979:plate 3)
Comments

Number 41
Location ?
Catalogue Number ?
Age ?
Ethnic Affiliation Salish (?)
Collector ?
Where Collected ?
References Kew (1979:plate 5)
Comments

Number 43
Location ?
Catalogue Number ?
Age ?
Ethnic Affiliation ?
Collector ?
Where Collected ?
References Kew (1979: plate 12)

Number 45
Location BCPM
Catalogue Number 9864
Age Historic
Ethnic Affiliation Stalo
Collector D.C. George/ C.F. Newcombe
Where Collected Lower Sardis, B.C.
References Kew (1979:plate 15)
Comments Unavailable for examination when I visited location.

Number 46
Location BCPM
Catalogue Number 10352
Age Historic
Ethnic Affiliation Cowichan
Collector A.C. Newcombe
Where Collected ?
References Kew (1979:plate 16)
Comments Not available for examinatin when I visited.

Number 47
Location BCPM
Catalogue Number 10503
Age Historic
Ethnic Affiliation Cowichan
Collector C.F. Newcombe
Where Collected ?
References Kew (1979:plate 17)
Comments unavailable for examination when I visited this location.

Number 48
Location BCPM
Catalogue Number 10692
Age Historic
Ethnic Affiliation Cowichan
Collector C.F. Newcombe
Where Collected ?
References Kew (1979:plate 18)
Comments Unavailable for examination when I visited this location.

Number 77
Location BCPM (on loan to Nanaimo)
Catalogue Number 456
Age Historic (?)
Ethnic Affiliation Coast Salish
Collector ?
Where Collected ?
References none
Comments Unavailable for examination when I visited this location.

Number 78
Location BCPM (on loan to Nanaimo)
Catalogue Number 2388
Age Historic
Ethnic Affiliation Coast Salish
Collector C.F. Newcombe
Where Collected Nanaimo, Vancouver Island
References none
Comments Unavailable for examination when I visited this location.

Number 79
Location BCPM
Catalogue Number 14985a and b
Age Made in 1976
Ethnic Affiliation ?
Collector Made by George Elliott
Where Collected N.A.
References none
Comments Unavailable for examination when I visited this location.

Other Known Whorls

In addition to the whorls listed above there is a group of wooden and whalebone whorls at the Makah Cultural and Research Center, at Neah Bay Washington. I did not visit this center because of time constraints. Murray (1982) cites a sandstone whorl found at a Duke Point site (DgRx5), near Nanaimo, B.C., as well as referring to another sandstone whorl mentioned in Burley (1979). I was not able to locate either of these whorls for analysis.