ESTABLISHED FABRIC TECHNIQUES

USED TO CREATE MOTORIZED FORMS

PROBLEM IN LIEU OF

THESIS

Presented to the Graduate Council of the

North Texas State University in Partial

Fulfillment of the Requirements

For the Degree of

MASTER OF FINE ARTS

By

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Denton, Texas

December, 1973

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

Ruth Kaufmann, in her book The New American Tapestry, reflects the vitality of most of today's weavers when she describes the American weaver thus:

> A compelling new form of weaving has recently appeared as a result of their [American artist-weaver] unhampered experimentation--free hanging two-and three-dimensional woven objects. These stunning sculptural creations have refused to stay passively on the wall. Instead, they have moved into space (1, p. 13).

The wrapped columns of yarn created by Claire Zeisler, suggest powerful sculptural monoliths, that seem to stand as a tangible proof of the power of the yarn medium. Lenore Tawney's fresh use of an ancient fiber, linen, is reminiscent of that fiber's Egyptian origin only in terms of material, not form. This is not to say that the fine Egyptian linen cloths are not beautiful, but simply that these fibers have taken a new direction, not dictated by utilitarian demands, but by design principles only.

It is out of this spirit of experimentation that the projects described in this investigation evolved. The two projects which formed the basis of study for this paper emphasized the use of motion with the texture of the woven form. Movement was created by the use of simple motor actions, and texture was created by the use of established textile techniques.

The ancient artist's influences can still be felt in today's craftsmen. For example, the contemporary weaver Sheila Hick's prayer rugs are an assimulation of the textile techniques of ancient Peru, Persia, and India, and the macramed forms of the contemporary Spanish artist, Aurelis Munoz, are suggestive of the woven huts of many primitive cultures. Because of this influence upon the current investigation, the evolvement of weaving and its techniques, as well as the three-dimensional techniques of basketry, in different parts of the world and in different historical periods are reviewed briefly.

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CHAPTER II

HISTORICAL OVERVIEW OF WEAVING, LOOMS, AND BASKETRY

Weaving

Man's need for clothing and shelter provided the impetus needed to begin the exploration of the weaving of cloth. It started with perhaps no more than the knotting together of reeds or grasses, or the mere pressing together of bits of animal fiber until it formed a matted surface. Through slow evolution he realized that the interlacing of more than one element, which is the basic idea behind the weaving process, would add strength and durability to the construction. All of the hand manipulated textile techniques, including weaving, knotting, coiling, wrapping, twining, looping, and braiding, resulted as man attempted to create a stable structure to serve his varied needs. The next steps in the evolution of weaving were the invention of appliances to speed up the slow, tedious finger-controlled techniques. These devices called looms had simple beginnings, but over the centuries became more and more sophisticated. Some present-day looms are computerized. A more complete description of the various weaving appliances is reported later in this paper.

Fabricating techniques have changed very little from culture to culture and from generation to generation--the differences lie primarily in the materials indigenous to each area, the specific needs of the people, and the artist's own interpretation. The artist's interpretation was usually dictated to some extent by the society in which he lived. Even the most rudimentary matting processes invented by early man are still found in various parts of the world today. Tapa cloth, produced by the natives in Africa, the South Sea Islands, and certain areas of the Western Hemisphere, is the result of the pounding of the inner bark of the moraceae tree (5, p. 2). Other examples of this felting process, which was not too different from the ancient matting process, are the finely embroidered Numdah rugs of India, and the felts made from various synthetic fibers (5, p. 3). Textile techniques have found their way into all areas of the world. Each technique and each process contributed to the wealth of textiles through the ages.

When did man discover the weaving process? Early evidences can be traced to textile fabrics found in Egypt in the Nile Valley areas of Fayum and Badari, dating from about 5000 B.C. (8, p. 3). Because of the wide distribution of spindle whorls and other weaving tools, many anthropologists feel that the craft did not evolve in one area alone, but was discovered concurrently in various parts of the world (5, p. 14).

Two cultures, remote from each other in time and geographical location, curiously enough compare the weaver to a spider in their poetic interpretation of the origins of weaving. The Greeks attribute the beginnings of weaving to Minerva and Arachne--a contest between the two resulting in Arachne being transformed into a spider, to spin and weave forever (5, p. 14). The Navajo Indians of the southwestern part of the United States have a legend which says:

> Spider-Woman instructed the Navajo women how to weave on a loom which Spider-Man told them how to make. The crosspoles were made of sky and earth cords, the warp sticks of sun rays, the healds of rock crystal and sheet lightning. The batten was a sun halo, white shell made the comb. There were four spindles: one stick of zigzag lightning with a whorl of cannel coal; one a stick of flash lightning with a whorl of turquoise; a third had a stick of sheet lightning with a whorl of abalone; a rain streamer formed the stick of the fourth, and its whorl was white shell (10, p. 32).

Perhaps the analogy is not too far fetched since the craft of textile making, like the spider's web, has for centuries been deeply entangled in the affairs of man, politically, economically, and aesthetically.

Man's early attempts at weaving included the interlacing of fibers for mats, dwellings, and baskets. At some time in the manipulation of fibers, man realized that by twisting fibers they could be lengthened and strengthened. This process in turn led to the invention of the spindle, a stick to which a piece of fiber could be attached and when dropped would create the same twisting motion produced by the fingers when rubbing two or more fibers together. It was somehow discovered that by adding a round disc, called a spindle whorl, to the bottom of the stick the thread could be twisted more evenly. The production of thread is essential to the development of weaving. The raw materials for supplying this thread vary from country to country and have been responsible for changing the economies of many lands throughout the ages. In ancient Egypt, one of the major areas in the development of weaving, the principle fiber used was flax, from which linen yarn is produced. Wool was known, but considered inferior. "Sumptuary laws" demanded that Egyptian priests refrain from wearing wool next to their bodies (8, p. 3). Pictures drawn on the walls of ancient tombs depict the slow, tedious process of growing, harvesting, and preparing the flax plant for weaving (2, p. 41). The Egyptians produced fine linen cloth, containing as many as 540 warp ends to the inch, on looms which contained two beams, one for cloth and the other for warp (2, p. 50). Many heald rods, also called heddle rods and used for lifting warps, must have been used because some of the fabrics were patterned (2, p. 51). Weaving was done by slaves whose lives must have been anything but pleasant because the inscription in one tomb reads: "The carpet-weaver inside the house is more miserable than a woman; his knees are at the place of his heart; he does not taste the air; if he should do but a little in a day of his weaving, he is pulled like a lotus in the pool. He gives bread to the doorkeepers in order that he may see daylight (2, p. 52)." From Egypt come the first examples of textiles created to fulfill the desire to please aesthetically, such as the tapestry linen garment of Amenhotep II dated 18th dynasty, 1555-1350 B.C. (17, p. 6). Embroidery, a technique closely bound to the technique of weaving and serving as an embellishment for the latter, was used in ancient Egypt. The Egyptians also did applique, employing leather and beads (15, p. 26).

The Babylonians, Assyrians, and Phoenicians were developing their textile arts at the same time as the Egyptians. Their primary fiber was wool (8, p. 1). From inscriptions on clay tablets, we find that the kings and rich merchants of these lands had workshops in which slaves toiled to produce cloth for trading with Egypt (2, p. 62). Such trading among countries provided an exchange of ideas and designs as well as products and was the early beginning of the textile arts as a powerful economic factor. The loom used in this area was a two-barred one with heald rods to control the warps, and some of the designs used then can be found among people living in the mountains between the Caspian and the Black Seas (2, p. 64).

The Babylonians and Chinese are believed to be the first to use the knotting technique with their weaving which produces the pile rugs (2, p. 65).

The Phoenicians are noted for their dying of textiles and discovered the means of producing purple from certain shellfish (8, p. 4). These beautifully dyed cloths were much sought after by other countries.

Chinese legend tells that the first silk was made by the Empress S-ling-chi in 2700 B. C. (2, p. 75). The earliest textiles were found in excavations in Palmyra attributed to the period between 200 B. C. and 300 A. D. (14, p. 17). Unlike Egypt and Peru, the climate of China was not conducive to the preservation of textiles. Many have survived in European churches where they were used as clothing for the clergymen (14, p. 18). Their beautiful brocades and damasks were cherished trade items and greatly increased their wealth. For many years they guarded their secret for the making of silk, a process which involves the spinning of the filament produced by the silkworm in the making of its cocoon. Anyone attempting to transport silkworms and mulberry leaves, on which the silkworm fed, out of China was punished by death (2, p. 77), However, two monks are said to have succeeded in smuggling out some silkworm eggs in a hollow cane and brought them to the Emperor Justinian in Constantinople in A. D. 552 (8, p. 4). About the 3rd Century A. D. the secret of silk making reached Japan, to be followed by India, Persia, Central Asia, Byzantium, and by the 10th Century as far as Sicily (2, p. 78).

Cotton was the basic fiber in India and is referred to in the ancient Hindu Laws of Manu (ca. 400 B. C. - A. D. 200) (8, p. 2). The Encyclopedia of World Art says:

> The ancient Chinese called it (the cotton plant) the 'lamb plant', it being said the 'cotton lambs' grew on shrubs, each cradled in its own downy pad. The stem of the plant was supposed to be flexible, permitting the bolls to bend down and graze on the adjacent herbiage. When all the grass within this narrow orbit had been eaten, the lambs disappeared, leaving their coats behind (8, p. 2).

Whatever poetic stories were developed concerning the cotton plant, none could have predicted the far reaching popularity of the textiles it produced in today's world. Cotton fibers are not as long as flax fibers and do not stick together like wool fibers, so a different spinning technique in which the spindle is set in a bowl with water has to be used (2, p. 90). The Indian loom was different, too. It consisted of two bars parallel to the ground, with a harness for lifting the warp threads that was operated by foot pedals which were in a hole in the ground (2, p. 93). India is famous for its India prints, created by the wax-resist method of dying, and they also produced "brocaded" silks, the latter not so fine as those produced by the Chinese (2, p. 96).

The Greeks also were avid weavers. According to Verla Birrell in her book The Textile Arts, "Herodotus, describing the weaving methods of his period, said: 'Other nations make cloth by pushing the woof upwards, while the Egyptians, on the contrary, push it down,' and this would indicate that the Greeks used a vertical, warp weighted loom (5, p. 14)." The Greeks also had guilds, which maintained standards of work and there was a kind of specialization of industry--one shop might carry one kind of cloth, while another would emphasize yet another kind (2, p. 121). Certain towns were famous for certain cloths--Syracuse for dyed woolens, Corinth, Miletus and Samos for carpets, and the island of Cos for a fine soft cloth (2, p. 122). By the 5th Century B. C. the Greeks had become far reaching traders, sailing to Egypt, Phoenicia, and Africa, and overland to China and India (2, p. 125).

Most of the Roman textiles came from the peoples they conquered—weavers from Greece, Gaul, Egypt, and the Near East were used to supply their needs (5, p. 15). However, they were experts at cleaning and bleaching woolen cloth, a process which called for washing the woolens with a clay-like earth called "fuller's earth (2, p. 136)."

Wool and linen were the most important fabrics used in Europe during the Middle Ages and many weaves were used including burre, serge, linsey-woolsey, Baptiste de Cambrai, and brunette (5, pp. 16-17). Beautiful tapestries were embroidered to cover the cold stone walls of the castle, the most famous one being the "Bayeux Tapestry," measuring 214 feet in length and 20 inches in width, depicting the conquest of England by William the Conqueror (2, p. 149). The Middle Ages marked the discovery in Europe of other important weaving centers--Byzantium, Persia, Egypt, and Spain (2, p. 160). The Crusaders did much to open the eyes of Europe to the beautiful textiles of the Near East and the textile industry became a thriving business during this era (5, p. 17).

Textiles began to bloom in Italy and France during the Renaissance, the latter stressing tapestry weaving. The French tapestry weavers were organized into a group called the Gobelin Factory, named after Jehan Gobelin, who previously had established a dye works (5, p. 19). Renaissance weavers also created silk and velvet brocades, damasks and cloths of gold (2, p. 184). England's textiles were a composite of many countries since most of the weaving was done by refugees from the continent, but it was in England that the beginnings of mass production began, organized by John Winchcombe (5, p. 21). A series of inventions in England at the beginning of the 18th Century heralded the start of textiles as the mechanized industry we know today. In 1735 John Kay invented the fly shuttle, a device which greatly speeded up the throwing of the shuttle, and in 1787 Dr. Cartwright invented an automatic loom, which changed the shed and threw the shuttle when the reed was operated (5, p. 23). In 1767 an English spinner, named James Hargreaves, invented a machine called the "spinning Jenny" that could turn many spindles at one time (2, p. 241). These inventions not only increased production, but also demanded more raw materials. In 1792 the cotton gin was invented by Eli Whitney, a Georgia school-teacher, to meet such a demand (5, pp. 23-24).

The 19th Century saw the invention of yet other machines to speed up the textile process. These were a power loom for weaving checks, invented by Alfred Jenks (1810), the sewing machine, invented by Elias Howe (1830), and the Northrop loom, perfected by James H. Northrop (1889), a loom which completely mechanized the plain weave technique (5, p. 24).

In America was found a more sporadic dispersal of the textile arts than in Europe. Along the Mississippi River and into the Ohio Valley dwelled the Indians known as the Mound Builders. In the remains of this culture has been found cloth made of a plant fiber, probably cotton, but it is not known whether the Mound Builders created the cloth or traded it from the Indians of the Southwest or Mexico (2, p. 202).

The Navajo Indians of the Southwestern part of the United States were skilled weavers. Their strong colors and vibrant geometric designs make their rugs a most sought after art form even today. The Tlingit Indians of Alaska, using the ancient warp-weighted type of loom, produced fine ceremonial blankets by twisting the fibers into the free hanging warps. But the most outstanding weaving in America was produced by the Incas in Peru. Many weaves and embroideries were explored and are considered among the finest of textiles found anywhere in the world.

Early United States textile mills were located in New England, because they were powered by water and that area seemed best suited, but as the 20th century progresses the mills are shifting to other areas such as Texas, Arizona, and California (5, p. 24).

The principles of weaving and basketry, despite the inventions of power machines, still remain essentially unchanged. There will probably always be a need for handcrafted items. Perhaps this is the reason for the recent revival of interest in the ancient techniques of knotting and handloom weaving. Some excellent examples of today's application of ancient textile techniques were on view in the major international exhibition of contemporary fabric forms called "Deliberate

Entanglements", assembled by Bernard Kester at the UCLA Art Galleries in November 1972, and including some of the world's renowned contemporary weavers (12, p. 13). The exhibitors were Magdalena Abakanowicz (Poland), Neda Al-Hilali (California), Olga de Amaral (Columbia), Tadek Beutlich (England), Jagoda Buic (Yugoslavia), Francoise Grossen (New York), Sheila Hicks (France), Ritzi and Peter Jacobi (Germany), Aurelia Munoz (Spain), Walter Nottingham (Wisconsin), Kay Sekimachi (California), Dorian Zachai (New Hampshire), and Claire Zeisler (Illinois) (12, p. 13). Now, as in ancient times, the craft of weaving is not restricted to one area, but it is found all over the world, each artist using the medium of fiber as his vehicle for self-expression.

Looms

Looms for making fabric structures are many and varied, extremely primitive or highly sophisticated, but their purpose remains the same, no matter how different the construction. That purpose is the supporting of vertical threads, called the warp, so that the horizontal threads, called the weft or filler, may be interlaced, one with the other. In so doing it is necessary to create an opening, called the shed, between the two sets of threads so that the weft may pass through to create a pattern. The tool which carries the weft is known as a shuttle.

An even tension is usually desired for the warp threads so that a more aesthetically pleasing and structurally sound fabric may be formed. The various means of controlling this tension and patterning of the warp threads has led to a variety of loom appliances. The more primitive looms had no heddle devices, the heddles constituting that part of the loom through which the warp fibers are threaded to control the design of the piece. Heddles are fashioned of bone, string, metal, or wood. The heddles and the harnesses which house the heddles made it much easier to better control the pattern of the fabric and quickened the weaving process.

Probably the most primitive of looms were the free-warp looms which, because they had no frames, harnesses, or heddle devices, could be set up virtually any place one could stretch cord. The free-warp loom requires that the warp is attached to the holding cord stretched between two uprights. It is necessary to use a twining technique, the same process that is employed in basket making, rather than a weaving technique because the warp threads are free hanging and not tensioned. The rows of weft twining are pushed upward to form the fabric.

Another kind of free-warp loom is the bag loom or Ojibway loom, named for the Ojibway Indian, around the Great Lakes region, who made cornhusk carrying bags on these devices (18, p. 30). This loom is simply a frame loom with a dowel placed vertically on either side. A holding cord is tied around these upright verticals to form a loop. The warp threads are attached to the holding cord forming the loop and the twining technique is employed.

Warp-weighted looms constitute another kind of fabricating device. Weighted warps were used on the horizontal looms of the Near East and North Africa, as well as the vertical looms on both the Eastern and Western Hemispheres (5, p. 59). Some cultures used heddle rods while others lacked them--the looms of pre-Dynastic Egypt, ancient Greece, and Southwestern Asia, employed heddles, while those in the Americas and the Pacific Islands did not (5, p. 59). A beautiful product of the latter is the ceremonial blanket woven by the Chilcat Indian in the Northwestern part of North America. The women of the tribe wove the blankets, but the men created the designs (18, p. 46).

Cardboard looms and frame looms are simple types of primitive weaving devices, now often used in the education of beginning weavers. Both are very simple in construction. In using cardboard looms the warp is stretched around the board and held in place by notches made in the board. In a frame loom nails are placed at regular intervals at the top and at the bottom of the frame and the warp threads are wound around these nails. The weft may be inserted into the warp by finger manipulation or a long needle may be used. This loom device is the same as that used by children today to create potholders or units for larger works.

Back-strap looms have been used for centuries and have had a wide distribution geographically--Tibet, China, Korea, Japan, The Philippine Islands, Santa Cruz Island, Peru, and Mexico--and can be found in use today in Borneo, Indonesia, Formosa, Africa, The Philippine Islands, and Central and South America (5, p. 83). The weaver himself produces the warp tension. One end of the loom is attached to a rigid support, while the other encircles the waist of the weaver. By leaning forward or backward, the artist can lessen or tighten the warp tension. The patterning is controlled by string heddles or rigid hole and slot heddles and shed sticks (18, p. 31). Such a loom, though primitive in concept, still offers a multitude of design possibilities. Many of the technically fine fabrics produced in Peru in pre-Columbian times were woven on back-strap looms.

The hole-and-slot heddle looms also had a wide distribution. They were found in India and the Island of Bali, and are still used today in India, Austria, Germany, Norway, and Finland (5, p. 94). These looms are constructed so that the warps are threaded alternately through eyes and through slots between the eyes. The heddles may be made of string, wood, bone, or metal. The shed is produced by raising or lowering the harness. A modern day example of this loom is the tongue depressor loom fashioned by school children.

The inkle loom is one means of weaving either narrow bands for belts or strips of wider cloth. This loom has fixed heddles, like the hole-and-slot heddle looms mentioned earlier, and a continuous warp. The pattern resulting is always a warp-face one with the weft seen only at the selvages. A multitude of patterns are possible through the use of pickup designs.

Card weaving, card-heddle belt looms, Egyptian-card weaving, or tablet weaving, are some other loom processes. These techniques, all similar, were found in pre-historic times in Egypt, Iceland, Sweden, and China (1, p. 1). No loom frame is necessary--the warp is controlled by means of cards with holes in each corner through which the yarn is threaded. The cards may be made of cardboard, wood, metal, or plastic. Each card is numbered, and each hole in the card is lettered, and by turning the cards the weaver is able to manipulate the pattern. Usually the cards are no more than three inches square with rounded edges, but rectangular, triangular, and pentagonal ones may be used, depending upon the design desired. The warp is stretched between two sturdy supports. By turning the cards in prescribed directions, a pattern is formed. The structure of the fabric is a strong one because the weaving results in a twisting of the warp threads. The weaving width is usually not very wide, as with the inkle loom, since manipulation of many cards would be extremely tedious.

The vertical tapestry loom consists of two upright bars with a cloth bar at the top and bottom, and heddle bars. These looms may vary greatly in size and sophistication, but the weaving may not necessarily suffer from this lack of refinement. An example are the beautiful rugs woven by the Navajo Indians of the southwestern part of the United States.

The table loom had its beginnings in the far East and was counter-balanced, meaning that the harnesses containing the heddles holding the warp threads were lowered rather than raised, as in a rising shed loom, to form the shed for weaving (5, p. 185). The harnesses of a table loom are hand operated with either side or front levers. They are very efficient for weaving small items and a number of designs are possible depending on the number of harnesses added.

The foot-powered loom enables the weaver to control the opening of the shed by means of treadles attached to the harnesses. There may be as many as twenty-four harnesses per loom. Today's foot-powered looms boast stainless steel heddles, and frames made from prime wood such as cherry or oak. The treadles may be attached with cords, or better still, with chains. A much wider weaving surface is possible with this loom than with the table loom. Widths up to ninety inches are possible, but require two sets of treadles, and two weavers to throw the shuttle.

Mechanically powered rug looms were used in Europe in the late Renaissance (5, p. 186). The first power loom appeared in the United States in 1839 and was run by water (5, p. 189). The addition of the cam apparatus to the foot-powered loom heralded the machine age of weaving.

These cams are levers mounted on a cylinder set below the harnesses and when the cylinder revolves the lever pushes the harness up as it comes into contact, thus controlling the design (5, p. 223). The power looms of today are capable of weaving any weave, other than hand tapestry, and hundreds of yards in one day--the Draper X-2 Automatic loom, is such a loom (5, p. 224). Today's world sees the computerized loom which demands only the push of a button to create a design.

With all of this mechanization, the hand loom is still in use in many areas of the world. Not only does the expense of power looms prohibit a popular use of such appliances, but man's need to create and to express himself still provides a strong motivation. Primitive and sophisticated looms have existed for generations and probably will do so for generations to come.

Basketry

Basketry is closely allied with weaving. The process of interlocking reeds, fibers or pliable branches is one of creating a three-dimensional object as compared to the flat, two-dimensional surface which is the usual result of weaving. It is difficult to determine the exact origin and age of basketry since the materials used are of such a perishable quality, but sufficient discoveries have been made to indicate it existed over a widely scattered area, and at the earliest stages of man's development. Several varieties of twined baskets were uncovered at level 11 at Danger Cave near Wendover, Utah, dated

7000 B. C. (5, p. 24). In the near East at Jarmo, Iraq, mud impressions of woven mats, dating 5270-4630 B. C., have been discovered (4, p. 244). Other evidences were found at Fayum, Egypt, dating 4784-3929 B. C., the British Isles, dating 2000 B. C., among the Basket-Maker Indians of the southwestern United States c. A. D. 1-700, and in a late Neolithic Chinese culture (Yangshao), dated 3000 B. C. (4, p. 244).

A Pueblo Indian creation story tells of the woman-and-the basket:

> He made a man out of a ball of mud . . when the man grew lonesome the God made a woman as his companion . . he taught her to make baskets of the bark of roots. She was asleep and dreaming of her ignorance of how to please man, and she prayed to the God to help her. He breathed on her and gave her something she could not see, or hear, or smell, or touch, and it was preserved in a little basket, and by it all the arts of design and skilled handiwork are imparted to her descendants (13, p. 1).

Like weaving, basketry had very humble beginnings, developing out of natural animal and vegetable fibers existing in each area. As in flat weaving, the processes for making baskets have remained essentially the same for centuries, with each culture adding its own interpretation of design. The basic techniques of basketry have slowly been modified so that a variety of three-dimensional objects resulted.

Basketry had been used for many purposes. The Egyptians made boats out of water plants and papyrus. They also made mats, baskets, boxes, caskets, and sandals (6, p. 397). The first Christian Church in Britain at Glastonbury in Somerset in the first century A. D., had a thatched roof and walls of wicker work (4, p. 244). Primitive man often twined thatches for dwellings, or fibers for fences, or fish weirs. Cradles were fashioned to carry the young, and men used woven shields, helmets, and body armor when they went into battle. There were baskets for storage, for cooking, and for carrying. The Hupa Indians twined baskets so tightly that liquid could be retained in them (4, p. 244).

Baskets have been, and in some instances still are, a part of tribal ceremonies. The basket dance is a fertility ceremony performed by the Pueblo Indians of the Rio Grande during the spring (13, p. 2). Another fine example of basketry is the woven mask such as that worn by natives of New Guinea, Africa and North American Indians who believed that by donning a mask they could assume another role, perhaps of a spirit (9, p. 30).

The materials for basket making vary from area to area. Esparto grass was used in ancient times in the Mediterranean area, wild rye grass was used by the Aleutian Islanders, and cultivated plants of wheat straw, flax stems, and corn husks, were used by the Egyptians, Swiss Lake Dwellers, and the Iroquois Indians of New York, respectively (4, p. 245).

Basket making involves one of two techniques, either coiling or weaving. The primary tools are a knife for cutting the fibers and, if coiling is used, a needle is required. As yet no machine has been devised which can satisfactorily replace the artisan in producing this handicraft.

In coiling there is a foundation, a long flexible element, and a sewing strip. The Encyclopedia Britannica describes the most common varieties of coiled work:

> (1) Simple oversewn coil--each stitch passes over the new coil and pierces a portion of the coil; (a) furcate coil--the new stitch splits the stitch in the preceding coil, producing a forked effect superficially suggestive of crochet; (b) bee-skep coil--the stitches are spaced widely apart and are not in direct contact with stitches in the preceding coil. (2) Figure of eight (or Navaho), in which the stitch is worked in figure of eight, passing behind, up and over and down in front of the new coil; then behind, down and out and under the preceding coil. (3) 'Lazy squaw', in which the long stitch passes over two coils at once. The sewing passes in front, up and over the new coil, winding around it one or more times, then it passes behind and down under the preceding coil and up over the new coil, completing the characteristic long stitch. (4) Crossed figure of eight (or knot stitch). The stitch passes in front, up and over the new coil, and behind, down and under the preceding coil, as in the long stitch of the 'lazy squaw', but the sewing is next brought out between the two coils, to the right of the last long stitch, which it crosses, giving the appearance of a knot. (5) Cycloid or single-element work, consists of coils usually of cane, looped into each other. Although this may be grouped with coiled work, it has no foundation (4, p. 245).

The coiled technique was used for the foundation of the boats of Mesopotamia, and the finest examples of baskets using this method are found in the western United States among the Pomo, Washo, Pima, and Tulare tribes (7, p. 388).

The main varieties of woven basketry are:

> (1) Check, in which the warp and weft pass over and under each other singly in the familiar over-one-under-one checkerboard pattern. This includes wattlework, in which the warp stakes

are planted in the ground and the weft branches bent in and out between them. (2) Twilled, in which each warp passes over and then under two or more warps. Diagonals are formed by the regular progression of the weft element one to the right (or left) on each successive movement around the basket or across the mat. (3) Wrapped, in which flexible wefts are wrapped around each warp in passing. (4) Twined, in which two or more wefts pass alternately in front of and behind each of the warps, crossing them obliquely. Twining with two or three wefts is technically 'fitching' or 'waling', respectively. In wrapped--twined, 'bird cage' or lattice work, the foundation consists of both horizontal and vertical elements, often rigid, at the crossings of which the weft or wefts may be twined or wrapped. (5) In hexagonal work the wefts, instead of being horizontal and vertical, are worked in three directions, forming in open work hexagonal spaces, in close work six-pointed stars (4, p. 245).

Some of the best examples of twill basketry are found among the Chitamacha Indians in Louisiana, but there are also examples from pre-Columbian Peru, and Indochina (7, p. 392). Examples of twined work may be found among the Haida Indians of British Columbia and the Pomo Indians of the western United States (7, p. 393).

Decoration in basketry is achieved by varying the size and texture of the elements used, or the materials may be dyed or painted. Another form of embellishment called false embroidery, examples of which have been dated 7000 B. C., is a means of adding contrast to two-strand twining by adding a third strand so that it appears on the outside of the basket only (7, p. 395). The Pomo Indians of California incorporate yet another form of decoration by adding feathers and shells to their basket structure.

Basket making has declined in today's world. The Cherokee Indians of North Carolina are the largest producers in the United States, but a sizable proportion of baskets in the United States are imported from Germany, Poland, Yugoslavia, and Italy (3, p. 246).

Basket making is a slow, tedious undertaking and most people are not willing to pay the price that a finely woven article should bring. It is unlikely that the desire for the handcrafted will ever be sufficient to revive the ancient art and restore the craft to its previous high position in the civilization of man.

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CHAPTER III

THE PROJECTS

Two projects which combined traditional weaving techniques with movement were the basis for this problem. The first project consisted of a motorized three-dimensional form which has an opening-closing action. The second consisted of a twelve panel weaving which changes its surface appearance at regular intervals, by means of a revolving timed action.

Interest in these two projects was stimulated by the investigation into the ancient textile techniques and also the dynamic weavings being created by today's craftsmen. The basketry technique opened up the possibility of the three-dimensional sculptural concept for weaving the projects. Intriguing, too, was the idea of the kinetic in art. The primitives, either consciously or unconsciously, explored the possibility of motion in woven works when they donned their ceremonial basket masks. Banners, waving in the breeze, conjure up another kind of motion, driven by the forces of nature. Woven sails of boats are another example of motion created by nature. Woven jewelry and body ornaments such as the basket mask depend upon the human body for motion.

Using this criteria, woven articles of clothing would also be a type of kinetic fabrication. All of these examples depend upon nature or man to propel them. It was the intention of the writer to use mechanical means to move the projects. It was desirable, too, to attempt to combine the motor action, the fabricating technique, and the form of the piece into a harmonious and aesthetic entity. Outside consultation was sought concerning the design and construction of the skeletal structures which were to support the fabrications, and the building of the motors to drive the structures.

Two projects were created, with two different approaches to form and movement. The first project, called "The Clam", produces an opening and closing action; the second project, called "The Billboard", involves a revolving, time-sequence action. It was decided that the scale of both pieces should be large for visual impact.

Weight and balance were of prime consideration in "The Clam". The opening and closing action of the piece required the use of light weight materials to minimize the size of the motor. Aluminum tubing, 1/2 inch in diameter was used.

"The Clam" evolved from an organic form with an emphasis on a contrast of textures--the exterior smooth and the interior highly textural. A variety of textile techniques was chosen to create the textural interior. See Figure 1 on following page.

Fig. 1--Outer shell covering for "Clam" project

Rich red-brown calf leather was cut and fitted to the outer shell, following, as a pattern, for stitching, the basic outline of the underlying metal structure. See Figure 2 on following page.

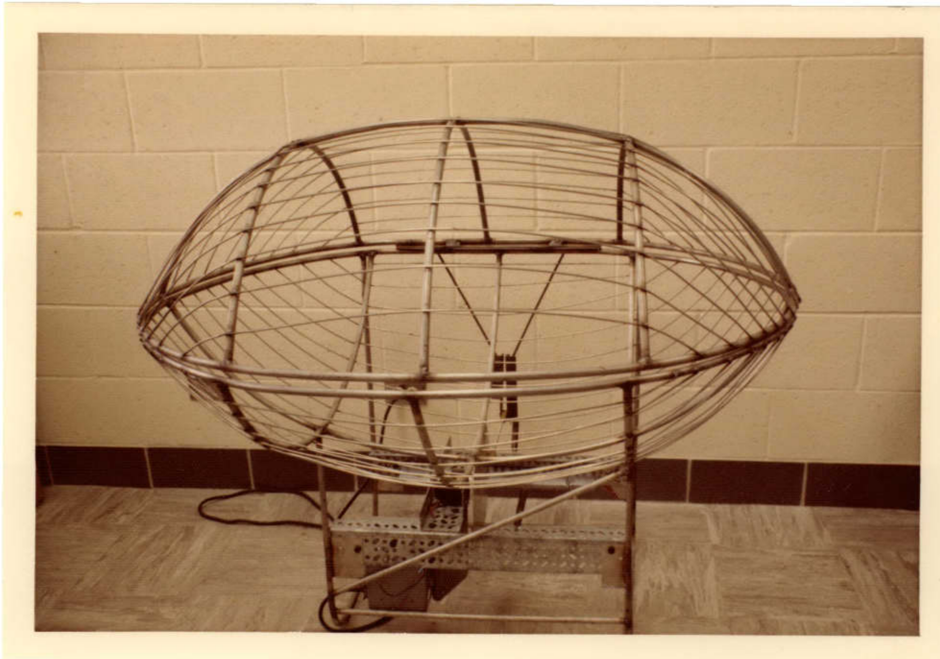

Fig. 2--Metal structure for "Clam" project

Following the ribbing of this skeletal form facilitated the drafting of the pattern for the leather. This leather "skin" was then stitched to a heavy cotton underliner and filled with dacron batting. Following the outer rim of the upper and lower shells, the leather was folded over this rim and hand stitched to the cotton underliner.

To achieve a fibrous textural interior, it was necessary to build layer upon layer, the underlying one was stuffed with kapok. This layer was then covered with satin fabric and overlaid with a canvas cloth which had been painted with yellow acrylic. The yellow acrylic formed a circle approximately 18 inches in diameter and was surrounded by an outer circle of dark purple. To further enhance the filamentous effect, the technique of knotless netting was used. This netting is one in which the half-hitch loop is carried through previously formed loops of yarn to form a mesh (1, p. 314). A jewel-like effect was achieved by weaving hand-strung beads, of various sizes and colors into a light magenta linen warp, and utilized as a covering for a stuffed egg form which was stitched over the yellow circle of painted canvas. See Figure 3.

Fig. 3--Jeweled Egg - Interior of "Clam" project

This phantasy egg form was further developed by stitching flowing streams of tie-dyed wool yarn, moving outward from the beaded form to the outer perimeter of the interior stuffed form. This process created a veining pattern, composed of pale yellows, warm red-pinks, and bright yellow. These yarns end in a mass of darker magenta netting. See Figure 4.

Fig. 4--Interior of "Clam" project

The interior of the upper shell employs the same magenta netting stitched to a kapok-stuffed form slightly smaller than the overall interior dimensions. This netting repeats the color and technique of the lower shell, but the same veining process is not used that was used in the lower interior shell. Instead, a dark dusty rose handspun Haitian cotton yarn was stitched to the magenta netting to further enhance the textural surface quality. See Figure 5 on following page.

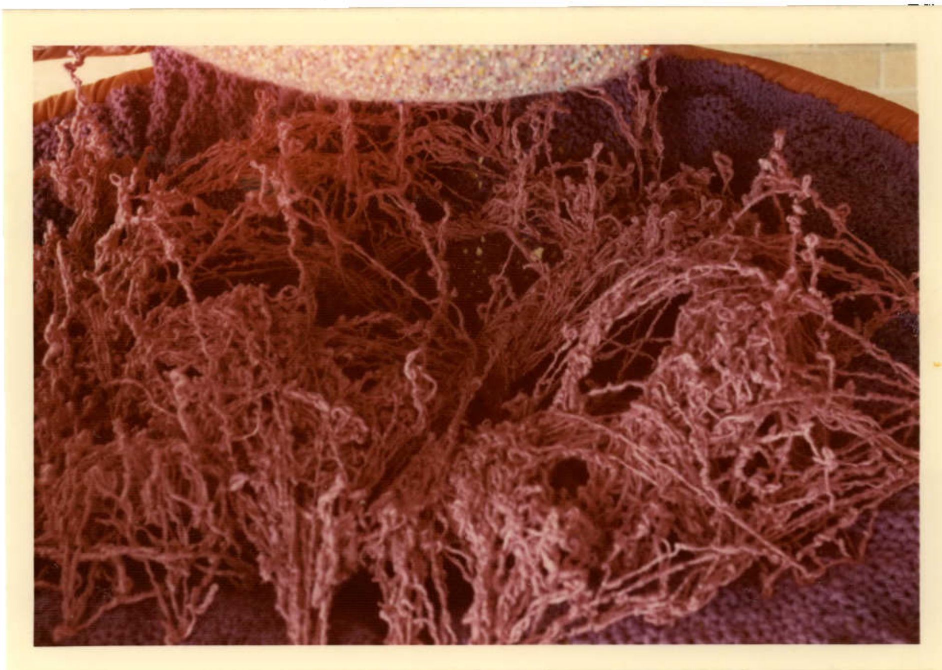

Fig. 5--Interior of upper shell of "Clam" project

A birchwood base was constructed to house the motor, completing the combination of contrasting materials: smooth leather, fibrous yarns, shiny beads, and waxed, subtly-grained wood. The total impact is one of a baroque phantasy egg, deriving its form from the clam.

There were some problems encountered. The large scale of the piece made it difficult to control the stuffed under-structures because the kapok in the forms tended to shift and had to be stitched through all layers to the upper and lower shell frame. Care had to be taken that the exterior and interior construction of the lower shell would not impair the movement of the motor. To accomplish this, no covering, other than the one encasing the kapok, was added to the exterior of the area of the lower shell that was directly over the motor. This area is not visible because the motor is enclosed within the birch box stand. The outer leather skin had to be pieced to insure a smooth fit on the aluminum frame of the upper and the lower shell. It may have been more desirable to have used a smooth, unseamed surface. This was tried, but it proved to be unsuccessful due to the curving contour of the shell surface. In addition, it was difficult to reach the furthermost areas of the interior surfaces of the shell, making it tedious to complete the knotless netting portions. Several finishes were considered for the birch box stand. A mahogany stain was used and applied to the wood surface. The surface was then covered with five coats of brick colored Trewax, and then buffed to a satin shine.

The idea for "The Billboard" was suggested by the motorized highway signs, the purpose of which is to convey more than one piece of information in a more interesting way to the passing motorist. Like its signboard counterpart, the motorized woven "Billboard" presents three visual experiences to the viewer. It was designed around a modular unit which used two-dimensional weaving surfaces to create a three-dimensional form. Each unit employed three different weaving techniques to further emphasize the changing surfaces.

Twelve panels were made, then combined into three sets of four panels each. Each panel measures two feet wide and seven feet high, and 3/4 inch thick, forming an overall assembled dimension of eight feet wide and eight feet high (including the one foot high base). Each panel frame is constructed of 1/8 inch thick plywood nailed to a frame of white pine with metal brackets attached at the top and bottom of each frame. The metal brackets are notched to fit into triangular-shaped housings which, in turn, are attached to an aluminum base. See Figure 6.

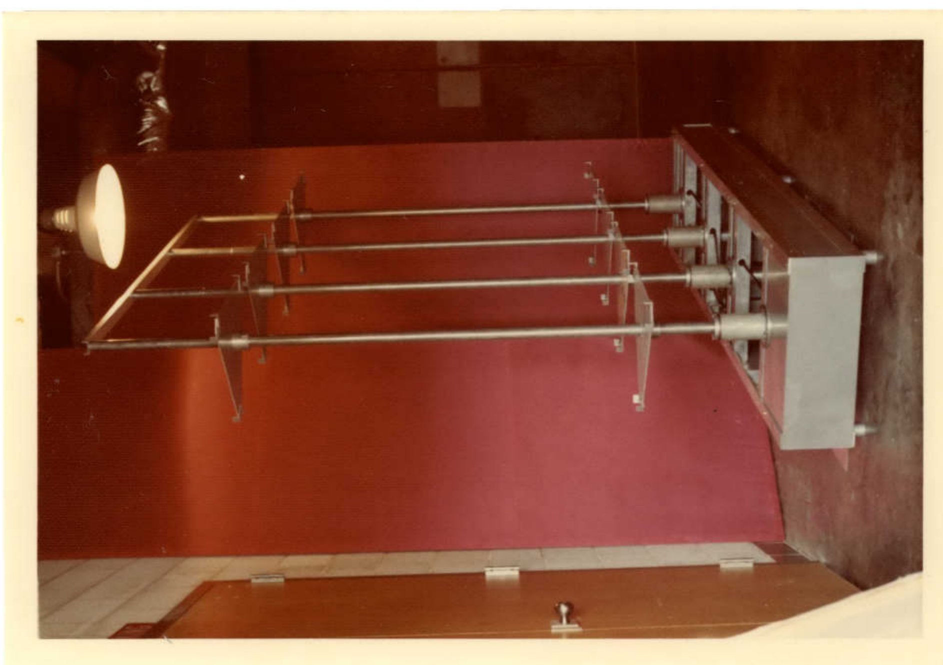

Fig. 6--Metal housing for "Billboard" project

The aluminum base houses the motor which drives four shafts attached to the central core of each panel. See Figure 7 on following page.

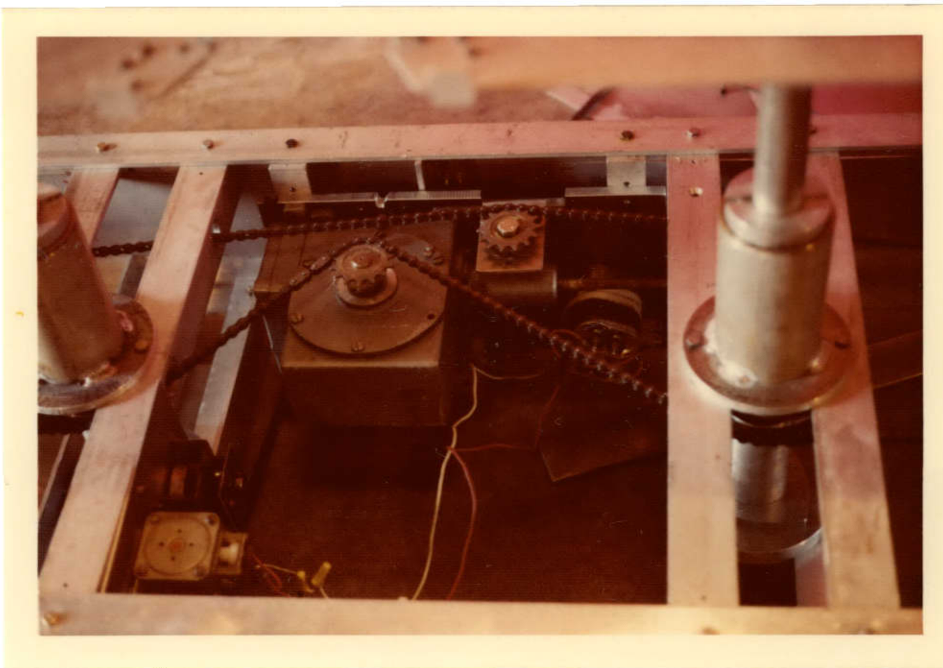

Fig. 7--Motor assembly for "Billboard" project

A timer is attached to the motor action to create a stop-start movement.

To create three different visual experiences, the weaving techniques of slit tapestry, ikat, and plain weave were utilized. Natural greyed colors and brilliant colors were juxtaposed to add to the variety of the total piece. Flowing designs, as well as structured designs were chosen to further heighten the variety of the work.

In the first set of panels the effect was that of spilling paint. See Figure 8 on following page.

Fig. 8--Ikat panels for "Billboard" project

The technique of ikat weaving, a process in which sections of the warp and/or weft are tied and dyed before the yarns are threaded on the loom, was employed (1, p. 409). Acrylic paints were used to achieve a brilliant color. Each panel was woven only at the top and the bottom to facilitate the adhering of the fabric to the panels, and so that the total result would be one of unwoven floating yarns, to create a sense of fluidity.

The second set of panels incorporated the technique of plain weave to best create a smooth texture which would not compete with the color of the stripes. See Figure 9 on following page.

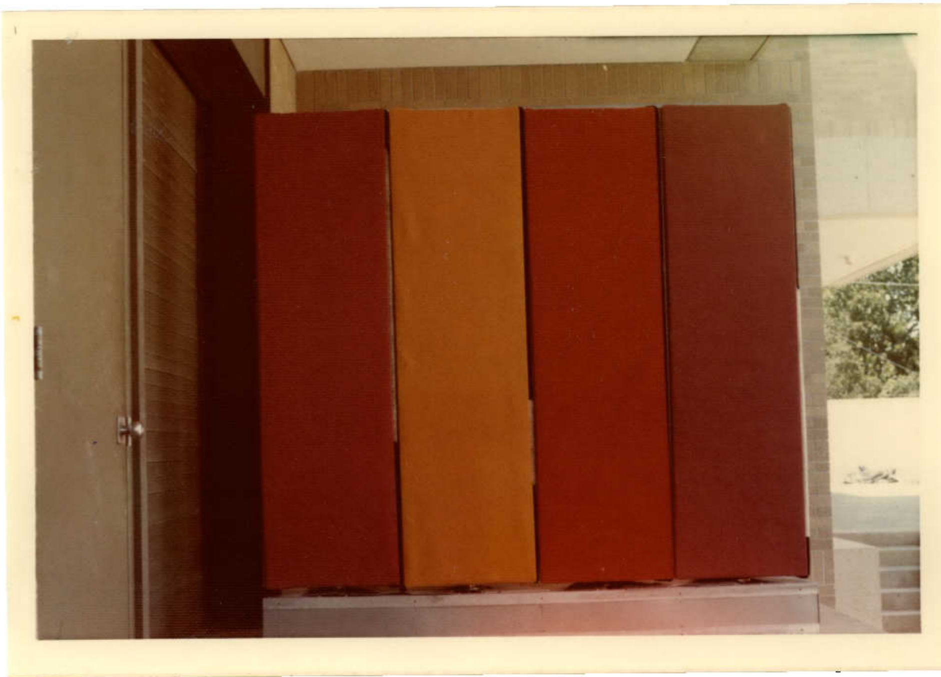

Fig. 9--Plain weave panels for "Billboard" project

Close color values were used for three of the panels and one contrasting color was used for the fourth panel to create interest.

In the final set of panels a more flowing, organic design was created. Natural greyed colors were used to insure a change of color pace. See Figure 10 on following page.

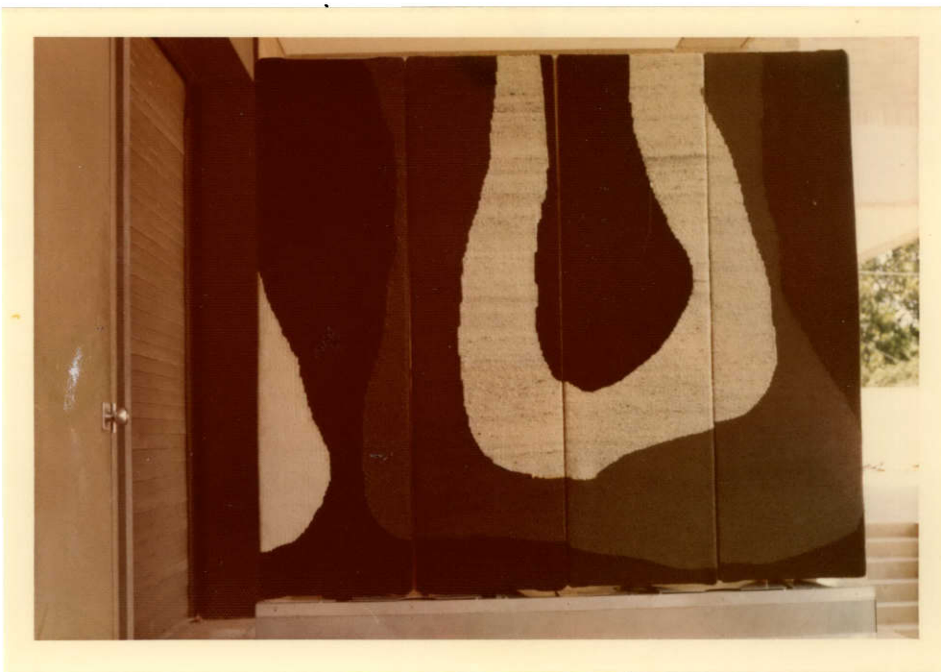

Fig. 10--Slit tapestry panels for "Billboard" project

The weaving technique of slit tapestry, in which one weft enters from the left and the other from the right and turn around adjacent warps, leaving a slit, was used (2, p. 74). This technique requires that the tapestry be sewn on the reverse side after the piece has been removed from the loom.

Some problems involved in these panels were foreseen and taken into consideration. Light weight panels for the understructure were necessary to minimize the stress on the motor. Large scale was important to match the impact of its billboard counterpart. Removable panels were designed to facilitate transportation.

There were some unforeseen problems encountered. The density of warp threads required for the ikat panels resulted in an unusual amount of twisting in threading the loom. Perhaps a different approach to warping off the yarn singly rather than in pairs would minimize this twisting of the warp. In transporting the work, some of the fabrics in the set of plain woven panels tended to stretch and had to be refitted to the boards. The warps in the ikat panels tended to shift during transportation and had to be re-combed.

The differences in yarn sizes on the various panels resulted in many problems relating to the mitering of the corners on the triangular modular units. The revolving of the frames holding the panels could not be adjusted so that the panels would have a close fit when in the stop position. In addition, a smooth stop-start action was desired, but in this problem with the type of mechanization used, a jerky, vibrating, action was achieved. This was not desirable and will have to be corrected on future models.

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CHAPTER IV

EVALUATION AND PROJECTION OF THE WORK

"The Clam" is the more successful of the two projects in terms of total presentation. It achieves the goals of combining mechanization, form, and textile fabrication into an aesthetically pleasing entity. The contrast created by the smooth outer surface of the shell and the textural inner surface produced the desired results. The scale of both pieces added power to the forms, and the motorized action enhances the works and creates a new dimension of vitality.

"The Billboard" is the less successful of the two projects because of the lack of precise fitting panels and the jerky, vibrating action. The tapestry panels, and the ikat panels are the most satisfying in terms of weaving. Portions of the tapestry panels tend to lose some impact because of the difference in dye lots of the yarn used. The solid color panels seem the least successful. A closer color relationship or a subtle change of texture may have added more to the total impact of these color sets.

The works involved a greater expense than was anticipated, and the scale of the pieces, with the weight resulting from that scale, make them difficult to transport. These considerations tend to deter future investigations along these lines.

Yet, in spite of all the problems and complications encountered, the idea of motorized fabrications is still an intriguing one and the surface of exploration has scarcely been scratched. Many other actions, or combinations of actions, could be investigated, resulting, perhaps, in a multiplicity of moving forms. Materials could be woven directly into the fabric structure of a piece and be activated by energy sources other than those that are motor driven. A good example might be the weaving of stainless steel wire into a fiber warp which, in turn, would be activated by a powerful magnet to produce movement. Complicated, diverse patterns of movement might be achieved through the use of computerized motors. Smaller, more intricate pieces could be woven, perhaps a form of jewelry, and activated by transistorized motors. Other approaches might be woven "walls" that undulate, or woven or knotted floor sculptures that "breathe" with an up and down motion.

Motorized weavings have a strong vitality of their own. Moving fabrications seem to echo the course that today's weaver is set upon--the use of established fabricating techniques to create more dynamic art forms.

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