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Fountains: Ceramic forms that contain or move fluids

John Caster

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John Caster

Candidate for the Master of Fine Arts Degree in Ceramics

of the College of Fine and Applied Arts

of the Rochester Institute of Technology

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Fountain: a term applied to simple arrangements for letting water gush into a basin, and to more elaborate ones in which water is forced mechanically in high jets.[1]

The fountain was originally a natural spring. Fountains were made with increasing complexity to create artificial or modified natural streams of water directed into an appropriate basin. Fountains served as sources of water, as symbols of religious significance, and as demonstrations of wealth and luxury.

Now that the fountain no longer needs to be associated with these ancient usages nor reserved for the visual delights of the priviledged few, many new concepts can be explored. In my thesis I have sought to explore the various properties of fluids directed through the fountain to create many statements in hydro-kinetic sculpture. That the units are small, portable and self-contained further illustrates my departure from the ancient concept of a fountain. No longer associated with serving a large group in a servile function nor as a massive decorative statement for the few, I have sought to create fountains containing subtle, visual changes to be observed at close range.

Before embarking on the correlation between moving fluid and static ceramic form the various properties of fluid as a separate entity were explored. The initial, obvious fluid explored was water.

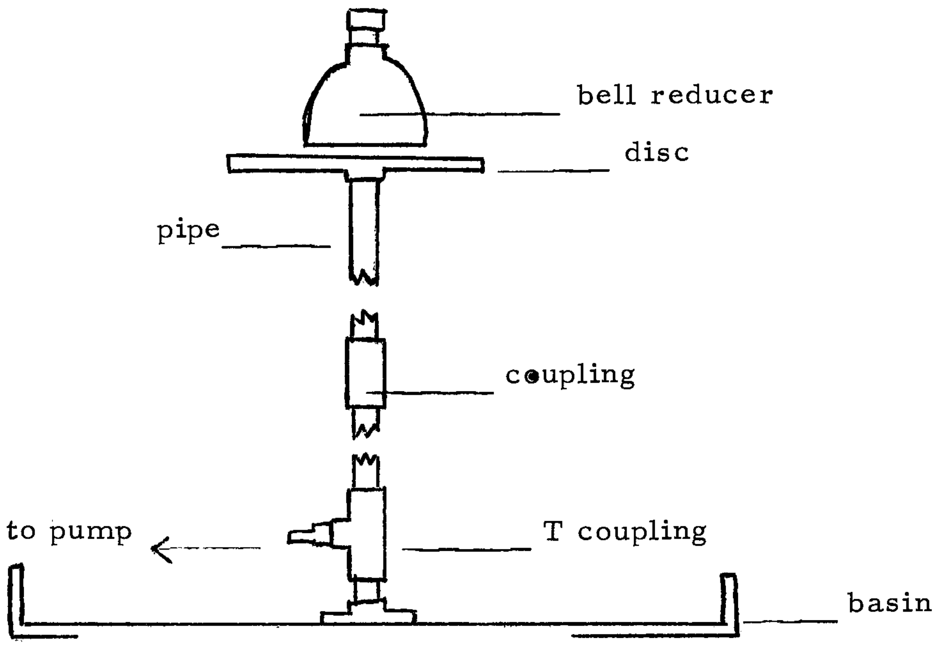
In observing various fountains it was interesting to note how subtle, virtually unnoticeable changes in surface contour of the lip greatly affected the flow. Small projections on the lip changed sheet flow, a smooth sheer drop, to white water, a bubbling, turbulent mass. This introduction of turbulence of sufficient scale entrapped air in the stream and blew up the mass of water with air bubbles. This imparted a quality of additional mass to the flow of the water.

To explore the potential of each type of water action, sheet flow and white water, various means were used. Initially, relatively inexpensive means were employed. A submersible pump and garden hose were placed inside a basin. By regulating the amount of water, sheet flow or white water was produced. The more water that flowed through the hose, the more turbulence was created with the predictable result of white water. When this effect was not desired the amount of white water could be radically decreased by enlarging the jet orifice or spout opening.

These unsophisticated means, however, were not consistently reliable and to create a dependable situation a complete facility involving the study of liquid in motion, or hydraulics, was needed.

The following full scale hydraulic facility was put together.

Fig. 1

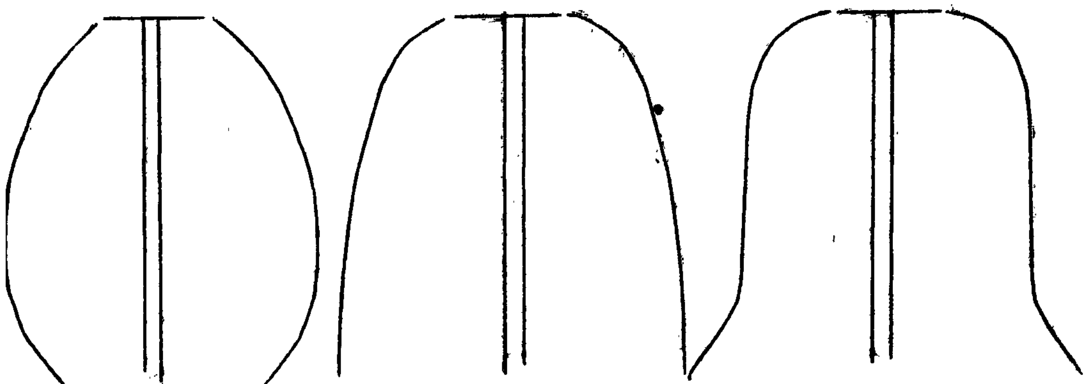


The bell reducer controls flow rate. The disc and the lip angle controls sheet flow. The coupling and pipe can be regulated in height and distance to control the form of the fluid.

Consider a liquid flowing with radial symmetry from an orifice, as one might see flowing from the bell reducer in Fig. 1. As the liquid sheet falls towards a collecting basin of liquid, it is found to stay intact and to form a surface of revolution about the axis of the pipe. If the dimensions become too great the flow may become unstable and break-up into droplets. Such a surface may be termed a "water-bell"[2], see Fig. 2. The shape of the water-bell is dependant on the initial thickness and velocity of the fluid and upon the various forces acting as the sheet descends.

One of the most important forces is surface tension. Various shapes are possible of which two extreme types and a "normal" parabaloid are shown below in figure 2.

Fig. 2



a. contacted bell b. normal bell c. expanded bell

An explanation of the shapes in qualitative terms may be attempted as follows. Gravity, accelerates the sheet. It spreads out under its initial outward momentum and must become thinner. This means less mass per unit area and thus the sheet becomes more sensitive to the forces of surface tension and air pressure. Surface tension acts to pull the liquid together at the higher levels while an air pressure within the bell below atmospheric pressure will also give a net inward force. Such a set of forces will then result in a form as shown in Fig. 2a. If air pressure is equalized by breaking the surface, a more normal shape, as shown in figure 2b results. As the sheet meets the liquid in the basin air may be entrained in the fluid and carried out of the bell, reducing pressure, or due to turbulence some trapped air bubbles may break within the bell and raise the pressure. Furthermore, at the boundary where sheet meets liquid in the basin if there is a net motion of the liquid away from the central axis, the sheering forces of viscosity and the surface tension may act to pull the sheet outward, as shown in Fig. 2c. Viscosity is also important in that it reduces local disturbances and helps prevent the sheet from breaking up into droplets. As the fluid falls it seeks the form of least surface energy which will be a sphere or droplet.

In review, we may assert that there is a dynamic equilibrium state reached in which the influences of initial velocity, sheet thickness, air pressure difference, gravity, surface tension and viscosity are all delicately balanced. A change in any one of these, or in the geometry of the orifice and its height relationship to the surface will change the size and shape of the bell. At present we do not have sufficient information for a complete understanding and prediction of the bell shape. However, we do have enough control to use the fountains.

One of the first experiments in fountains that I tried was actually a method of measuring surface tension. A slow, steady stream of liquid issues from a circular nozzle and falls on a convex surface. This obstacle produces stationary corrugations called standing wave patterns on the liquid surface, as shown in Fig. 3. Changes in the pattern can result by raising and lowering the convex surface.

Fig. 3 Standing wave patterns on a liquid jet

There are other liquids which behave differently than water and offer a varied source of interest. Fluids such as liquid starch, clay slip, honey and motor oil offered alternatives to water and its typical flow pattern. All increased the viscosity thereby decreasing the turbulence. However, these fluids did have draw backs. First, they broke down quickly and formed lumps, sludge or crystals which made pumping difficult. In addition, the first three picked up bacteria, and motor oil had an objectionable odor.

In the search for other liquids I discovered the water soluble resin Polyethylene Oxide. This substance has many exciting, functional and aesthetic qualities. They include a high thickening efficiency, a high resistance to bacterial attack, a soft silky feel in solution, a flexibility of film, and a reduction of splattering and misting in solutions. These qualities proved the "Polyox"[3] solution superior to water in many instances.

This polyethylene oxide, Polyox, comes in eight grades and one molding compound. Work was conducted using three of these resins, Polyox WSRN-10, Polyox WSR 1105, and Polyox WSR 301. The WSR series proved to have higher viscoelasticity than the WSRN series. The WSRN series has a more stable viscosity under sheering acting than the WSR polymers.

Testing the flow of liquid was necessary as a preliminary step in understanding the action of the liquid itself before attempting to relate this variable form to the constant form of the ceramic sculpture which served as a container.

My essential objective, of course, was not merely to develop new artistic idioms that utilize sophisticated technology. The goal was to correlate art form and technology. Furthermore my intent was to create new statements suggested by our life conditions. Being conditioned as we are to an abundance of movement we respond easily to kinetic forms. The hydrokinetic form was obviously closely related to this, and therefore selected as an appropriate vehicle for demonstrating the correlation between art and technology.

The protagonists and the practitioners of science-art see their use of the most modern artifacts of science and technology as a logical extension of a long tradition.[4] Certainly the collaboration between art and technology has ancient roots. The artist has always worked with the tools of his time. The particular science and technology that reflects our time offers us a new means to express it.

Fountains, of course, are not only an intellectually conceived hydrokinetic science, but also a physically visual art form. Upon concluding the various tests with liquid involving the preceeding technological considerations of physics and hydraulics I was able to begin creating workable forms. First, I decided what basic effects were desired. Next I attempted to reach an understanding of the visual quality of each of these effects. Finally, I sought to work out a plan for the total display. Further development was through renderings, models, photographs, and analogies. Ultimately the hydraulics and economics, i.e. pumps and related materials, were correlated with the ceramic form to create the final design.

The ceramic fountains followed the above discoveries made from working with hydraulic systems. The first few fountains were simple jets of water running out a spout and into a basin. As my knowledge of hydraulics increased the fountain systems became more elaborate. The later fountains using polyox produced an ultra smooth, immobile quality whose perfection seems associated with the controlled effects of man-made technology. In this way it was sophisticated beyond the somewhat unpredictable splattering flow of water, and yet by virtue of its velvet quality became associated with the subtle, tranquilizing, hypnotic properties of being totally at one with nature.

As I further explored the use of water and polyox in the fountains it became clear that polyox was far superior to water with respect to my work. The polyox, because of its properties, involved considerably more interaction with the viewer. Whether they were peacefully hypnotized by its action, or appalled to discover their physical world challenged by a fountain that did not appear to flow, all responded. I found this an interesting phenomena.

The most recent series of fountains displayed textural variations on the ceramic form. This added yet another dimension. As the liquid flowed over the surface a vibration or pulsating stream was created. The experience was similiar to the blinking of neon lights that have become so common a sight in our technological society. Yet once again there was a certain peace associated with natural phenomena and utterly opposed to the obnoxious blinking intrusions that glaringly disturb our vision and tranquility.

In order to reach a more complete understanding of my search it would be appropriate at this point to discuss explicitly the sequential development of my fountains.

In my first fountain the technological considerations were joined with the creation of the aesthetic form. Water was able to flow successfully through the unit. Upon completion, however, I noted that it was too similar to a functional piece of ceramics such as a covered jar, as seen in photo 1.

For my next few pieces I sought a more sculptural form. Again, the water was able to stream through it properly. Later in my explorations, having discovered the valuable properties of polyox, I decided to substitute this liquid. It eliminated the splashing that had occurred in a small basin when water was used, see photos 2, 3, and 4.

In my search for a continuously improved sculptural form that could function as a fountain, I explored the concept of positive and negative space. The strong positive form was obviously that of the ceramic piece. The water seemed to suggest a negative form due to its translucency and lightness of weight. I therefore decided to play the seemingly negative form of the water against the actual negative space on the other side of the piece, and the positive mass of the total ceramic form. The conceptual volumes of the water and the hole were considered as an integral part of the total design as seen in photo 5.

At this point in my research I began to delve into the historical aesthetic roots of the fountain concept. Intrigued by the mythical sources used as subject matter I explored a design that reflected this and the method of issuing water, see photo 6.

Although my fountain reflected the innocuous historical forms, I discovered that many old fountains actually demonstrated a vastly different concept. Fountains such as the "Fountain of Stags" in the castle of Schwetzingen[5] showed animals or mythical creatures in torment, and the water gushed out with violence and force to form huge splashing droplets.

Upon consideration of the concept this latter type was displaying, I evolved a design that reflected the contemporary vision. Abstract ceramic forms became part of the water that was forming forceful streams and huge droplets, see photo 7.

My next series continued to deal with correlating the actual ceramic form to the form the water assumed. Changes were made in the approach, however. Added clay was applied to the main body to create a more subtle display of this concept. I also added an additional value to the water via the resulting creation of standing wave patterns as seen in photos 8, 9, 10 and 11.

I have endeavored to show examples of fountains via changes in flow patterns, a comparision between water and polyox as suitable liquids, and the play of texture along the surface. The fountain used as correlation between art and technology creates an intriguing relationship that can stimulate or tranquilize the senses. The accompanying photographs are in black and white to stress this investigation of aesthetic form and scientific control of flow. For the reader interested in a more complete representation of each piece, I suggest he look to the following section containing color slides. In retrospect, the fountain can be viewed as an exciting phenomena that offers many challenges to the sense of vision and one's state of mind.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

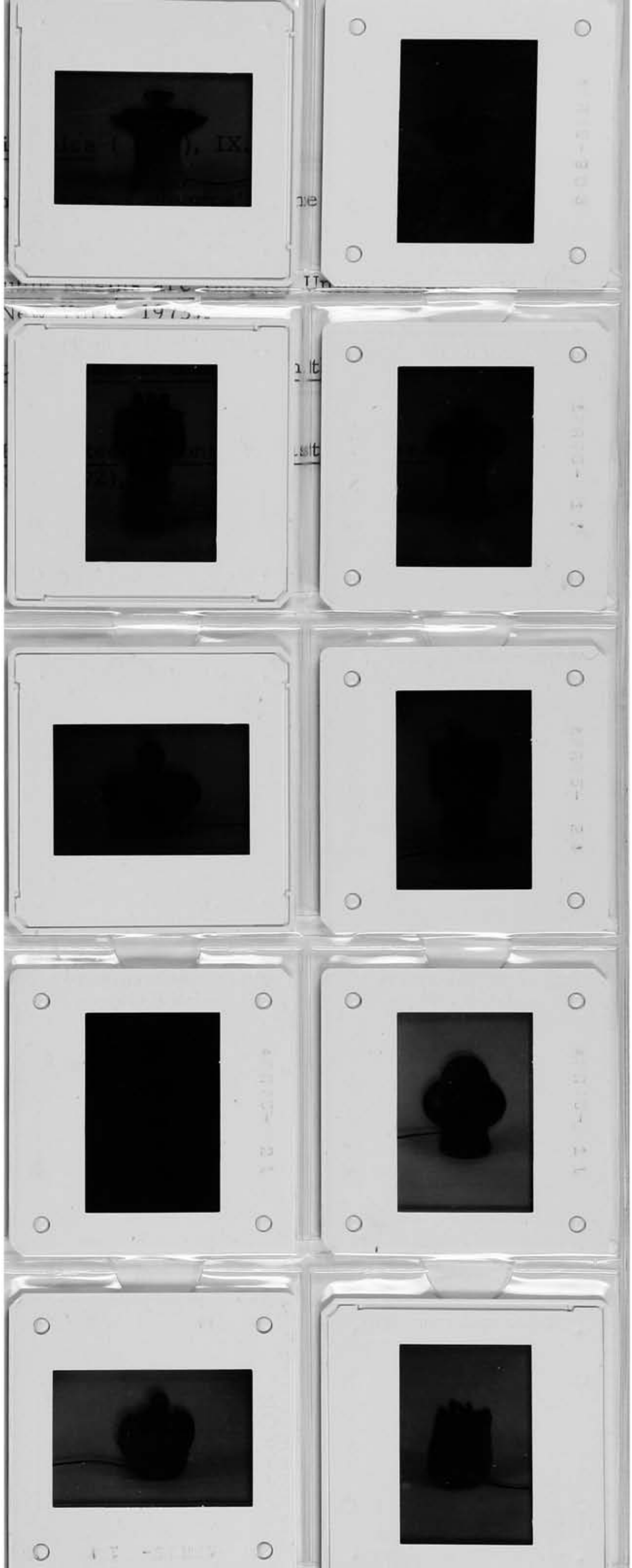
Photo 7

Photo 8

Photo 9

Photo 10

Photo 11



[1] Encyclopaedia Britannica (1973), IX.

[2] R. C. Brown, "Contemporary Physics", 'The Surface Tension of Liquids', XV:4.

[3] Polyox Water-Soluble Resins are Unique, Union Carbide Chemicals and Plastics (New York, 1973).

[4] Stewart Kranz, Science and Technology in the Arts (New York, 1974), 19.

[5] Claude Arthaud, Enchanted Visions; fantastic houses and their treasures, (New York, 1972), 85.

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