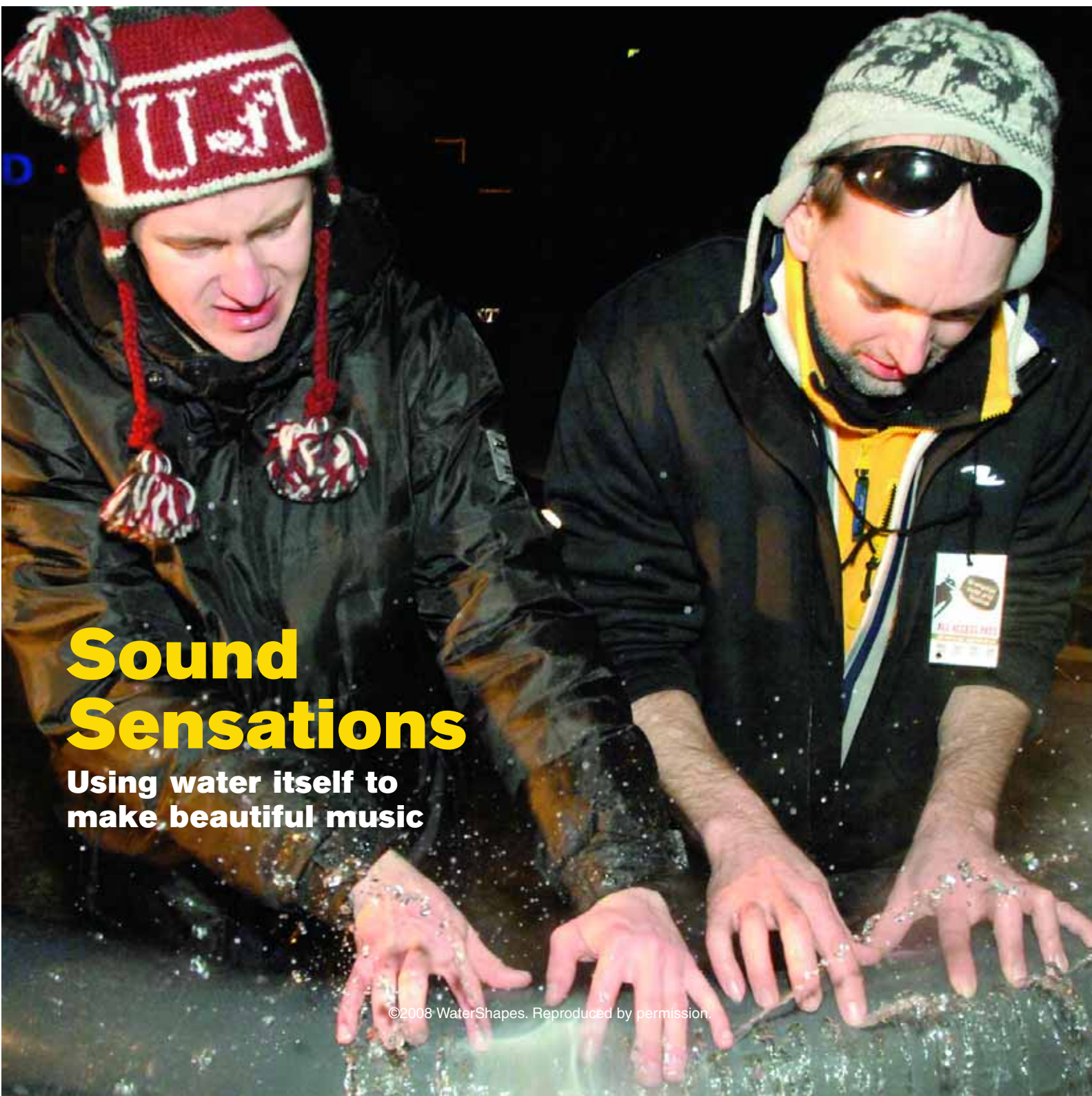
WATERSHAPES
Design • Engineering • Construction



Sound Sensations

Using water itself to make beautiful music

Fluid Melodies

For the past 20 years, Toronto-based artist, scientist, inventor, professor and musician Steve Mann has been inventing, creating, building and playing what he calls 'hydraulophones.' Part fountain, part interactive waterfeature, part musical instrument and in all ways unusual, these systems enable adults, children and anyone who cares to give one a try the ability to manipulate the flow of water to create musical notes, harmonies and melodies.

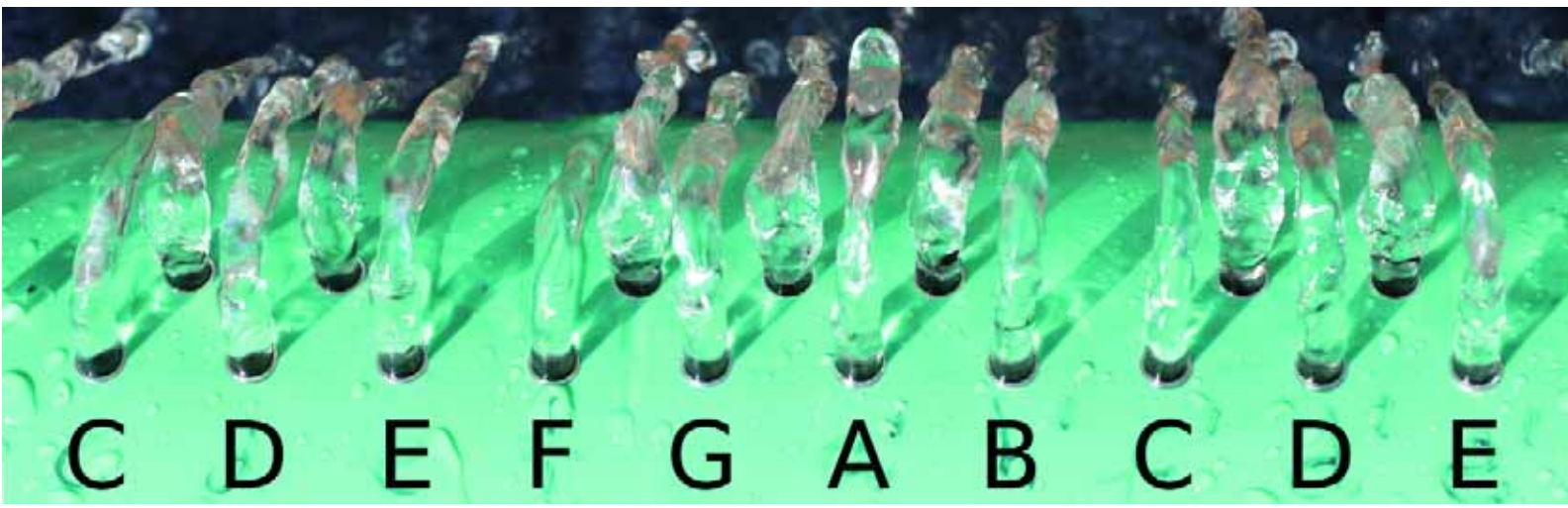
An Interview with Steve Mann

Not to diminish the painted ponies of *The Wizard of Oz*, but Steve Mann's hydraulophones are horses of a different color. These watershapes come in all sorts of shapes and sizes, from landmark centerpieces that have the sculptural grandeur of pipe organs all the way down to water-flutes that resemble brightly colored tadpoles.

What's most remarkable about these devices isn't just their structural and artistic variety or the ways they look as visual art: It's the *sounds* they make. At first, the natural comparison is to a pipe organ, but as you listen, a variety of shadings and other sonic reverberations emerge, slip and slide around you.

What's more, hydraulophones invite people to insert their fingers into the jetting water to shape the sound and squeeze out the shape of each note, and a variety of sonic textures are possible depending upon how the flow is manipulated. With practice, participants can sculpt an array of purely aquatic sounds as well as what sounds like an entire orchestra of oboes, flutes and harmonicas.

The hydraulophone's inventor, Steve Mann, has been playing with (and playing) these devices for about 20 years now, finding more and more ways to put them in places where people can see, hear and become personally involved with them. We caught up with him early in December 2007 as he was rehearsing for a formal holiday concert at which his instrument of choice was to have a starring role.



Through years of development, the hydraulophone has become a serious musical instrument capable of great range and depth of sound – so much so that it has moved into the concert hall where it holds its own among conventional orchestral instruments.

WaterShapes: **How did you start down this path of creating musical instruments that use water to create sound?**

Steve Mann: I began by wanting to challenge the conceptual boundary between work and play.

A big part of the idea behind the hydraulophone is the notion of what I call the "urban beach," a place where aquatic sculptures invite people not only to look at them as objects, but also become engaged with them as active parts of the environment. It's a place where people can play in the water with either their fingers or their whole bodies.

The great thing about a hydraulophone is that it injects this note of playfulness and alters one's perception of a space in subtle ways – maybe even *subversive* ways. It works because a hydraulophone can be a majestic architectural centerpiece at the same time it brings aquatic play into the picture. In effect, it breaks down the separation between parks and beaches and serious places where people don't typically think of fun and play.

Business parks or university campuses, for example, can be very serious architectural environments: What a hydraulophone does is introduce a playful element into the setting in a way that enhances the scene rather than contradicting it the way an ordinary play feature would.

WS: **So the concept of 'play' is extremely important?**

Mann: My use of the word *play* is a double entendre in the sense that we talk about "playing an instrument" at the same time a hydraulophone is about getting people of all ages (not just children!) to "play" in the sense of a child playing with a toy.

I think that's an especially fascinating concept: It's as much about getting adults to play as it is getting children to play. And with hydraulophones, they are often invited to do this playing in spaces that one would not normally think of as play spaces – such as at the main entrance to a landmark architecture site.

WS: **What made you think of marrying water and music?**

Mann: When we learn about music in school, we're taught that there are only three kinds of acoustic instruments:

strings, percussion and wind. As I studied music, I began to think of percussion and strings as being far more similar to each other than either of them are to wind instruments: Strings and percussion instruments both make sounds with solid matter while the wind instruments use air.

But the piano, for example, is both a percussion *and* a string instrument: It challenges this boundary. So before long, I came to think of only *two* categories of acoustic instruments – solid and gas – with two subcategories in the solid column (strings and percussion) and two more in the gas column (woodwinds and brass).

Taking this line of thought a couple steps farther, school also teaches us that there are three states of matter in nature – solid, liquid and gas. This led me to ask, "Why not try to create an instrument that works off matter in a liquid state? Why not take an instrument similar to a flute and have water flow through it instead of air?" In that sense, I was thinking of a hydraulophone as an entirely new category of instrument.

WS: **Where were you when you first came up with the idea of creating a liquid musical instrument?**

Mann: It's something I've had in the back of my mind for a very long time, so I can't think of an exact time or place. But if there was a specific trigger that really motivated me to further develop and perfect this invention, it's an event I remember from the mid-1980s.

At the time, I was watching and listening as a liquid-nitrogen truck filled the tanks in a nearby building and remember being intrigued by the sound of the fluid flowing

Along a distant but parallel track, hydraulophones also moved onto the playground, where children (and their parents) are utterly fascinated by the curious sounds the tadpole-shaped Nessie makes when they play with the jets of water.

through the pipes and how it made a whistling noise that was actually a very pure note that would shoot up a perfect fifth every once in a while. This inspired me to make up a song in which I tried to capture the spirit of the sound: It was called "Liquid Nitrogen," and to this day it's one of my favorite songs to perform on a hydraulophone.

As I experimented more and more, I developed systems with high and low pressure levels in which different kinds of sounds come from the instrument depending on how you position your fingers over each of the water jets. What's really fun about hydraulophones is that sounds differ when you block the edge of the water jet (where the water is moving with less velocity) as compared to blocking the center.

WS: **What made you think you could do all this? How did your background influence you and contribute to the hydraulophone concept?**

Mann: Ever since I can remember, I've been interested in interdisciplinary studies and thinking. I went to the Massachusetts Institute of Technology because MIT is the kind of school where students are encouraged to be technically crazy as well as artistically crazy over a wide variety of disciplines.

This education taught me to think in terms of combining disparate concepts to create something totally new. The hydraulophone is a perfect example of that kind of thinking: On the one hand, it's a technical device with various hydraulic and structural elements; on the other, it's very much about art both in being a musical instrument and in being sculpture. And when you consider that it blends art and technology with fundamental forms of human behavior, you can see that it cuts across several major conceptual boundaries.

That sort of creative collision has always fascinated me. I think that's where new things come from, by combining ideas and applying them in ways that haven't been considered before. At the same time, I take personal joy in disrupting traditional categories and like the fact that I've stirred up some controversy in the field of organology because authorities in the field simply don't know how to categorize hydraulophones.

WS: **Do you particularly enjoy challenging conventions?**

Mann: I think there's something to be said for asking questions and challenging boundaries. As James Baldwin once said, "The purpose of art is to lay bare the questions which have been hidden by the answers."

Insects exist by performing very specific, categorical functions. Humans are more complex, and I believe we should have the capacity to transcend categorization. And, yes, I do like the fact that the work I do confounds categories.

WS: **When did you create the first hydraulophone?**

Mann: I've invented, designed and built hundreds of different types of hydraulophones through the past two decades, each of them quite different from one another, so it's hard to put an exact date on it. But it was at some point in the mid-1980s, when I composed "Liquid Nitrogen" and began pursuing distinct sounds, tuning and intonation with my early hydraulophones.

WS: **How have they evolved?**

***Mann*:** The first hydraulophones were *very* difficult to play. You had to press down on the jets *really* hard to create a note – upwards of 60 to 70 pounds of pressure per square inch. In fact, when I first started playing back then, I would do pushups on my fingertips to make my fingers strong enough to play the instrument comfortably – and even then my hands would quickly become extremely tired.

In the years since those first incarnations, much of the development/refinement process has been aimed at creating instruments that require just a light touch so that everyone from very small children – even babies – to elderly people with arthritis can play them.

It interests me that people talk about hydraulophones as though they're all one thing, but I've actually made hundreds of different instruments that respond in different ways

and operate on vastly different principles. In actuality, it's a whole family of instruments that use water: Some are simple and others are extremely complex.

WS: **So the use of water is the unifying characteristic?**

Mann: Obviously, yes, but there's also the way they're played that unifies them and makes them all "hydraulophones." The one thing they all have in common is that you have a row of water jets and make sounds by pressing down on those jets, obstructing the flow and creating different notes and chords.

The whole range of hydraulophones shares this unifying characteristic. On one end of the spectrum are massive public-art pieces that exist as permanent installations; on the other, we make very simple hydraulophones that are scaled for use by small children – and there are numerous iterations in between.

WS: **What actually creates the sound?**

Mann: That's an interesting question, because among people who make musical instruments of all sorts, there's a constant debate about what actually makes the sound. In a woodwind instrument that has a reed – such as a clarinet, for example – the reed vibrates in such a way that it can be partially credited with generating and manipulating air movement.

In a reedless wind instrument such as the flute, however, the sound is most certainly made by the air. Thus flutes are purer examples of wind instruments: Although the sound is modifed by covering up finger holes (or pressing the keys or levers) in different combinations, the wind is what makes the sound.

The potential these watershapes have to attract the attention of musicians, parents, children, seniors – people of every age and walk of life – has made hydraulophones star performers in public places, where they break down basic social inhibitions and encourage interactive play in a way few other installations ever could.

Hydraulophones are new, so their sound production is not as well understood and is something we're investigating. What I've done in all cases is replace human breath with the flow from a garden hose or pump to create different notes at different finger holes while

maintaining the ability to affect subtle, independent changes in sound at each hole.

WS: **Are all hydraulophones custom-made for specific applications?**

Mann: Not quite. I've worked through the years with designer Chris Aimone, and together we've come up with a "standard" hydraulophone for interactive waterplay. These units resemble giant tadpoles or small whales – a sort of sea-serpent-like shape, so we call her "Nessie" after the Loch Ness Monster. Children seem to love her.

On larger scales, Chris and I do custom design/production work, generally breaking things down into three steps: initial study, design and execution. To that extent, larger pieces of the sort that become civic sculptures are definitely application-specific instruments.

WS: **I can't help noticing that you refer to hydraulophones using the female gender. Why is that?**

Mann: It just seems to work that way. The Loch Ness Monster, for example, is always referred to as "she," and ships are usually also referred to in feminine terms – as are many large bodies of water such as lakes. But there may also be something else at work here, something more primal, because people have told me that hydraulophones speak with a feminine voice.

The Ears Have It

This is a case where hearing is more than half the fun.

To get a clearer sense of what these instruments are all about, go to the Internet, type in *www.youtube.com* on your browser and search on *hydraulophone*.

You might also want to look in at *www.funtain.ca* and *www.wearcam.org* – sites with more information on hydraulophones.

There are several film clips for viewing, and we'd recommend closing your eyes to drink in the sounds if it wasn't so much more interesting to watch.

– WS

I once played a concert in New York, and afterwards a woman came up to me – crying and smiling at the same time – and said that she was really moved by the performance. Then she said something that's stuck with me ever since: "This is really fantastic, it's really *woman*. Air instruments are male, but water is woman." We don't necessarily want to read too much into it, but there's probably an aspect of water that invokes the whole idea of the return to the womb.

WS: **Were you influenced by the Water Organ at Villa d' Este and its use of water to create sounds?**

Mann: Actually, no. People have asked me before if I was inspired by Greek or Roman fountains that made sounds, but those installations didn't use water as a "user interface," nor did they make sounds with water. Instead, the water was a source of power that moved air to create sounds. In a hydraulophone, by contrast, the water isn't just a source of power, but is also both the user interface and the source of the sound.

WS: **Where have you been installing your hydraulophones? What sorts of environments?**

Mann: So far, we've placed them in public parks, college campuses, community aquatic centers, waterparks and even some retirement villages, and I have the sense that they'll work just about anywhere people congregate. What's unique about them is that they bring the concept of waterplay to a level of sophistication that makes it appeal to people of all ages. Children love them and so do adults; in fact, some older folks with arthritis actually use hydraulophones in music therapy, which strikes me as a wonderful application.

It's interesting to note that, while aquatic play appeals to people of all ages, adults sometimes don't indulge in it because of social constraints on behavior: You might *want* to run through a fountain on a hot day, but you don't do it because that's not what adults generally do unless they've imbibed a bit and have broken down their inhibitions.

But hydraulophones are musical instruments, so that whole psychology shifts and adults feel free to play because they're making music: That's a much more sophisticated form of play than simply splashing around and getting wet.

There's also the educational aspect: Whereas parents are often hesitant to let their children play in public fountains and come home with wet clothes, they seem to take delight at hearing their kids play simple songs on the hydraulophone.

We even do music lessons on the hydraulophone: Learning music has never been this much fun!

WS: **How would you describe your creative process?**

Mann: That's not so easy to answer. With the hydraulophone, for instance, I was directly inspired by a dream I had that I was playing a fountain the way someone would play a pipe organ, but well before then I'd spent a great deal of time in my childhood taking things apart to see how they worked.

Hydraulophones function and exist based on known scientific principles using common materials. They may be based on what may seem wild-eyed or off-the-wall concepts, but the process of making them is very thoroughly grounded in reality.

One of the things I like most about what I do is that I've given myself license to dream *and* work – to have my head in the clouds and my feet on the ground at the same time. Again, it's my way of breaking down the boundaries between technology and art.

WS: **Do you think the fact that hydraulophones use water to make music is the main reason people find them so fascinating?**

Mann: Absolutely. There's something almost otherworldly about the sounds they make, but I accept the fact that the water itself stirs people's imaginations and evokes emotional responses: They don't have to think about it much to conjure the almost primal feeling of being connected to nature by touching water. When you add in the fact that by touching water *you make music*, something very interesting happens that is fairly profound at the same time it's a lot of fun.

There's something frolicsome about it. You don't have to be a musician to enjoy playing it, but musicians go nuts because they can play songs while having all that fun.

WS: **Do you write music specifically for hydraulophone?**

Mann: Yes I do, and I've even invented new kinds of musical notation for hydraulophones to capture their full capabilities.

A hydraulophone has all the notes that you'd expect to find on common orchestral instruments, but the sound has a different quality from any other instrument I've ever heard. Its basic sound suits songs written in minor keys – which is fantastic because children seem to respond well to music in minor keys for some reason – but of course it can be played in major keys as well.

The sound is almost otherworldly, a singing voice of a very special sort. And with practice, you can learn to bend and squeeze notes by the way you press the jets, which allows you to expand the range and create notes that don't exist on standard instruments.

WS: **Because hydraulophones exist in the environment and can be played by anyone who wants to give it a try, do they change the way you think about 'performance'?**

Mann: Most definitely. In fact, they completely break down the separation between the audience and the performer.

In a typical concert, the performers sit on a stage, protected by the proscenium, and the audience sits on the other side of that barrier at a set time in anticipation of hearing well-rehearsed pieces of often-familiar music. By its very nature, a hydraulophone deconstructs that entire system, creating a space in which there's an ongoing performance with no separation between the audience and the performers.

In addition, one of the things I really like about the hydraulophone is that you can *see* what it sounds like. Not only does the same note sound sadder when you cover the edge of a finger hole instead of its center, but it also looks sadder, with the water jet drooping down in a sad-looking kind of way. This makes playing the hydraulophone very visual as a performance medium.

Also, because the hydraulophone makes sounds on its own when no one's playing it, you don't even need performers at all: Proximity is all it takes to enjoy what's happening. But usually, once people recognize that all they have to do is walk up, press the jets and make music, they don't hesitate to get involved: Hydraulophones are very friendly in that way.

At the same time as they encourage play, larger hydraulophones can also serve the monumental needs of public spaces, arriving on the scene like alien pipe organs to create visual cores for plazas, courtyards and civic centers.

Pagophone
Solid H_2O (Ice)

Hydraulophone
Liquid H_2O (Water)

Idratmosphone
Gas H_2O (Steam)

Plasmaphone
Plasma "H_2O" ("Lightning")

Hydraulophones and the "States of H_2Orchestra"

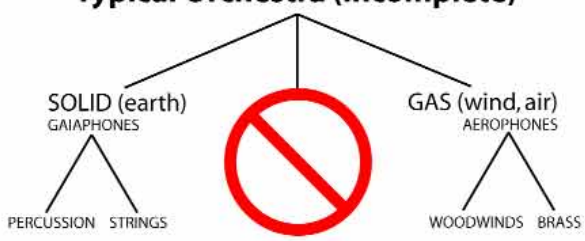
Dihydrogen monoxide H_20 exists in the familiar states-of-matter or phases, known as ice (solid), water (liquid) and steam (vapor, gas).

FUNtain's "H_2Orchestra" demonstrates a wide range of artistic and design creativity and an ability to invent a wide range of new sculptural forms such as musical instruments that exist in all four "Elements" of H_2O: "Earth" (solid H_2O, ice); "Water" (liquid H_2O); "Air" (gaseous H_2O); and "Fire" (H_2O-initiated plasma).

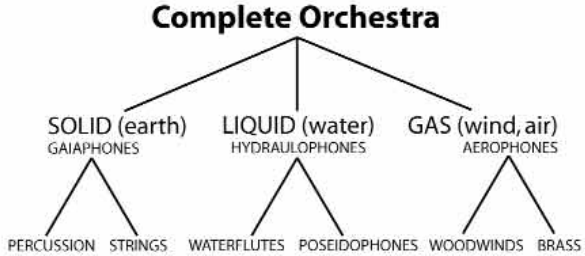
The States-of-H_2Orchestra was born in Canada in the early 1980s, with the invention of the hydraulophone. It was inspired by the sounds of liquid flowing through valves, by inventor Steve Mann whose work has been shown in numerous museums around the world, including the Smithsonian Institute, National Museum of American History, The Science Museum (Wellcome Wing, opening with Her Majesty The Queen June 2000), Museum of Modern Art (MoMA in New York), Stedelijk Museum (Amsterdam), Triennale di Milano, Austin Museum of Art, and San Francisco Art Institute. Mann also won the Coram International Sustainable Design Award (first place) for this interactive musical aquatic play invention/sculpture. These inventions are covered by an extensive patent portfolio, by patents filed in various countries.

Although water has been used to make music for many centuries, (ancient Greek and Roman water organs, Handel's water music, etc.), the hydraulophone is the first musical instrument in which the sound originates from turbulence and vortex-shedding phenomena of water itself. It is also the first musical instrument in which water itself is the user-interface (i.e. to be played by touching the water directly). The water organ and hydraulis of ancient times made sound from air, using water merely as a source of power to push air across a fipple mechanism or through some other kind of acrophone, controlled by a keyboard (i.e. non-water) user-interface.

Typical Orchestra (incomplete)



Complete Orchestra



Typically acoustic instruments produce sound by matter in its solid state (percussion or string instruments), or by matter in its gaseous state (by air in wind instruments). The invention of the liquid-based hydraulophone suggests that the space of known acoustic musical instruments should be broadened to include all three states of matter: solid (percussion or strings), gas (wind), and liquid (a new category of musical instruments). No orchestra is complete without a water section!

Interact with the ground nozzle by touching the water jet. Sculpt the water in different ways to intricately change the sound timbral properties.

The hydraulophone is available as an acoustic musical instrument, but it can also be ordered with sensors and controllers so that it can actuate other devices using MIDI, DMX512, or custom communications protocols like FUNtain's FLUIDI (TM). FUNtain's "Foot Frolic" product allows architects and waterpark designers to have ground nozzles that are general-purpose input devices. Stomping on this water jet can play a musical note, or change the programming, such as the lighting pattern or water spray sequences in the rest of the park, or elsewhere. Using water itself as a user-interface eliminates problems associated with other sensors used in waterparks.

www.FUNtain.ca | 330 Dundas Street West, Toronto ON, M5T 1G5, Canada | +1.416.946.3387

WaterShapes

It's the magazine for professionals who design and build with water – including architects and others related to the field.

It's about ponds, swimming pools, fountains, lakes, waterfalls, spas and all types of waterfeatures.

It's about a brave, new design frontier – and it's delivered, *free of charge*, to members of the watershaping trades.

---

q **Yes!** I'd like a **FREE** subscription to *WaterShapes*, the magazine of the watershaping industry. I understand that there is no charge for this magazine so long as I qualify as a reader. (Your signature is required.) q No

Signature _____ Date _____

Your name _____

Company name _____

Address _____

City _____ State ____ ZIP _____

Phone _____ Fax _____

E-mail _____

Please check the appropriate boxes below to indicate your qualification to receive the magazine free of charge and send the completed form to:

WaterShapes
P.O. Box 1216
Lowell, MA 01853

→ OR FAX IT TO (978) 671-0460 ←

1 I describe myself as a: (check ONE only)

A q Landscape architect
B q Landscape designer
C q Landscape contractor
D q Pool/spa designer
E q Pool/spa builder
F q Fountain designer
G q Fountain installer
H q Pond/stream designer
I q Pond/stream installer
J q Watershaper
K q Engineer
L q Waterfall specialist
M q Rockwork specialist
N q Hardscape specialist
O q Other _____
q Architect
q General contractor
q Government official

2 Which best describes the PRIMARY type of work you do? (check ONE only)

Recreational Water:
Designer/engineer/builder/subcontractor of
A q Residential pools/spas
B q Commercial pools/spas
C q Institutional pools/spas
D q A selection of all above

Ornamental Water:
Designer/engineer/builder/subcontractor of
E q Ponds/biological systems
F q Fountains
G q Waterfalls/cascades
H q Streambeds/water courses
I q Other custom waterfeatures
J q A selection of the above

Other:
K q Distributor
L q Manufacturer
M q Manufacturer's rep
N q Other _____

3 I use, recommend, approve or purchase the following: (Check ALL that apply)

A q Filters, pumps, motors
B q Heaters (fossil fuel, solar)
C q Valves, fittings, plumbing
D q Cleaning systems
E q Chemical treatments
F q Lighting systems
G q Control systems
H q Covers, enclosures
I q Landscape materials
J q Aquatic flora, fauna
K q Construction, excavating equipment
L q Interior finishes
M q Decking
N q Other _____