Plastic Ocean

Art and Science Responses to Marine Pollution

Edited by Ingeborg Reichle

DE GRUYTER

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NOISE AQUARIUM is a participatory art project that comes after a series of works which explored how to immerse the audience using scale and sound to bring forward the importance of the invisible and inaudible. This essay follows the trajectory of a number of collaborative artworks that have inspired and led to the concept and framework of NOISE AQUARIUM: NANO (2003), NANOMANDALA (2003), WATER BOWLS (2006), and BLUE MORPH (2008). All of these works involve scale, sound, and working with ways to slow down the audience by using technology to amplify the experience that requires balancing, stillness, and deep listening to give access to the invisible and inaudible realms. I aim to describe the coemergent process that was developed over the past two decades in order to create works that are ecocentric and transdisciplinary.

NOISE AQUARIUM: Iterations, Variations, and Responsive Ecotistical Work

Victoria Vesna

The artwork *NOISE AQUARIUM* used existing visualizations as an anchor to create an experience that amplifies the importance of plankton for life on Earth by submerging the participants in sounds of underwater noise pollution and prompting them to center and balance themselves. Many of us are still not aware that plankton is a central source of the oxygen we breathe and that noise pollution underwater is destroying so much of the marine life that has a direct impact on all living beings. The aim is to show that even though we do not see the plankton with our naked eye or hear the noise deep down in the oceans and seas, we are all implicated due to the destructive effects of our excessive exploitation of resources which has thrown our planet out of balance. Many different iterations of *NOISE AQUARIUM* (FIGURE 1) have been created over a period of three years (2017–present)—from linear videos to fully programmed interactive virtual reality (VR) and most recently, due to COVID-19 restrictions, as an online network collective meditation. In all instances, the goal remains the same: to remind everyone that the oxygen for every second breath we take is produced by plankton and that we are all part of the complex web of life. The intent is to create an ecocentric[1] point of view and immerse the audiences into active deep listening.[2]

NANO: Making the Invisible Visible, the Inaudible Audible Although I could rewind the film back much further when considering the importance of sound, vibration and frequency as an anchor for visual experiences, the starting point of what led up to *NOISE AQUARIUM* was without question the *NANO* exhibition in Los Angeles, USA (2003–2004).[3] This ambitious collaborative project with nanoscientist James Gimzewski involved contributors from many disciplines and was the beginning of consciously imagining a series of connected art installations that involved full audience participation. The invitation to develop an exhibition in the annex of the Los Angeles County Museum of Art (LACMA) came because of institutional museum restructuring, which opened an opportunity to create a series of experimental works that allowed the audience to interact with the artworks and experience a different sense of space and movement. This exhibition took place just after completing my first fully collaborative work with Gimzewski, *ZERO@WAVEFUNCTION*—an interactive installation

FIG. 1
***NOISE AQUARIUM* at Ars Electronica Center's Deep Space 8K, Linz, Austria, 2018.**
© Victoria Vesna, photo: Glenn Bristol

FIG. 2
ZERO@WAVEFUNCTION *at the* »*Inner cell*« *of the* NANO *exhibition at the Los Angeles County Museum of Art* (LACMA), 2003–2004.
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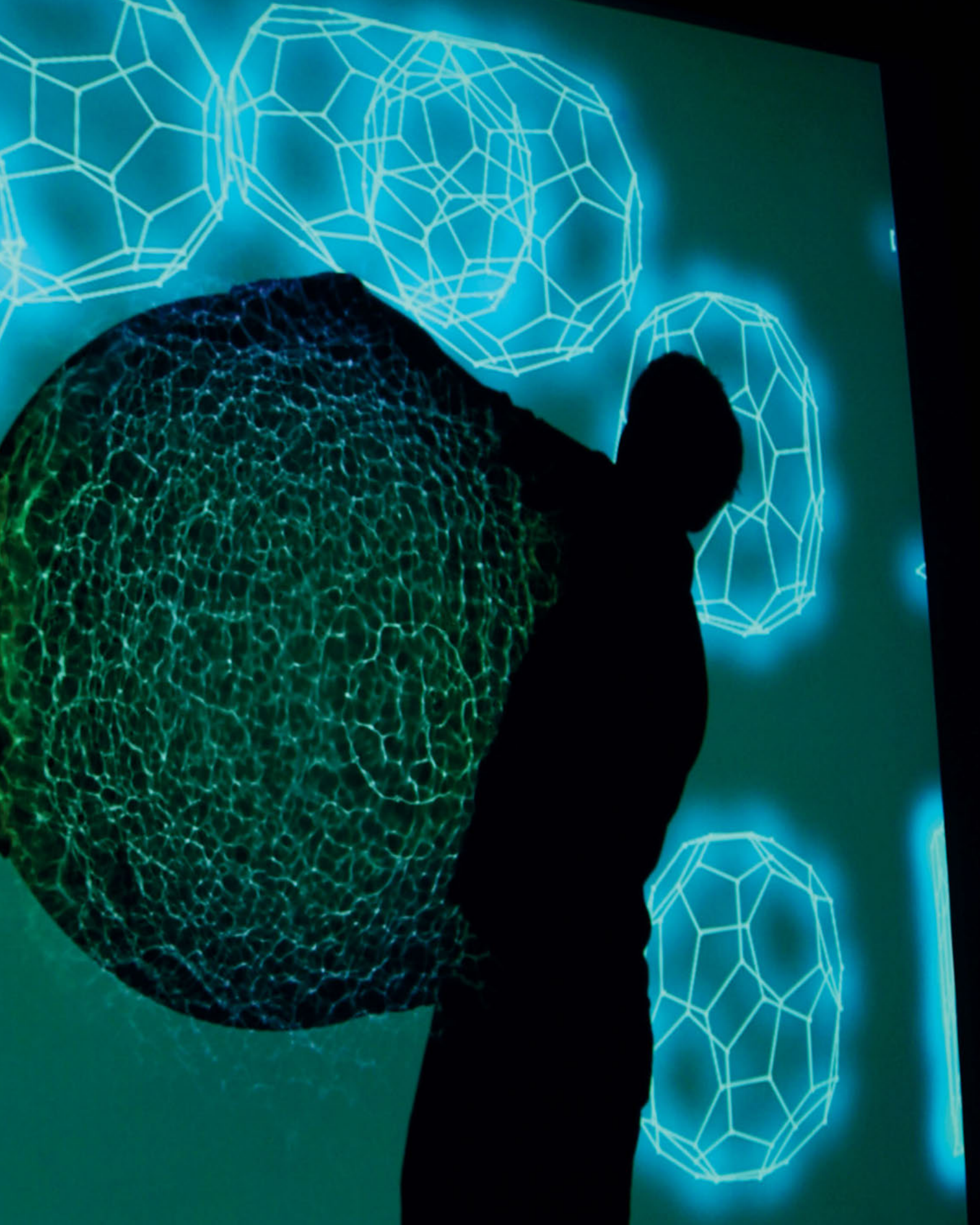

with visualizations of buckyball molecules being manipulated by the visitors' shadows (FIGURE 2).

Buckminsterfullerenes, or »buckyballs,« discovered in 1985, are named after the architect, engineer and visionary R. Buckminster Fuller, »Bucky« (1895–1983), who designed many geodesic domestructures that look similar to the molecule with the formula C_{60}—discovered two years after Fuller's death. Ideas to expand further the experience of the molecular realm were developed in discussions, amongst others with N. Katherine Hayles, a U.S. postmodern literary critic, who was Professor of English at the University of California Los Angeles (UCLA) at the time,[4] and her students who were invited to write about the process and work. On top of that, the museum connected us to architects who were also actively participating in the structural design of the exhibition—again reflecting Fuller's ideas of geometric and organic forms found in nature.[5] ZERO@WAVEFUNCTION became the central piece from which all other installations emerged, including their architecture.

As we moved further into the development of the exhibition, the museum curators became concerned that the concept was not connecting to contemporary art enough, and so I was asked to look through the collection and pick a few works that could also be included. At that point in time the highly collaborative and interdisciplinary process of developing a work of art was foreign to the museum curators and was even not perceived as art. Thus, the idea was put forward that adding some artworks from the collection would somehow help the audience to appreciate this kind of art and science work. This endeavor to put on display a selection of artworks in tune with our project was more challenging than one would imagine as it seemed forced and did not make sense in more ways than one. However, as I began to cast my net wider than the contemporary art collection, I was attracted to the East Indian collection and thought that a Buddhist work would be perfect—as James Gimzewski kept saying, we are looking into empty space when we peer through a scanning tunneling microscope (STM) since all we see there are waves and particles. When this idea was presented to the curators, they brought to our attention that a group of Tibetan monks would be at the museum to build a sand mandala and that perhaps we could work with that in one way or another. We were thrilled and wanted to talk to the monks directly as we had a shared goal—to show how everything is interconnected.

***NanoMandala*: CoEmergence/Transitory Nature** Over the next three weeks, we watched the sand mandala being created. The monks were chanting throughout the process and told us that they did not know exactly what the sand mandala would look like when finished. When the curator asked when it would be completed so that they could schedule a showing, the answer—to the organizer's frustration—was that they were not sure

FIG. 3
Destruction of the Chakrasamvara sand mandala by Tibetan Buddhist monks, in conjunction with the CIRCLE OF BLISS exhibition at the Los Angeles County Museum of Art (LACMA), 2004.
© Victoria Vesna

and there was no way to predict or influence the creation process. It took four monks working for weeks, eight hours a day, to complete the Chakrasamvara sand mandala, and after a few weeks on display, its destruction was a major and a disturbing ritual that included a lot of movement and noise (FIGURE 3): the monks swept up the sand and, with the audience following them, they ceremoniously walked down to the beach at the Pacific Pier to throw it back into the ocean. Observing the monks' performance was a lesson for us and our own project as it demonstrated the transitory nature of life and the importance of sound in the process of creation and destruction.

Our collaboration with the Tibetan monks, which we called *NanoMandala*, immersed the audience in a meditative piece with three levels of perception: photographic, optical, and through scanning electron microscopy (SEM) (FIGURES 4–5). The *NanoMandala* is projected onto a round bed of sand that is the same size as the original sand mandala, and the images move at a scale beyond the powers of ten, beyond the visible realm. However, ultimately, what pulls one into this piece is the audio

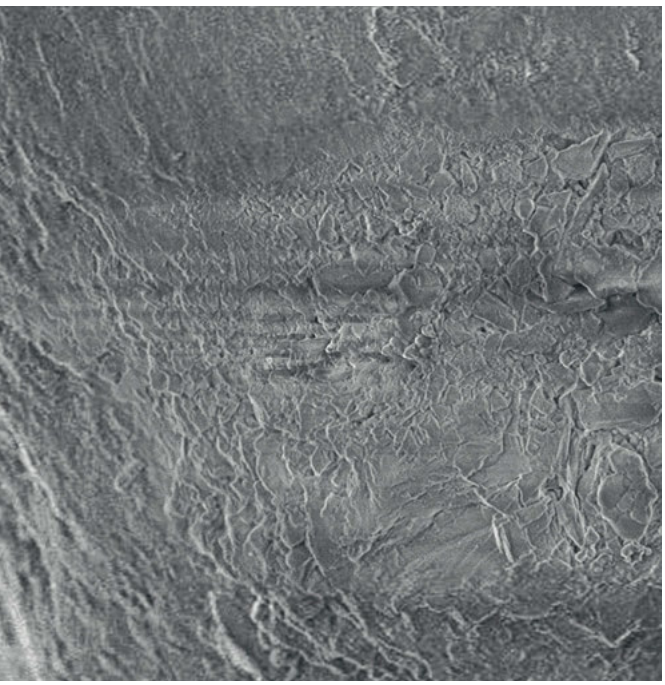

FIG. 4
Scanning electron microscopy (SEM) image of the surface of a grain of sand, 2003, James Gimzewski, UCLA PicoLab.
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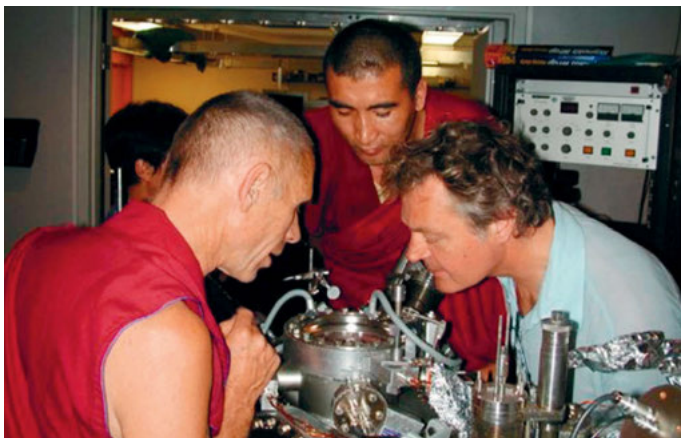


FIG. 5
Monks being introduced to the scanning tunneling microscope (STM) by James Gimzewski at the UCLA PicoLab, 2003.
© Victoria Vesna

vibratory field: sounds of the ocean, the audio recording of the mandala being created and the human voices chanting.[6] The piece is a meditation on the importance of every particle and wave, of the interconnectivity of us all and everything surrounding us, as well as on our amazing ability to take huge data sets of information and reduce them to the essential truth in the blink of an eye. It took billions of sand grains to construct the complex sand mandala, but now we have the ability to see that each grain of sand is itself composed of many billions of molecules.

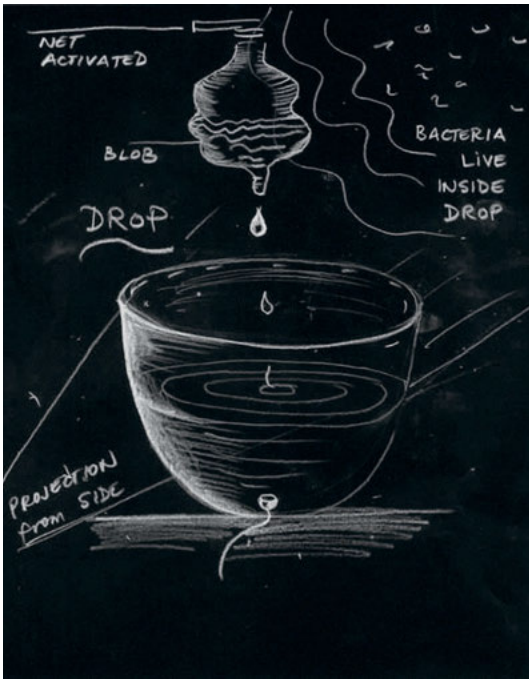
NANO: Movement through Scale and Space __ In the NANO installations, one of the main rooms, the »Inner Cell« had a floor that was inspired by the surface of a graphene—an allotrope of carbon consisting of a single layer of atoms arranged in a two-dimensional honeycomb lattice. Electron waves in graphene propagate within a single-atom layer, making them sensitive to the proximity of other materials, and this laid the foundation for much of the nanotech revolution in materials science. As people moved through the space they were influencing the floor, as would happen with the needle of the STM. Here was the ZERO@WAVEFUNCTION piece, with bucky-balls projected in this central space of the installation that were influenced and transformed by the moving shadows of the audience. Very quickly, people figured out—usually by watching others—that in order to create

change, they had to move slowly. This slow movement was inspired by watching the monks working patiently and slowly on the sand mandala and the scientists manipulating the molecules—in both instances, fast movement would mean destruction and thus it was important in both of these processes to move slowly and deliberately.[7]

An additional element was added to the interactivity in the form of robotic balls that were manipulated—moved—by the audience in the adjacent room from a table that had a bird's-eye view of the people in the room with the graphene floor. Here, we were mimicking the process of manipulating and moving around molecules remotely with the robotic balls moving around seemingly independently and influencing the movements and behavior of the audience in the main »Inner Cell.« All this was to show the different ways of being and how we are capable of causing change from a distance as well as how our own behavior is influenced by outside forces, whether we are aware of it or not. An important part of the series of installations was the quantum tunnel which additionally addressed the nonlocality of our thoughts, relationships and existence. The sounds utilized were those of yeast cells manipulated by Gimzewski's team, with the movement output being sound rather than a graph. This later became a larger installation, *Cell Ghosts*, and further informed and inspired the BLUE MORPH installation (see below).[8]

This virtual and metaphorical molecular space provokes the audience to discover through physical engagement, to learn by feeling. Viewers experience the act of manipulating molecules and encounter the effects of their bodily movements on the surrounding space. Instead of emphasizing how small the scale of nano is, we created an experience that reminds the audience that we live in a molecular world that is shaped by our presence: the audience becomes the performer and changes the work simply by being there.[9]

***Water Bowls*: Repurposing, Recycling Elements** The robotic balls in the ZERO@WAVEFUNCTION installation got damaged very quickly by younger audiences who were too eager to play with the objects. After the exhibition, these spheres were lying around the studio, and being aware of the fact that they were polycarbonate plastic, I was not comfortable with throwing them away. They were also quite expensive and beautiful as objects, but they no longer had a purpose and took up a lot of space. At one point, a projection light was accidentally thrown on them and the reflections were so intriguing that I was moved to start experimenting. The first thing I did was to put the balls into a bowl filled with water and project light onto them. Eventually, I placed hydrophones inside the bowl and developed a work that was in many ways a precedent to NOISE AQUARIUM. I set up four water bowls—half full or half empty—and started to extensively research water as a life-giving element, which led me to underwater noise as well



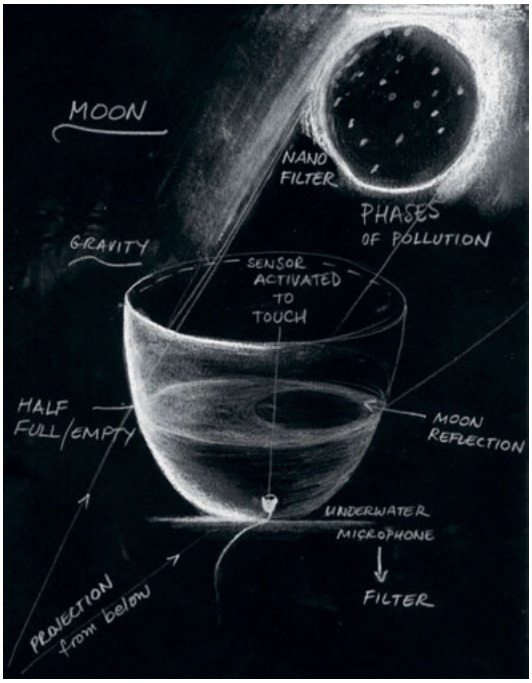


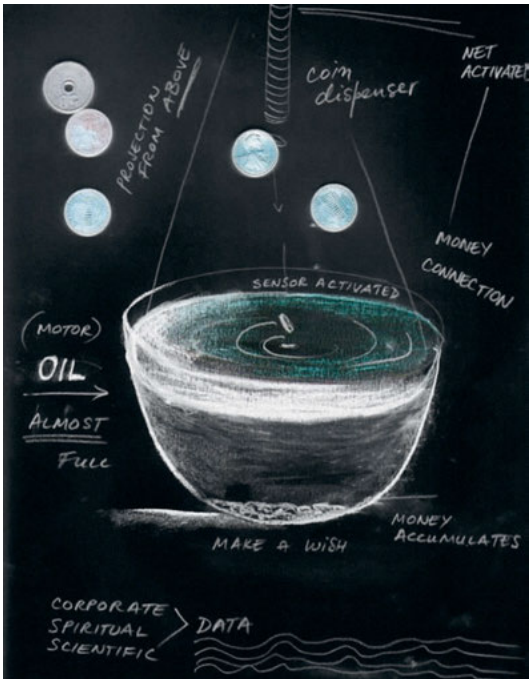
FIG. 6—9
WATER BOWLS: conceptual drawings.
© Victoria Vesna

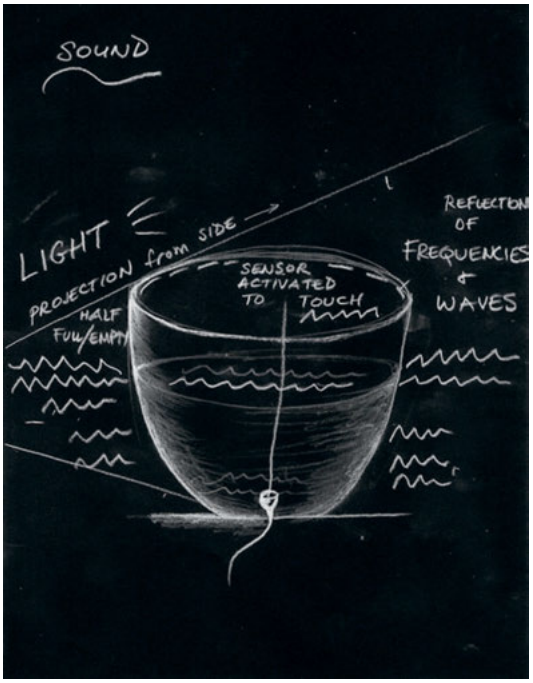
as to oil and plastic pollution and, in general, to looking at the impending disaster of water pollution and water shortage. The installation was set up as a meditative space that, at first, seems very beautiful; but the longer you stay, the more you discover the sad state of water. The audience is invited to touch the water and make noises, create a disturbance and influence the state of the environment—we are all implicated.[10]

Water Bowls: Moon~Sound~Drop~Oil—Local/Remote Participation

Four water bowls—half full or half empty—reflect different aspects of water related to the collective, global human condition. Some of the most common metaphorical associations of water—such as the reflection of the moon, a drop of water, the sound of water, as well as oil and water—are revisited through using some of the latest scientific observations. The bowls »Moon« and »Sound« were envisioned to be locally interactive, while »Drop« and »Oil« were interactive both locally and remotely, emphasizing the global connectivity of both water and human systems, beyond borders (FIGURES 6—10).

In »Moon,« visitors were invited to touch the water; the sounds created by their interaction were picked up by an underwater microphone and amplified. An animation of water molecules, cycling from a heavily



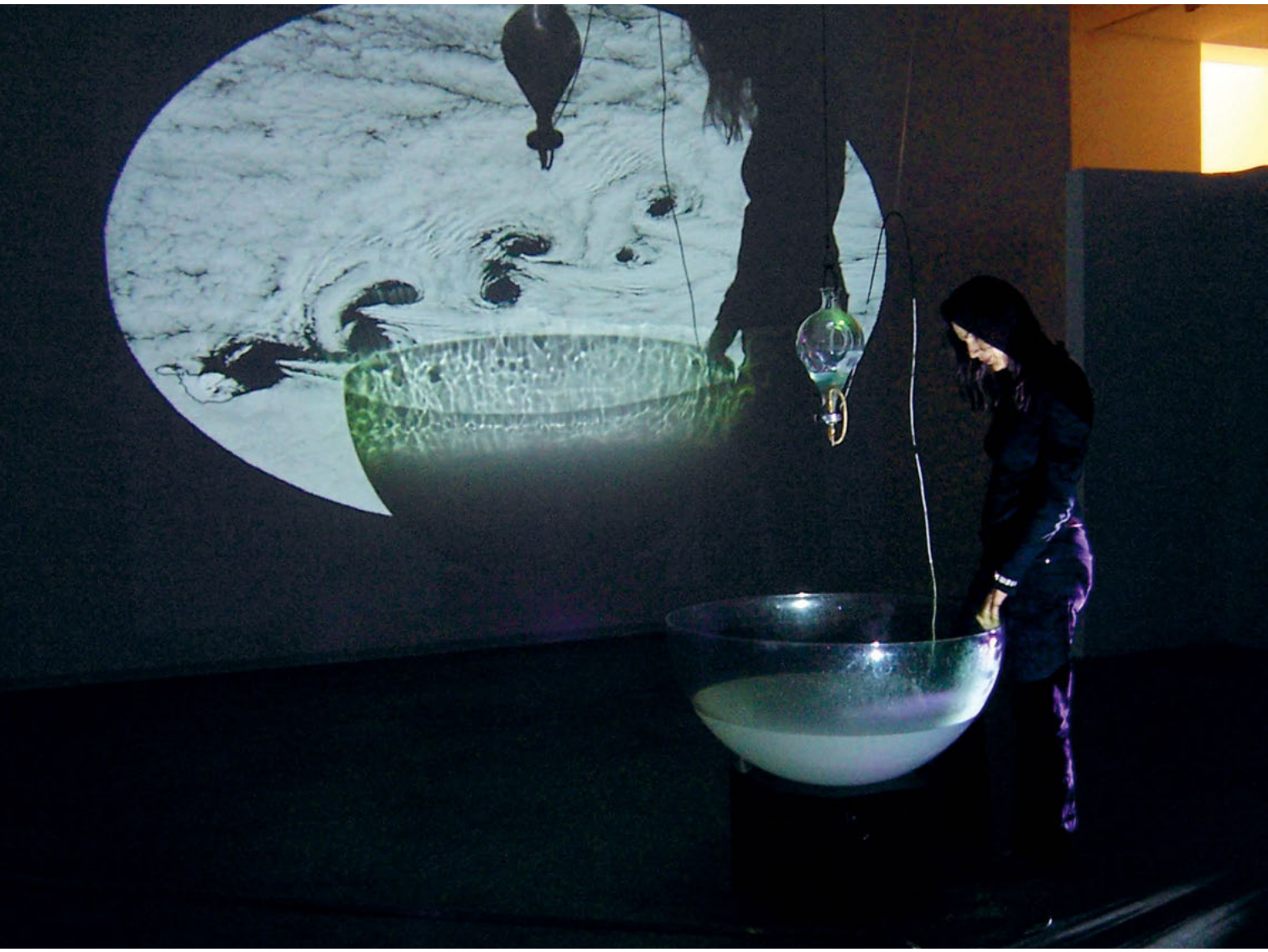


polluted state to clearing and back, was projected onto the water. »Sound« was also activated by a person's touch, which generated a disturbance of the water reflection and allowed the person to feel the vibration of sounds based on underwater pollution (such as sonar frequencies, explosions, and submarines) as well as whale sounds and cell vibrations.

In »Drop,« a drop of water released into the bowl breaks the surface and triggers images derived from maps of water bodies that ripple away. On the project website, visitors could remotely release this water drop from a dispenser suspended above the bowl in the exhibition space. Upon entering the website, visitors were asked to identify themselves with a body of water, for example, the Nile, the Ganges, the Danube, the Pacific, the Atlantic Ocean, the Mediterranean Sea, or any other water body of their choice. The online interface then pulled up a topographic map of the chosen location. The location of the participant was mapped by tracking the Internet Protocol (IP) address of their computer and pairing it with the water body they had identified with on the map. The participant could then add a drop of water to the bowl. The topographic map and the visitor's position on it were also projected onto the bowl in the exhibition space.

In »Sound,« audiences were invited to move the water with their hands, creating sounds that were underwater pollution noises—fracking,

sonar, shipping, as well as naturally occurring sounds. This was really when I began to understand the dire situation that is unfolding and the importance of bringing this issue to the attention of the public. We are all participating in creating this noise and later, with *NOISE AQUARIUM I*, I was really able to bring this to the forefront. The »Oil« bowl contained both water and oil which mix over time and are not clearly separated substances—contrary to what we are often told. I would collect dirty oil from a local gas station and the coin dispenser device above was designed to throw a copper cent into the bowl that generated a disturbing explosion



sound in the room and created a visual mix of the oil and water reflection. The idea was to additionally have people throw pennies into the oil bowl to make a wish which would generate a similar effect, and also to allow remote visitors to type in their wish and release a copper coin into the bowl from the dispenser above it. The wish would be projected onto the oil and visible on the wall behind the bowl as a visualization of dissolving particles. This bowl was almost full.

***Blue Morph*: Iterations, Variations/the Audience as a Performer** __ Just like NOISE AQUARIUM, the BLUE MORPH project was initiated by an invitation from the outside and required learning and research. James Gimzewski's work on cellular vibrations attracted much attention and at one point he was asked if he could measure the vibrations of a butterfly metamorphosis. Although not of particular interest to his research or my artwork, both of us were intrigued and started looking, exploring, visualizing. What was particularly fascinating was that the beautiful iridescent wings of the Melenaus blue morpho butterfly are in fact nature's nanotechnology: it is empty space and patterns that make us see that blue shade, visible in the jungle from miles away. *Morpho melenaus* is an endangered species and has been used by many investigators of biomimicry with applications such as anti-counterfeit money and credit cards. The optics of this butterfly are amazing, but the real surprise to us was the discovery of the way cellular change takes place in the animal.[11]

Using the same technique as for the detection of nano-oscillations of yeast cells, we recorded the sounds of a metamorphosis by measuring the motion of the pupa surface as it transformed from one stage of development to another with an atomic force microscopy (AFM) detection setup. Raw data files of the chrysalis membrane »sound« vibrations were speeded up and amplified by arbitrary amounts, depending on the individual sample. Although we tend to imagine butterflies as silent, colorful creatures, they in fact generate intense noise, inaudible to humans, while in the process of changing. The microscopic encasing becomes the interface of sound intensity, while scattered light mimics the simultaneous beauty and turmoil inherent in the butterfly metamorphosis. We discovered that change does not happen gradually as we might like it to happen, but is a sudden, intense surge of energy that is destructive and creative at the same time. The visualization of the surges of metamorphosis very much resembles the ups and downs of the current financial markets in crisis. Metaphorically, we see this as a collective feeling of »butterflies in our stomachs«—a nervous anticipation of the shift in the human condition. The BLUE MORPH project emerged as an experiential installation that changed form as it moved sites and was increasingly shaped by the different audiences that interacted with it as a ritualistic experience. The installation consists of an interactive seat that one person at a time occupies, wearing a hat pulled up high

FIG. 10
WATER BOWLS: »Drop« – every drop that falls into the bowl activates sounds from a hydrophone and a map image of a water body somewhere on the planet is projected. UCLA Broad Arts Center, 2006.
© Victoria Vesna, photo: Anne Niemetz

into the ceiling as a space for invoking a personal metamorphosis (FIGURE 11). In order for the microscopic butterfly wing patterns and sounds to fully emerge, the participant has to be centered and still. The work evolved over time in relation to site-specific installations, with the source of the conceptual framework being the Integratron, an acoustically perfect tabernacle and energy machine situated on a powerful geomagnetic vortex in the Mojave Desert, California. The structure itself dictated a shift to the audience performing their wish for change by connecting to the frequencies of metamorphosis.[12]

BLUE MORPH came to the attention of Dr. Alfred Vendl, former head of the Department of Technical Chemistry and Science Visualization at the University of Applied Arts Vienna, Austria, who at that time was also utilizing STM in his visualizations and working on visualizing plankton. Dr. Vendl contacted James Gimzewski and visited the PicoLab and the Art Sci Center at UCLA—the beginning of our dialogue that eventually turned into a collaboration. This is yet another example of being open to what is presented to us: I had little-or-no knowledge about plankton and had it not been for this encounter, I most likely would not have gravitated toward this subject, let alone made it the center of my work.

NOISE AQUARIUM: Immersive Sound Vibrations/Animations __ Work on *NOISE AQUARIUM* started in 2016 when Dr. Vendl first introduced me to the amazing plankton visualizations produced in close collaboration with biologists Stephan Handschuh, University of Veterinary Medicine Vienna, and Thomas Schwaha, based at the University of Vienna. The animations had been commissioned for the movie *Voyage of Time* by film director Terence Malick. In the end, however, the work was not used in the movie. Dr. Vendl invited me to make an artwork with the beautiful animations created by Martina R. Fröschl, his PhD student at the time, and I started learning about plankton as fascinating micro creatures. It took me some time to imagine how I could contribute to these amazing animations. The images were magical. I was so intrigued by the complexity and diversity of plankton that it only took work with seven species – and very few visualizations – to realize that there are millions of plankton species in the ocean waters and that they produce the oxygen for every other breath we take. »Why is this not common knowledge? How are these creatures impacted by all the underwater noise and pollution?« I wondered.

In *ZERO@WAVEFUNCTION*, my wonder with regard to buckyballs prompted me to blow up the visualizations as large as possible and give the audience the opportunity to manipulate their shapes while hearing the sounds of the cells. I decided to do the same with the plankton—blow them up as huge as whales in order to bring them to the attention of the audience and bombard visitors with the underwater noise that marine life is subjected to (FIGURE 1). Once I had the concept of scale and noise

FIG. 11
BLUE MORPH
at St. John's Cultural Centre, Gdańsk, Poland, 2011.
© Victoria Vesna

pollution in place, I reached out to Paul Geluso who specializes in immersive surround sound compositions and with whom I had already worked with on the *BLUE MORPH* project.[13]

Over the past few years, many dead whales have washed ashore and lab reports have revealed that they died due to hemorrhaging around the brain, as well as blood around the ears. Findings also revealed that the hemorrhaging was caused by many hours of intense and constant underwater sonar sounds generated by U.S. Navy warships. This was another, more urgent reason for me to blow up the plankton to the size of whales—to show the complexity of the plankton at the bottom of the food chain. And just as in *BLUE MORPH*, when the audience is quiet and centered, the noise disappears and we hear the song of the whale who depends on the plankton—just like we do.

Much of the underwater noise comes from fracking and sonar related to fossil fuel drilling—fuel that is used to produce plastic and is moved around the oceans in ships to reach consumers all over the world. As vast amounts of plastic are thrown away and end up in the ocean, the full circle is complete. When I first saw video images of microplastics being consumed by plankton, I was shocked and my sense of urgency escalated. Dr. Alfred Vendl's reaction was the same and he asked the biologists mentioned above to visualize this in their lab in order to add this important element to the project: It is the entire system of consumerism that creates all the noise we deal with underwater and in our own lives. We are all interconnected in this incredibly complex system and have lost our way in the noise that we are submerged in. Rewind back to the *WATER BOWLS* installation where the whale sounds were also heard in the far distance…

A linear video version of *NOISE AQUARIUM* was first presented in Singapore and Brisbane as part of the On|Off 1001010101 Festival. The plankton organisms were blown up to extraordinarily large dimensions, but somehow the sound was lost by the organizers and, in my opinion, this meant that the entire meaning and intent of the project was lost. The visuals alone are stunning but they do not convey the same sense of urgency of the message that sound can as the driving force of the project. So from that point onward, I insisted on having the sound as immersive and loud as possible and the visualizations as large as possible whenever *NOISE AQUARIUM* was exhibited. Without the sound, the message is lost.

Working closely with Martina R. Fröschl, we developed visualizations of various underwater noise that I mixed and recorded together with Paul Geluso, a specialist in spatialized sound composition. The same interactive computer balance platform that was used for *BLUE MORPH* was repurposed, and with the help of programmer Glenn Bristol, we created a game-like experience where one has to balance in order to get the plankton to come forward and reduce the noise. When perfectly centered, the plankton would come into full huge view, the noise recedes and

the room is filled with the song of a whale. This further inspired Bristol to create an additional VR version of the installation where the audience can be fully immersed while standing on the balancing board—one at a time with others watching.

Perhaps the most impactful version of *NOISE AQUARIUM* to date was accomplished in the Ars Electronica Center's Deep Space 8K in Linz, Austria, in 2018, where the sound was spatially immersive, the projections in high resolution for the audience to intensively experience visuals and sound together. However, it was not possible to install *NOISE AQUARIUM* in this setup at most places that were interested in showing the work, and a more traditional approach was then taken instead, which was also very effective. For instance, at the Historical and Maritime Museum of Istria in Pula, Croatia, the installation consisted of Augmented Reality (AR) prints, three aquariums with plankton and a video projection (FIGURE 12). The sound bounced off the walls naturally, and being in a historical building made it all the more powerful.

Most recently, at the time writing this essay, the installation can be experienced at the Łaźnia 2 Center for Contemporary Art in Gdańsk, Poland, in a similar setup with linear video. For one day, it was also installed as a VR experience at a sound festival in Vienna, Austria. Due to the COVID-19 pandemic restrictions, only very local audiences, and only a few people at a time could experience the work, which prompted me to create a new version: an online network sound meditation where audiences from all over the world can participate and the message can spread wider.[14] For this iteration, I asked the organizers to introduce me to a local sound artist and they suggested Anna Nacher. We immediately connected and started an acoustic call-and-response exchange across the ocean that paid homage to the underwater creatures.

The COVID-19 pandemic sparked an extreme economic slowdown in March 2020, sending cruise ships to port and oil tankers to anchor. This is a very special moment, for the pandemic has actually rendered the seas and oceans quiet and the underwater creatures happy; it has also enabled scientists to make comparisons with the preindustrial age. But on the other hand, plastic pollution is worse than ever because single-use masks and surgical gloves are just like other plastic items, be it plastic bags, fishing lines, drinking straws, or plastic bottles. They take hundreds of years to break down in the environment and decompose into tiny fragments called secondary microplastics and nanoplastics that contain chemicals and pollutants that are released into the ocean. These micro- and nanoplastics are mistakenly consumed by plankton species as food.

In coastal regions, many people report that they are hearing more birds again, which had either been drowned out by noise or their existence forgotten. So, we do have a chance to listen, take a moment and consider

and imagine how we would like our future to look once the pandemic is over. This is the time for artists and scientists—those fortunate enough to be in safe spaces with a job—to work together, raise the frequency of our collective brain waves and move away from mass consumerism to new ways of thinking and being that respect and honor not only the scientific and technological advances but also the ancient and indigenous wisdoms.

FIG. 12
View of aquariums at the Historical and Maritime Museum of Istria in collaboration with Aquarium Pula at the Pula aMore festival, Croatia, 2019.
© Victoria Vesna

1 Joe Gray, Ian Whyte, and Patrick Curry, »Ecocentrism: What It Means and What It Implies,« *The Ecological Citizen* 1, no. 2 (2018): 130–131.
2 Pauline Oliveros, *Deep Listening: A Composer's Sound Practice*, New York: iUniverse (2005).
3 The architects of the *NANO* installations were Johnston Marklee & Associates, principals: Sharon Johnston and Mark Lee. For a full description and list of collaborators, see: http://victoriavesna.com/nano (last accessed November 3, 2020).
4 N. Katherine Hayles, ed., *NanoCulture: Implications of the New Technoscience*, Portland, OR: Intellect books (2004).
5 James Gimzewski and Victoria Vesna, »The Nanomeme Syndrome: Blurring of Fact and Fiction in the Construction of a New Science,« *Technoetic Arts* 1 (2003): 7–24.
6 The sand mandala in these images was created in 2003 by Tibetan Buddhist monks from the Gaden Lhopa Khangtsen Monastery in India and constructed on site at »The Circle of Bliss« exhibition of Nepalese and Tibetan Buddhist Art at the Los Angeles County Museum of Art. It was photographed at about ten intervals with a wide-angle lens, then switched to a macro lens at the last level. The center of the mandala was recreated in James Gimzewski's PicoLab, first imaged by an optical microscope and then with a scanning electron microscope (SEM).
7 Virtual C_{60} molecules—buckminsterfullerenes or »buckyballs«—are projected onto a large wall area. People move and distort the buckyball shapes with their shadows; slow movement rather than forceful action creates changes. This mimics the careful manipulation of molecules by scientists using the scanning tunneling microscope (STM). A camera is watching the projection, and the computer is able to isolate the participant's shadow against the gray background of the image.
8 For the complete catalog of the *NANO* exhibition, see: http://victoriavesna.com/nano/files/nano_lacma_book.pdf (last accessed December 2, 2020).
9 See the entire catalog *The Fourth State of Water: From Micro to Macro* for the description of the *Water Bowls* project and an exhibition of artists and scientists working with water: http://victoriavesna.com/ebooks/4th_State_Catalog/4th_state_catalog.html (last accessed November 3, 2020).
10 The *Water Bodies* website in collaboration with Claudia Jacques emerged as an ongoing project from the Drop Water Bowl: http://waterbodies.com (last accessed November 3, 2020).
11 *Morpho peleides* and *Danaus plexippus* wings and pupa were provided by Dr. Richard Stringer, Department of Math, Science and Allied Health, Harrisburg Area Community College. Additional technical assistance from Andrew Pelling and Paul Wilkinson in recording the heart beat of *Danaus plexippus chrysalis* is kindly acknowledged.
12 The Integratron was built in 1954 by George Van Tassel, an aircraft mechanic and flight inspector, who described it as »a machine, a high-voltage electrostatic generator that would supply a broad range of frequencies to recharge the cell structure.«
13 Using samples obtained from the U.S. National Oceanic and Atmospheric Administration, I worked with Paul Geluso to spatialize the audio at Harvestworks, New York.
14 For more information on venues, documentation and credits, visit http://noise aquarium.com (last accessed November 3, 2020).

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