adaptations to extremes

An Art / Science Collaboration
Adaptations to Extremes
an Art-Science Collaboration and Exhibition
January 19 – February 22, 2019
Lake George Arts Project
Courthouse Gallery
Lake George, NY
Adaptations to Extremes

The artistic creations and interdisciplinary connections displayed in this exhibition resulted from conversations and insights from a year-long dialogue between a group of artists and scientists. The exhibition was co-curated by Laura Yon Rosh and scientists Dr. Joan Bernhard and Dr. Sam Bowser. Artists include Elizabeth Albert, JoAnn Axford, Terry Conrad, Josh Damon, Susan Hedinson, Eva Henderson, Charlene Leary, Deanna Lee, Corwin Lev, Marilyn McCabe, Joy Muller-McCaa, Jeann Noordzy, Shaun O'Boyle, Victoria Palermo, Rebecca Smith and Kathleen Thum.

Above: two views of the Adaptations to Extremes exhibition at the Courthouse Gallery.

Through this exhibition we hope to enhance public understanding of science. As a discipline, science has done a wonderful job of advancing humankind in untold ways. It has sent spacecraft beyond the solar system, which has placed us in proper perspective. We are one species, to paraphrase Carl Sagan, inhabiting a pale blue dot in the vastness of space. It has unlocked the basis of many diseases and provided cures, or at least provided hope, for those who suffer from them. It has even revolutionized the way we communicate in fundamental ways. But science has done a miserable job of explaining itself to those who benefit most from its advances — namely the totality of our species. We hope that artists can help with this fundamental problem.

Dr. Joan Bernhard's research is an eclectic mix of basic science in the fields of paleontology, geological oceanography, ecology, and biogeochemistry. Her work probes the breadth and depth of marine processes, and provides basic information that benefits fields ranging from climate science to paleontology. But what does it do for customers standing in line at the post office? Why should they care?

For nearly a century now, such questions have gone unanswered. As a result, we are living in an age where scientists are regarded as members of the "intellectual elite." This "us vs. them" division is palpable in the public eye and is exploited by political folly.

What to do about it? We are not alone, of course. Artists face similar problems. Together perhaps we can forge some answers.
A major theme in the biological sciences is the way in which organisms adapt to environmental extremes. The Santa Barbara Basin is a bowl-shaped geological formation off the coast of Santa Barbara, California. Limited movement of water in this depression has created an environment severely depleted of oxygen. In such a place it would be surprising to find organisms that need oxygen to live, yet scientists have documented the existence of Foraminifera, a type of single-celled organism, living there in abundance.

How have foraminifera adapted to an oxygen-deprived habitat? For that matter, how do any organisms respond to living in such extreme environments? These questions fuel the research of Dr. Joan Bernhard, from Woods Hole Oceanographic Institute, and her colleagues in their study of this natural "dead zone" in the ocean.

Above: Diagram of a natural dead zone in the ocean.
Above right: Foraminifera found in the Santa Barbara Basin. Reflected light micrograph (left) and scanning electron micrograph (right).
Bottom left: Dr. Joan Bernhard's research team sampling ocean sediment in the Santa Barbara Basin aboard the R/V Robert Gordon Sproul.
Bottom right: Dr. Joan Bernhard.

The exhibition Adaptations to Extremes presents work by a group of artists engaged with the scientists involved in this research, as well as samples of their communications over the course of this ongoing project. One group of artists explored the theme specifically using the optics of Dr. Bernhard's research. These artists made new work based on correspondence with Dr. Bernhard and her colleague Dr. Sam Bowser, scientific advisor to the exhibition. They were offered access to technical reports, photographs, and the researchers' hypotheses. The group met informally throughout the year at gatherings they playfully titled Forum Forums.

A second group of artists - selected for the exhibition because of their interest in the biological or marine sciences - had already produced original works germane to the broad theme of adaptation.

One artist, Terry Conrad, was invited to assist Dr. Bernhard's crew aboard the Scripps Institution of Oceanography's R/V Robert Gordon Sproul as they sampled the sea floor in the Santa Barbara Basin in May of 2018.

Above: Artist Victoria Palermo and scientist Sam Bowser discuss her piece Foram Canopy.
Bottom left: Artist Jay Muller McGee taking notes during a Forum Forum meeting.
Bottom center: Artist Terry Conrad shares his experiences working aboard the R/V Robert Gordon Sproul.
Bottom right: R/V Robert Gordon Sproul.
Dr. Bowser engaged with all the artists by questioning them on their artworks using the scientific method of hypothesis testing. The resulting dialogues, in both groups - artists responding to scientific research, and scientists responding to artwork - were often surprising, sometimes amusing, and always thoughtful and fascinating.

What informs both the work of science and art is a spirit of inquiry and imagination. Equally, both disciplines must embrace their sometimes perplexing results — and then dive in and ponder further.

The following pages offer statements from each participating artist about their work and experiences while involved in this project, followed by the scientists’ response.
Elizabeth Albert

I have several bodies of work that are developing concurrently. The pieces chosen for the Adaptations exhibition are from the “Harbor” series and the “Beast” series.

“Octopus and Moon” from the “Beast” series. In John Berger’s essay Why Look at Animals, he states that we are distinguished from animals by our capacity for symbolic thought, yet the very first symbols were animals. Animals offer explanations far and parallel with our behavior, or at least lend their name or character to particular human qualities. These paintings feature allegorical scenarios involving a cast of invented animal characters and landscapes that reference psychological states, power struggles, and environmental anxiety.

“Chamber” from the “Harbor” series. Warships, oil slicks, feral cats, carrionbirds. Nature under pressure from industry, technology and aggression surrounds my studio on the New York Harbor, approaching and receding without end. “Harbor” is a body of work about the triangulation of progress, abuse, and resilience realized through a conversation between direct painting, photography and projection. The image is altered and distilled as it moves through shifting media lenses, as a kind of visual call and response.

Scientists respond: Like Elizabeth’s process for creating artwork, our understanding of life in the Santa Barbara Basin is a triangulation of progress (short steps in attaining knowledge), abuse (the nature of sampling is locally destructive; fortunately on small scale), and resilience (we can extract information from the fifty thousand year record from Santa Barbara Basin sediment cores).

Elizabeth’s work entitled “Chamber” evicts memories opening the lid of a sediment box core and peering in to see its contents. In fact, we were tempted to deface her work by taping a photograph of a bacterial mat in the center of the piece. “Octopus and Moon” seems like an odd addition to the theme of adaptation in the Santa Barbara Basin, but in the past, certain foraminifera have adapted by floating to the ocean surface where oxygen and light abounds. Furthermore, the tangle of octopus arms reminds us of the tangle of foram pseudopods (see also Eva Henderson’s paintings in the exhibition).

Elizabeth was very generous with her time through in-depth discussions of various topics. We lamented our lack of success in applying the scientific method when interviewing artists. Her reply was that creative thinking is common to art and science, but that scientists and artists are different in their use of language. Her remarks about “failure” were insightful and comforting. Scientists are not rewarded for failure - in fact, they can be ridiculed to obscurity. Elizabeth pointed out that as an artist she accepts failure and learns much from it. Perhaps scientists should make this way of thinking part of their psyche.
JoAnn Axford

The invitation to participate in this project allowed me to go off on one of my “Creative Tangents.” These are times when I put my carved porcelain pots on hold for a bit, and try something outside my comfort zone.

When I began to study “foraminifera,” I was immediately amazed at the variety and beauty of the forms, textures, and structures of these single-celled creatures. I responded to this challenge by creating 14 small sculptures, to give the viewer a tactile experience of this organism that is usually seen only through a microscope.

Terry Conrad

I see a print as not a fixed mark, but an evolving trace that can change from initial impression. Like a memory, scar, or a learning moment, the impression sets in motion a slow evolving change. The uncertain moments of printmaking fascinate me – the moment of lifting paper off the press – where certainty appears, then goes again.

Process is inseparable from the finished object. With a focus on the transformation of materials, I explore opposites, control and chance, waste and decoration, finite and recycled materials. I use print media and its language to explore the process-based themes of systems, such as geology, architecture and the landscape. Combined with print processes, I use sculpture, paper making and design to explore these themes.

In the studio, I comb through a growing collection of found objects, scraps and raw materials. Often projects have parameters based on materials or the location where they were found. I play with and explore these found materials with an interest in both craft and an undefined, direct sensibility.

The found object printing presses are constructed tools that aid in printing. The resulting image is an impression created over several days, through oxidation of metals and hand-mixed inks left on the paper, making a multiple in a slow and inefficient manner. The project has evolving parameters based on exhibitions and new questions. The results are meditative images that are suggestive of rocks and minerals, which also form over time and under pressure. The presses are built in piles and tiers as if they are themselves layers or strata.

Scientists respond: Terry’s unconventional printmaking, using what we see as a backup Box Core device, led to the creation of a new foraminiferan: a print he calls Psmammochonos anomali from the Greek: psmammochonos (sand), chthonic (belonging to the underworld) and anomali (fakking oxygen). We were afraid to ask what he would name the perforated tin can that has an uncanny resemblance to Bobina pacifica, and wonder how Terry’s work would respond to a different type of field research, for example, climbing the rainforest canopy to collect poisonous sting insects.
My work is not a political commentary, but I'm always aware of the disconnection we humans imagine and reinforce between ourselves and other living things. This lack of identification with nature has led us down a dark path, which has culminated in the catastrophe of climate change. The pools and channels in my paintings stand as a metaphor for what we have lost, and for the mysteries of the deep. I have always been obsessed with the bizarre creatures that live in total darkness at the bottom of the sea. When I read about foraminifera, I instantly related to the idea of adaptation and hybridization.

In recent years, I've been trying to avoid imagery (animal, vegetable, machine) that's derivative or derivative. My 2017 painting "Night Visions" is an example of this world of hybrids, where each hovering entity is a conglomeration of organic living forms. In "Night Visions" and "Shipwreck," the sense of scale is always shifting from the microscopic to the cosmic, from the above to the below, from inside to outside. The process itself is one of constant adaptation.

Scientists respond: Like Josh's paintings, science is not supposed to be political. Unfortunately, politicians and corporate lobbyists have made it so, particularly with respect to environmental issues.

In selecting his work, we were at once struck by what appeared to be a foraminiferan-like shell in "Shipwreck." We understand that organic seal paint is only one thing. Josh, our 2017 painting "Night Visions" is an example of this world of hybrids, where each hovering entity is a conglomeration of organic living forms. In "Night Visions" and "Shipwreck," the sense of scale is always shifting from the microscopic to the cosmic, from the above to the below, from inside to outside. The process itself is one of constant adaptation.

As scientists, we also relate to Josh's overall theme of shifting scale from the microscopic to, in our case, the global, as we interpret our findings in the context of climate change. We too, see processes that are "of constant adaptation" — research approaches, adapted from other fields to the questions we ask about life in the "dead zone" of the Santa Barbara Basin.

Susan Heideman

Inside/Outside, spatial/animal, natural/natural, we tend to sort the world into categories of opposition. But some things just don't fit. Conflating these "unsortable," entities that live between taxonomies, lies at the heart of my art-making.

Several years of passionate engagement with the micro and macro aspects of the natural world informed my visual conceptions. The drama I create defy Newtonian physics: unnameable things flow, hurl, creep, or ride gyre-like spouts; spurs sprout and retract; molecule-like forms mineralize; rock-like things liquify. Do they exist?

Proteana #16 is part of the ongoing series of works on paper I call the Proteana Series. I invented the word "proteana," derived from "protein," to suggest entities and their situations straddling kingdoms, evolving and mutating beyond classification. Baring, suturing, painting, embroidering, ripping, and layer-building into a stratifying topography, my process is improvisatory with no clear and image in mind. Might this grafting and mongrelizing be akin to nature's own irresponsibly continuous transforming? Am I making the world up, or is it making us up? Or is it both? Indeed, like the unlikely dead-zone anemone foraminifera, we may be discovering that Everything exists Somewhere. How glorious!

Scientists respond: Proteana #16 is colorful and exuberant - much like the way scientists indirectly image life in the Santa Barbara Basin at the cell biological and microscopic levels. We might see in this artwork a foraminiferan, ablaze with physiological processes, organizing its immediate surroundings, fighting to move upward against the steady rain of material from above.

Or perhaps we see the symbiotic associations between bacteria and "higher" organisms that, together, define adaptation for life in the Santa Barbara Basin? Indeed, these concretions - proteins - we've discovered there have defied all of our expectations. Her use of the term "mongrelizing" is quite appropriate.

One point stands out in discussions with Susan. When asked how she knows when a painting is finished, she quotes Phillip Guston, who said that a piece is finished "when all roads of the arbitrary have been walked...and this day is finished "when the artist is finished". While this clearly applies to us (scientists) to this day. Does the same principle apply to science? Is our work in the Santa Barbara Basin "finished" when we have disambiguated everything, or is it finished when we publish a paper that represents an incremental step toward disambiguation? Because publications are the currency of science, we hope that the former applies. We doubt that curiosity will ever let us finish the work.
Eva Henderson

These three paintings come from a body of work created during a summer in Brooklyn, NY, 2018. Inspired by efforts to clear the overgrown back yard my girlfriend and I shared, I quickly became fascinated by the tenacious and rhizomatic growth of various invasive plant species - particularly Kudzu, Japanese Knotweed, and Tree-of-Heaven. These plants are acutely well adapted to the harsh urban environment of Brooklyn, which is characterized by disturbed and malnourished soil, polluted air, and the fragmentation of green spaces by cement, asphalt, and metal. They war with the city, but mimic its connectivity at the same time. The splitting and rejoining of vines and rhizomes immediately calls to mind the behaviors of streets and subway lines. Rhizome no. 1 illustrates this pattern of parallel growth, of branching and coalescing. Rhizome no. 2 is a semi-accurate map of Ocean Hill, the neighborhood where this growth was observed (wedged between Broadway and Fulton). Tree-of-heaven no. 2, though fantastical, is not far off from reality; fully grown ailanthus can be seen growing from between the bricks of apartment buildings.

Scientists respond: There are obvious parallels between Eva’s “roadway” paintings and the pseudopod “roadways” extended by foraminifers. It is noteworthy that one of the most accurate descriptions of foraminifer pseudopod behavior was written by Joseph Leidy in 1879 from a freshwater species he discovered in the cracks of a sidewalk in Philadelphia. We wonder if this foraminifer lives today among the cracks of sidewalks in Ocean Hill?

Top left: Eva Henderson, Tree-of-heaven no. 2, ink and watercolor, 9 x 6 inches. Middle: Eva Henderson, Rhizome no. 1 and 2, ink and watercolor, each 5 x 6 inches. Bottom left: Phase contrast light micrograph of foraminifer pseudopods.

Charlene Leary

Adaptations to Extremes brought an exciting opportunity to learn about the foraminifera of the Santa Barbara Basin through the research of Dr. Joan Bernhard and Dr. Sam Bowmer, and a challenge to interpret new ideas in fiber. In looking at the micrographs of the foraminifers, I was struck by how complex these one-celled organisms could be seen both outside and inside (some with multiple chambers); many resembling beautiful sculptures.

I chose materials and techniques that could be manipulated from a flat woven surface into dimensional pieces for my interpretation of Urgenerina juxnea and Suggundina echia. Two other works in the exhibition are mixed media combinations of tufted silk fiber, metal and thread made to represent Spirilliplacita earlandi and Nonionella stella.

I was also drawn to the process of collecting sediment from the bottom of the basin. Through different staining and imaging techniques, information collected reveals the types and quantity of forams and bacteria at the bottom and top of the sediment and whether they are alive or dead. I created a sediment sampler (cylinder piece hanging from the ceiling) with layers of thread and wire woven to depict sedimentary layers collected from the bottom of the basin, with “slides” of forams and bacteria inserted into pockets.

Scientists respond: Charlene used aspects of weaving and metalurgy to create striking works depicting foraminifers inhabiting the Santa Barbara Basin, as well as a sediment core, which is the main tool we use to collect them. It is worth noting that a sediment core contains an undisturbed plug of the seafloor from which a plethora of information can be gleaned, for example, oxygen and hydrogen sulfide profiles, living and dead assemblages of foraminifers, and how the living assemblage interacts spatially with other organisms. Likewise, Charlene’s core contains information from every viewpoint.

Deanna Lee

As a child of a biologist, I grew up seeing electron micrographs and lab specimens, and much of my work refers obliquely to scientific images and ideas. It also reflects my long-term interest in the subject and substance of water and related themes, like fluid dynamics and features of water environments.

Through my artmaking process, I interpret existing information about natural phenomena, employing photographs or tracings and rubbings that I make from surfaces that record the effects of such phenomena. From these sources, I develop paintings, drawings, and site-specific installations.

Three concepts become my focus for this project: the layers of ocean sediment where benthic foraminifera thrive (often without oxygen, as in the example of the Santa Barbara Basin); the forams’ reticulopoda that function as multipurpose tools, providing a means of movement, of reproduction and metabolic exchange, and of grasping materials and food, among other functions; and agglutination as a method of formation and growth of certain foraminifera tests or shells.

Inclined toward interpretation through abstraction and metaphor, I made multiple small paintings on wood panels. The lines and forms in each painting were inspired by the ecosystems’ interaction with their implication of sedimentary layers and organic structures. The painted elements’ extensions over the edges of the panels suggest a shift of perspective and corollation of what is present on the face of the panels. The paintings may be seen as lenses of interpretations of aspects of foraminifera.

Scientists respond: Tipping our hats toward Nature more than Nurture, we’re convinced that Deanna’s genome contains more than half of her biologist parent. (That’s a biological joke.)

Deanna’s work speaks directly to us — the flow of patterns, the color schemes, the symbolism used — all reveal her deep understanding of the Adaptations theme. As Charles Darwin understood weather and seasonally, Deanna knows the ocean and its processes. Her intimate knowledge of science, examination of spatial scales, and ability to express these concepts in a painter’s language of color, shape and line, serves as a bridge connecting art, abstraction, and science.

Corwin Levi

One of the most extreme environments on the earth is the ocean. At the surface we may picture tremendous waves crashing and boats capsizing during a storm. But it is even more extreme further down where pressure amplifies and the temperature plunges. In my drawings of the ocean, on the one hand a viewer might see the colored dots and organic forms as stand ins for the variety of creatures hidden in secret depths that have adapted to environmental extremes. On the other hand, maybe these specs of color and form are instead the sordid plastics and other trash that take up an increasing amount of space in the earth’s waters. Maybe we can see the planet itself as an organism that is responding to the environmental extremes we humans have created, where the oceans are rising ever higher, ever steeper, and churning about, slowly wearing down the plastics like sea glass into smaller and smaller micro pieces.

Scientists respond: The news on ocean warming appears to be even more dire than expected, based on a new study published in Science magazine and reported in the January 10, 2019 issue of the New York Times. Certainly, we can expect the ocean to become even more “energetic,” as depicted in Corwin’s paintings.

Hopeful, Homo sapiens can adapt to less dry land with shorelines imbued with diluted sea water. Micro-size particles of plastics, some intentionally created and others the result of degradation of macroscale objects, are indeed extremely abundant in the ocean. Exactly how these materials will affect marine ecosystems is the subject of intense study. We have proposed asking if agglutinated foraminifera use these particles to build their shells and, if they do, whether or not these plastic shells will affect their survival. When one thinks of the earth as an organism, one may liken the spots of color in Corwin’s paintings to city lights viewed from space. In this sense, humanly can be thought of as the cause of environmental turmoil that is apparent in his work.
Marilyn McCabe

I often engage with the sciences in my work as a poet. Being invited to respond to this specific research enabled me to grapple with both ideas and with some actual images from the research, which fed the video-poems I presented. The video-poems both reference directly the research, as do the images, and functions as a sort of meditation on our humbling process across the science/art cultural divide. In the course of this on-going dialogue—I find it interesting how quickly I leap from the general facts of the research to a wide, possibly overly, interpretation of the findings, and, in typical Homo sapiens-centric fashion, from the forensic condition to the human condition.

The Santa Barbara Basin Dead Zone

God’s wash basin (how his face burns). Or man’s pisspot (we waste so much). Ocean’s unviable hand wipes it — Clean? Not quite — what settles of destruction.

Adapts to change: almost everything. The gods to a god to a Fright. A boost to a man, man to the moon, and here Foraminifera manufacture toxin to detoxify poison, extract from it the oxygen required for life. About which we know little. Still, what doesn’t kill us. What we make of what doesn’t kill us.

View Marilyn McCabe’s Video-Poem at https://vimeo.com/243201081

Adaptation to Extremes

A single-celled organism has learned to distill toxins to a slow drip of the one it needs, as how the wolf’s ear learns to live without human love or language, how the widow lives in loss, cannot throw away the hair in the brush, keeps it a small lacquered bow, how in a house of silence I learned to listen, how in winter the homeless guy who lives on the bank’s bench collects papers to peruse then wear against the cold, how in the factory clamor a friend learned to sing, but only in the key of the conveyor’s souse, how sometimes we take the poison for the good of the whole organism. It takes our hair, loosens our teeth, our insides appear sudden at our feet. But we go on, as it renegotiates certain cellular contracts, using chemistry’s desertions for life’s demands.

How every single cell of us can learn to live with luck.

View Marilyn McCabe’s Video-Poem at https://vimeo.com/243016359

Scientists respond: We feel that Marilyn’s video poems close in on Wagner’s vision of a “Gesamtkunstwerk” (roughly speaking, a work of art embellishing all the senses). When asked to briefly describe smells she might associate with the Santa Barbara Basin, she quipped “dead fish and the sea.” We wonder what other olfactory responses she might conjure it a “SmellO-Vision” app existed?
Joy Muller-McCoola

There are so many variations in the foraminifera forms. By selecting a hat resembling a foramin to wear, the gallery goer will take the time to examine and familiarize themselves with the appearance of the foraminifera.

Three main adaptations struck me when introduced to the forams: the symbiotic relationship allowing one to "breathe" (inspire) without enough oxygen in the environment, the ability to produce food beneath one’s "skin" (membrane), and the ability to create a test just as we create clothes ourselves. I’ve been exploring several ways to approach these three adaptations but have begun to focus on the anecdotical aspect, that is the Santa Barbara Basin issue.

The idea that this one-celled organism sends out a negotiator on a pseudopod to make a deal with a symbiote residing in a mutually beneficial relationship makes me think of parallels to our own society and the negotiators we use, the classic being someone in a suit. Although only one type of symbiote is usually used by the foram, we need many types of emissaries to create a successful arrangement.

Jeanne Noordsy

These pieces make up a series of portraits of the foraminifera of the Santa Barbara Basin (and the science employed to study them), exploring their strange beauty, ways they adapt to this environment of extremes, and some things about their lives on the sea floor. When we enlarge small things in nature to observe them with our human eyes (magnification, a human adoption), what is revealed in forms, mathematical patterns, and behavior often astounds us with its beauty and seeming mystery. It may just seem astounding to us -- is it because, at our relatively larger scale, we regularly miss the patterns of life in each seed and cell?

Some of these works are formally posed portraits, inspired by electron micrographs of the foraminifera. Like formal studio portraits of humans (in which we remove any background other than a draped cloth and present ourselves in a certain cleaned up way), things are changed to obtain such a portrait: forams are removed from the sea floor, viewed individually, and put through a process they don’t survive to obtain such images. Others in this series are intended as relaxed snapshots, like those we humans might post on social media. These explore form and content and out, and their natural environment. how I envision this in my imagination or what I have learned this might look like.

Joy reminds us that art, like science, is a controlled process conducted by highly trained and skilled individuals. Might we also add that art and science often can be playful and fun - a fact not often publicized.

Jeanne’s paintings are colorful adaptations of electron micrographs which, inherently, are colorless. Her use of color makes the stone appear exciting, and - dare we say? - alive. In discussions about her process, Jeanne says she often encounters branch points where her thoughts could take the work in different directions. We smiled and agreed that the process of making art and the process of doing science have that in common, and that those branch points drive innovation.

Top left: Jeanne Noordsy, Suggitrida echivi, watercolor, 12 x 9 inches.
Top right: Jeanne Noordsy, Where the Action Is (Perovskites & Goji), watercolor, 8 x 5 inches.
Left: Transmission electron micrograph of perovskite/endoplasmic reticulum/Goji complexes in foraminifera.
Shaun O’Boyle

I’m interested in looking at the present as the direct result of the complex and chaotic human and natural histories that have gone before. It’s a perspective that looks at the landscape as an ongoing process of change on both a geologic and cultural scale. The work looks at the present physical environment as both an inherited and manufactured landscape, where human activity and energy are required to shape architecture and other cultural artifacts. This extends the generative process that occurs as structures age, where energy is transformed, dissipating into the landscape, and nature retakes this altered space. This can be seen as environments going from a lower to a higher state of entropy, their complexity only increasing over time.

Scientists respond: We asked Shaun to participate in this exhibition because of his interest in landscape photography, particularly with respect to human structures in extreme environments that have been abandoned and are now returning to their “ground state” (in terms of entropy). There is something about this topic, particularly with respect to foraminifera that alter their immediate surroundings using pseudopodia to build shells or coccoons; after death these foraminiferal structures break down, or alter their state before becoming fossils (we call that taphonomy). His images, therefore, capture the essence of the Anthropocene— the geological age we now live in, where Homo sapiens has purposefully built a global structure that will ultimately return to its ground state. His work is a sobering reminder of the challenges that lay ahead for our species should we continue down our current reckless path.

Left: Shaun O’Boyle, Wilson’s Stone Igloo, Cape Crozier, Ross Island, Antarctica.

Cape Crozier is located at the easternmost point of Ross Island, Antarctica. It’s the location of one of the more extreme binding expeditions in history, described in detail in Apsley Cherry-Garrard’s book The Worst Journey in the World. In 1911, during Scott’s Terra Nova expedition, Edward Wilson, Birdie Bowers, and Apsley Cherry-Garrard set out from Cape Evans in the depth of the Antarctic winter to trek the 70 miles to this location to gather Emperor Penguin eggs. At that time it was the only known Emperor Penguin colony. It was thought that the embryos from the eggs would reveal important clues about the evolutionary link between birds and dinosaurs. The three men marched hauled sledges from Cape Evans on the opposite side of Ross Island in the pitch dark -70 degree temperatures of the Antarctic winter to this location above Cape Crozier, and built the stone igloo pictured here for shelter. It was here that they were struck by a hurricane force blizzard that tore the canvas roof from the shelter and left them exposed to the blizzard in their reindeer skin sleeping bags, for three days. They survived, just, and returned to Cape Evans with 3 frozen eggs.


This former playground for children living in the Soviet coal mining settlement of Pyramiden is now used as a resting place by Glaciers. Pyramiden was a fully functioning small city in the high Arctic housing as many as 1,000 people, with a cultural center, swimming pool, canteen, apartment buildings, schools, hospital, hotel, animal farm, all powered and heated by coal from the nearby mines on Pyramiden Mountain. In the background of this photograph is the Nordenskjöld Glacier, flowing into Billefjorden from the large ice fields of central Spitsbergen.
Victoria Palermo

Bolivina pacifica. The wonder of it all—living underwater, too deep for sunlight and no oxygen. How would you do it?

Imagine yourself having a shell, a contour with tiny pores—portals that allow an exchange between bacteria in the sea and your mitochondria within. In these exchanges, oxygen (the stuff of life) is being created.

In foram Canopy, I try to provide you with the inside view. Here, of course, inside this made-up canopy, you the viewer (and not the foraminifera) are the living thing.

The curve and the colors are here for you, are part of you, but the magic lies with porosity. It is through the perforations—our pores—that we see and then create the exchanges that are the stuff of life.

The wonder of it.

Scientists respond: Victoria’s work leads to imaginings at so many levels. By following Occam’s Razor, biologists seek simplicity and uniformity in our explanations of life’s processes. But our surprise comes when uniformity proves to be a false concept.

For example, we should expect that the bacteria coating the shells of Bolivina pacifica provide chemical energy or detoxification of hydrogen sulfide uniformly to permit survival in the Santa Barbara Basin. Bacteria are themselves living individuals, however, and at any moment in time the physiology of one bacterium differs from its neighbor. We wonder if the individuality of bacterial physiology leads to regional punctuality in foram physiology, as inspired by Victoria’s sculpture. The wonder of it, indeed!

Left: Victoria Palermo. Detail of Foram Canopy, Domus Bolivina pacifica.

Bottom left: Transmission electron micrographs of bacteria in the pores in the shell of Bolivina pacifica.

Bottom middle: Cartoon sketch by Sam Browne, to illustrate details of a foram pore.

Bottom right: Visitor experiencing Palermo’s Inside B. pacifica, a video piece that imagines what it may be like inside the shell of a foraminifera.
Rebecca Smith

Nonionella stella is a foraminifera species that has adapted to an ocean dead zone and therefore sets an example to us humans as we face climate change. I am a human whose home next to a tidal estuary is being threatened by rising seas. Nonionella stella, like most other living things, requires oxygen, yet has adapted to an oxygen-deprived environment. Biologist Dr. Joan Bernhard theorizes that it captures neighboring diatoms — algae that process ambient toxic chemicals to make oxygen for its host. In order to avoid extinction humans need to adapt their behavior to an environment becoming hostile — and resolve immediately to take dramatic steps to prevent the extreme warming that would render our species extinct.

A unicellular organism capable of radical acts of adaptability demonstrates its capabilities visibly through its physical structure. Nonionella stella creates its own shell or “test” as a series of chambers arranged around a central core. The cytoplasm features a soft body within (endoplasm) that is continuous with threadlike pseudopods (ectoplasm) that extend outside the test. Pseudopods gather food, capture diatoms, mobilize the foramin and perform other key functions. I have made a sculptural model of Nonionella stella because its form tells the story of its function. Also, it is elegant and visually intriguing with its concentric shape and oddly anthropomorphic, hand-like test feature.

Scientists respond: Rebecca has done her homework. Lots of homework. Her interest in climate change and its human impacts are clearly tabulated on a chart created for the exhibition. Her sculptural piece depicting Nonionella stella, with its pseudopodia extended to the ceiling and certain internal structures highlighted, is key to foraminiferal adaptation to nearly all aquatic environments. There are recent hints, however, that there may be exceptions to this rule. Looking into the future, we wonder if the next “Adaptations” exhibit will be dedicated to these exceptions...

Top left: Rebecca Smith, Foram Nonionella stella, mixed media, 13 x 24 x 22 inches.
Middle left: Rebecca Smith, Foram Study, graphite, marker, color pencil, 6 x 9 inches.
Bottom left: Scanning electron micrograph of Nonionella stella.

Kathleen Thum

In the drawing, Pulsations, I depict tubular, pipeline forms interacting and becoming a part of the landscape. I present the tubular structures as growing and altering landscape; even becoming their own living entities enmeshed within the landscape.

The pipeline forms are more organic than typical pipe forms found in petroleum infrastructures, as I want to present the pipelines as becoming anthropomorphic. I see the tubular forms as both adapting to ANBD creating the changes in the environment.

Left: Kathleen Thum, Pulsations, graphite on paper, 15 x 11 inches.
Right: X-ray of sediment from the Santa Barbara Basin revealing strata-like laminations.

Scientists respond: Kathleen’s drawing of “pipeline forms” mirrors that of the bacterial “pipelines” we encounter when examining microscopic sections of surface sediment in the most anoxic, sulfide portions of the Santa Barbara Basin. Should she shrink her perspective a few orders of magnitude, she would see similar industrial processes occurring, except in this case in the form of chemical energy being extracted and transported by bacteria among intricate gradients in the sediment.
Adaptations to Extreme Artists’ Bios

Elizabeth Albert is a Brooklyn-based visual artist, professor, curator, and writer. She earned her BFA from Boston University and MFA from Queens College. Her past work has been included in exhibitions at the Museum of Modern Art, the Brooklyn Museum, the Whitney Museum of American Art, the Jewish Museum, and the Brooklyn Museum of Art, among others. Her recent projects include working on the collection of the Whitney Museum of American Art and the creation of a new exhibition exploring the history of contemporary art. She is also a contributing editor to the magazine Art in America.

Johanna Fadsen earned her BFA degree at the University of Bridgeport, Conn, and her MFA from The College of Saint Rose. Her interest in botanical imagery led her to post-graduate study in Botanical Illustration at The New York Botanical Garden. It was during her studies in the Skidmore College studio that she developed her own style. Johanna’s work has been included in exhibitions throughout the United States, the Netherlands, and several exhibitions in Germany. She has also taught at numerous institutions, including the Rhode Island School of Design and the New York Botanical Garden.

Jutta Conrad sees printing as a medium of trade and mark-making as well as a way to connect with people and place. His interests as an artist are Italian Renaissance relief printing and glazes, and his work has been exhibited in numerous group exhibitions in Germany. His work has been featured in a number of publications, including Italian Renaissance Relief Printmaking: A Survey of the 15th-17th Centuries (1976), which he co-authored.

Charlene Leary’s mixed media pieces layer thread, dye, paint and metal into patterns and forms that reflect the natural world. Leahy found her expressive voice in woven prints during a required college course for occupational therapy training. She moved to New York in 1973 to practice occupational therapy, and continued to expand her learning of weaving and other fiber arts. Leahy has studied with notable instructors including Liz Cooke, Caroline Miller, and Polly Sterling. Over the past 35 years she has taught weaving and surface design and exhibited her works throughout New York City at numerous galleries and museums.

Deanne Lee was born in New York, NY, to parents from China and Taiwan, and raised in suburban Bronx. She grew up spending time in her mother’s biology lab and taking classical music lessons several times a year for 14 years. Comprising drawings, paintings, site-specific installations, natural history and Большой стартовальный прогон. Her work is often inspired by the natural world. Flower Hill, The Drawing Center, and Treeve Projects, her public artwork includes a mural on jersey barriers for the NYC Department of Transportation and a site-specific window installation in OGDON, Brooklyn. Her honors include awards from the Pinkstone Foundation, Arts Society, National Academy, Midtown Salon, and the Carol Kastning Foundation. She was also an expat artist with the Clipper Project innos in, and was recently a resident artist on Governors Island with Works on Water and Underwater New York. She lives and works in Brooklyn. You can learn more about her work at deannelee.com.

Carwin Levi is a mixed-media artist, curator, and illustrator, who investigates the limits of vision, experience, and memory by constructing maps of the unknown. He has full shows, participated in group shows, and exhibited across the country, and has been reviewed in publications such as the Washington Post, Ffluish Magazine, and Art in America. Levi’s work has been featured in numerous exhibitions, including the 2017 New York Times Young Artists, Art in America, the Paris Review and Numero Cinq. He lives and works in New York City. You can learn more about his work at carwinlevi.net.
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Acknowledgments
The general public knows a lot about popular extreme environments: The Sahara Desert, the Antarctic ice cap, The Dead Sea, Death Valley. By comparison, environmental extremes caused by human impacts are not widely recognized.

In recent years scientists have been alarmed by the discovery of huge swaths of “dead zones” on the seafloor near industrial or agricultural areas. And they are growing ...

Dr. Joan Bernhard and her colleagues are studying a natural dead zone - the Santa Barbara Basin off the coast of California - in order to predict the ultimate outcomes of those we have made or expanded on.

The future looks bleak for even the hardiest of animals, and only a scant few species of single celled organism, particularly those called Foraminifera, are adapted to survive.

How do they do it? The answer is complex. Very Complex.
How do scientists help the public understand this threat, and what the future holds?

Is art one answer?