ECDYSIS

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ECDYSIS

The Harvard College journal
for the artistic expression of science

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Introduction

In biology, *ecdysis* is the process by which an insect, spider, or other arthropod sheds its exoskeleton to live in a new one of its creation. Since these creatures wear skeletons on the outside of their bodies, it is also the process by which they grow.

At Harvard, we are all molting: constantly shedding old constraining views in order to accommodate our broadened skills and beliefs. Due to the flexibility of a liberal arts education, and the increasingly interdisciplinary nature of our coursework, some may feel the need for roomier skeletons than they may have first imagined.

At *Ecdysis*, our art originates from scientific knowledge, such that science itself becomes an aesthetic experience. As manifest in the remarkable range of submissions we received for this inaugural issue, work published in *Ecdysis* does not attempt to create art in science, but rather to show the beauty inherent to all scientific disciplines, from astronomy to microbiology. As you read a planet's existential musings and listen to the music of the Yangtze River dolphin, we hope you will see art and science not as existing in separate spheres but in a fluid dialogue, where the experience of beauty can function as a springboard for intellectual curiosity, and knowledge can lead to an appreciation of science that will, in turn, reveal its beauty.

How do our pieces offer such an experience? *Ecdysis* is meant for all audiences. For our pieces to be beautiful, one should have the chance to see their beauty. If you don't know what a pycnogonid or an exuvia is, chances are most of us did not either. So, as you examine each work, you have the option of looking at the accompanying description by the artist, which offers some academic and practical context. You may read the description as a primer for an unknown field or as a way of plunging deeper into the artwork; in either case, we are confident the description will enhance your exploration of each piece.

As for us, founding the journal has been a blast. Since our inception in February, we have grown into a cohesive and dedicated community on campus. And, as true ecdysozoans, we are still growing. Our shared interest in the fertile ground between art and science has allowed us to continue to build connections spanning Harvard and Cambridge. As our staff and contributors see it, making art for *Ecdysis* has provided the chance to delve inside our own passions - to step back from the rigid structures of class, lab, and the pre-career treadmill, to remind us why we learn what we learn.

So thanks for perusing our inaugural issue. As you look, read and listen, we hope you'll get a feel for what makes sharing of the things we love so rewarding.

Rebecca Greenberg '18, Editor-in-Chief

Masthead

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On Bridging the Arts and the Sciences

Dr. Brian Dorsey Farrell

Professor of Organismic and Evolutionary Biology
Curator in Entomology, *Museum of Comparative Zoology*
Director, *David Rockefeller Center for Latin American Studies*

As E. O. Wilson once pointed out, an extraterrestrial civilization advanced enough to visit earth could readily document and understand the biosphere with the technology that we already have. But to understand human culture, they would have to ask us. The arts and the sciences are different approaches to representing this world. They differ in formality but both represent ways in which we create symbols that allow us to express our concepts of the natural world around us and the cultural world within us, as we learn.

The beauty of science and the science of beauty offer two of many bridges between ourselves and our world, and yet, even before the 1820 poem Lamia, in which John Keats chides Sir Isaac Newton for "unweaving the rainbow," the chasm between the arts and sciences had already become wide and deep. Bridging this intellectual divide has never been more important, both for the promise of increasing understanding and for the potential of improving our lives and addressing the crises we face today.

Uniting the arts and the sciences does not mean the study of pigments used in paintings, nor the examination of the math behind music. It is the addition of new scientific approaches to the subjects most commonly tackled by the arts, whether it is depression, revelation, or inequality, and the addition of humanities approaches to our perceptions, explorations and representations of the natural world. The integration of the arts and the sciences has deep roots in the Harvard tradition. The idea was signaled by William James, and the experiences students undertake towards its fulfillment are the essence of John Dewey's admonitions in the very first William James lecture, "Art as Experience." James's vision of a forward-flowing "stream of consciousness" can also flow sideways, flooding the banks separating the arts and the sciences, as well as education and experience.

The power of our innate emotional attraction to the natural world, captured in the notion of biophilia, a term coined by E.O. Wilson for our evolved response to nature, is now verified by a myriad of medical studies documenting the lowering of stress and boosting of immune systems when we are exposed to nature. Perhaps nature education can amplify these effects. And perhaps it isn't only nature, but also our passions for music, art, and for being with each other that also produce good feelings along with stimulating the production of hormones and neurotransmitters, thereby boosting our sense of well-being and health. Perhaps all are enhanced by awareness increased by knowledge of what we see, hear, smell and feel in the world.

The links between our health and our experiences in nature, music and the arts, as well

TRE (the Dominican pronunciation of the word tres, meaning three) was an exhibit of three parts: contemporary art from three artists, an array of a dozen folkloric costumes from the Dominican Carnaval, and myriad oversized images of dragonflies and other insects of Hispaniola. Together, the interplay of ideas, colors, textures and forms of the exhibit created a synergistic marriage of art and science.

as each other, is reason enough to continue to probe the connections between the arts and the sciences, but increased understanding is also a benefit. William Faulkner once wrote, "The past isn't dead, it isn't even past." This is true not only for the evolutionary past that stretches through time to our ancestors on the African plains, reflected today in our many cultures of food and exercise, but also for our childhood years that continue to shape our responses to each other and our environment. Even in the past 24 hours, every encounter and interaction influences thoughts, awareness and our physiological condition in the present moment. All that is past is alive in us, just as the works of these contributors to *Ecdysis* reveal both their education up to this moment and their present consciousness. Taken together, our influences past and present are a guide, like the invisible, internal compass of birds, lending direction as we meander and explore our way towards future experiences in the world within and around us. As Jackson Pollock responded to a question about whether he was inspired by nature: "I am nature." *We are nature.*

Ecdysis, the process of molting that allows many kinds of animals to grow, is indeed a metaphor well-chosen for the aims of this brilliant new journal, which captures the essence of a liberal arts education. The contributors here herald the rapidly-evolving awareness and growth of this generation. In this vein, I am honored to welcome you to *Ecdysis.*

Cell Culture

by Angelo Mao

He watches us explore the surface plastic,
though we were sown sparse and individual,
and grope each other, our hands planting a trail
that pricks the surface where we go. We lick
hard plastic as we go. Our growth medium
chokes with sugar, our food beyond rich,
but we can only commence our becom-
ing when we have covered every inch
and our entire world has been discovered
and our bodies wedge into boundaries
and no more room. Then the manufactured
depots in our bodies bloom bright glassy eyes
that stare up through a blood cleansed of blood,
just darkness (we are used to the dark) and god.

The practice of cell culture is a standard laboratory process, in which cells harvested from tissue are propagated. This sonnet imagines the process from the perspective of the cells, describing their migration and proliferation. At the culmination of these stages, the cells reach a high density and differentiate (change their form). In this poem, the cultured cells are stem cells that differentiate into adipocytes (fat cells). Adipocytes produce lipid droplets within the cell body, which gives these cells an eye-like appearance.

Many cells in culture are fed a medium consisting of fetal bovine serum, which is essentially calf blood from a slaughterhouse, and processed to remove blood cells. The processing preserves a broad spectrum of growth factors in the blood in order to support cell culture.

Cells in culture are kept in incubators that provide temperature and carbon dioxide levels similar to those in the body. These incubators do not let in light.

Swarm

by Scott A. Chimileski

This biofilm was formed by Bacillus subtilis, *a harmless bacterium that can be found in soil and many other environments across the planet.*

Canon 5D mark iii, Canon 65mm macro lens, macro photography; swarm began with spot in center (5 mm diameter); each dendrite (arm) of swarm is about 1 mm wide

Watch the growth of a *B. subtilis* biofilm:

Persea borbonia (Redbay)

by Maya Chung

This specimen was collected on June 19, 2013 from the butterfly garden at the Smithsonian National Museum of Natural History *in Washington, D.C. It is a member of the magnolia family and is currently on display in the museum.*

ballpoint pen, 8.5" x 11"

Paper Birch

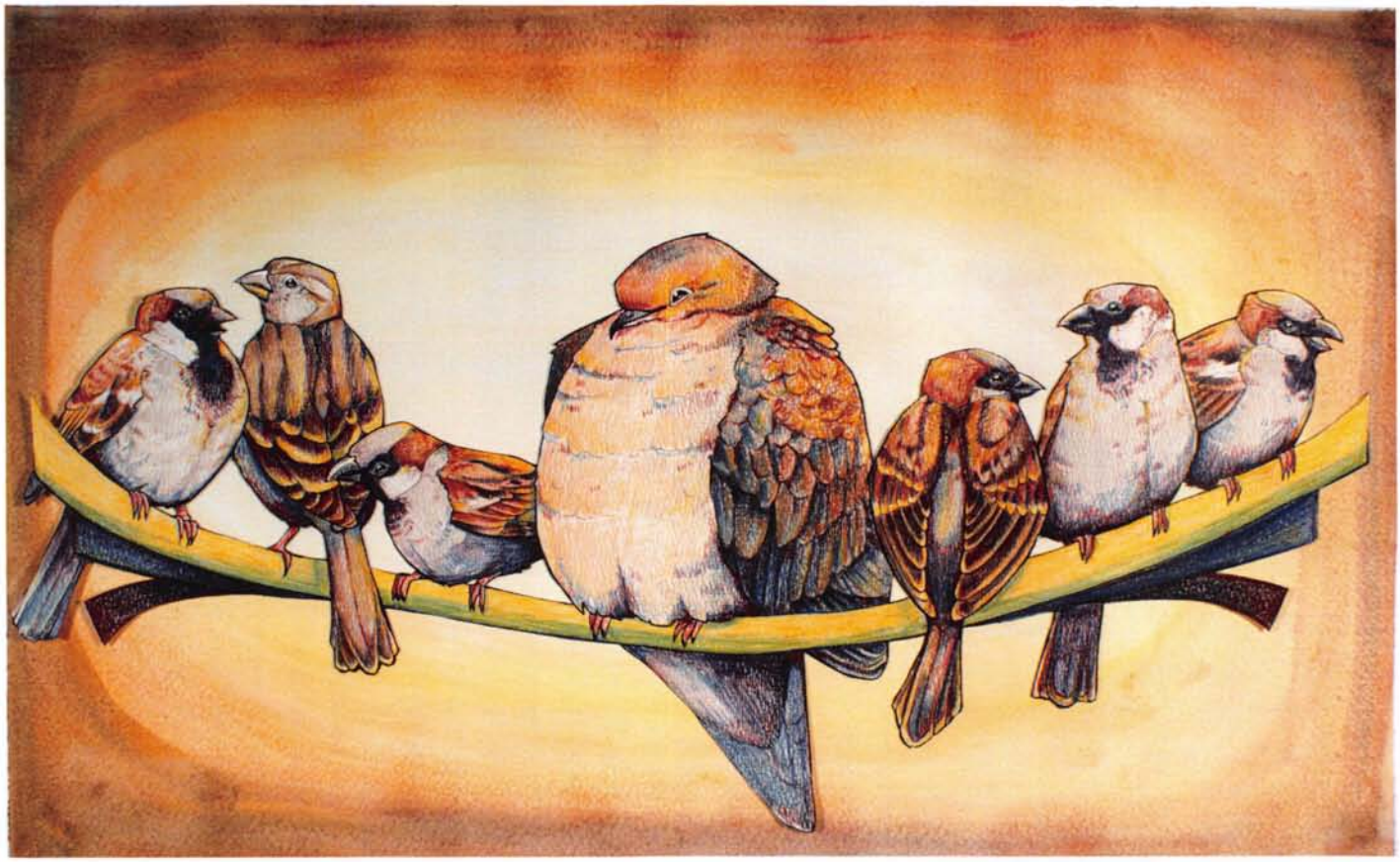
by Eamon Corbett

Bark is not a sheet of paper.
Not even this one.
Not smoothed, flattened, packaged
But a woody quilt
Of pockmarked cratered ridges
Carelessly wallpapered
With soft pastel folios
Of peach and gray and white and snow.
Or is that backwards?
Has the razorcut page
Peeling in tickertape arcs burst
At the seams
Cracked
Buckled
Birthed a landscape of crags and folds?
Is this a forest erupting from a meadow memory?
Unfurling upward
Or is it a prairie-yet-to-be?
Distant someday grasses
Sprouting from the bones of hemlocks
And the scattered confetti of birch bark.

I wrote this poem at the Harvard Forest after staring for a while at the trunk of a paper birch tree, a sun-loving species that is often one of the first to grow when older trees fall or are cut down. At the forest, researchers study the habitat not as a static set of trees but as a palimpsest of each successive ecosystem growing on top of the previous one. Almost all of the trees in the region were cut down for agriculture in the 1800s, but new ones have grown back in their place, so the forest often seems as if it has always been there and always will be. At the same time, however, an invasive insect called the hemlock woolly adelgid, is now felling trees, storms will take their toll, and the landscape will shift again.

The Commoners

by Lily Lu



There are some birds that are so common in our daily lives that we don't usually pay attention to them, such as the house sparrow and the mourning dove (middle). While these birds may look drab and dull, an examination of the patterns on their wings and bodies reveals their often overlooked intricacy.

color pencils, watercolor, and ink pen, 23" x 13"

Priceless

by Michael Ge

"Priceless" came out of a personal interest in capturing familiar subjects around us in an unorthodox manner. Here, the subject of a silver spherical mass is surrounded by dense gold coils and a nebula of diamonds parallels the planet Saturn. On the one hand, earthly luxuries are given a celestial beauty, while on the other, the unknown mysteries of Saturn are reduced to familiar and coveted metals and stones. As such, "Priceless" is ultimately an encouragement of scientific pursuit, representing the notion that nature can (and should) be both comprehended and sought after in order to acknowledge and glorify the beauty of the world around us.

digital art (3D), *Cinema 4D, Adobe Photoshop*

Interview with Jumai Yusuf & Ange Clayton

Founder of *ST@HC* and Co-Director, Writer and Co-Director, *I Don't Want to Forget How to Make the World Shiver*

by Trevor Chistolini

Can you briefly describe the mission of *Science Theater at Harvard College*?

J: Our mission, in a very broad way, is to inform and tell audiences about science using theater and to help them think about issues like how genetics may affect you, or how people experience mental illness, and learning about what it is to actually do science. [We want to educate] people through theater and bridge those communities together.

As the founder of *ST@HC*, what do you think of the current relationship between the arts and sciences on campus? Did it prompt you to start *ST@HC*?

J: I don't know about the general [relationship]. I thought it was interesting how the Theater, Dance, and Media concentration had their first departmental show, and they chose *The Man Who,* which is very sciency. I thought that was interesting, how for their first ever show they chose something that had to do with science. I don't know if that's indicative of the general atmosphere, but that's a pretty big thing that happened.

Prior to *ST@HC*, did you have experience writing or directing productions with scientific elements?

Ange Clayton

A: I really got into playwriting this last year. I was definitely interested in both science and art in high school, but it was not, in my mind, something I was able to bridge. I wrote a lot about psychiatry and psychology and science. But it was more that these science elements were just used in my writing, not that I was actually bridging the gap between the two disciplines.

J: I didn't really think too much about connecting them directly, because science was more like an academic [subject] while theater was an extracurricular. There wasn't as much choice in what theater you could do. I didn't even know I was interested in directing until coming to college.

Could you briefly describe the concept behind *Shiver* and what it explores?

A: *Shiver* is a play about a young college-aged woman with manic depression called Ignota. I should explain that I prefer to say manic depression rather than bipolar. I am not a fan of the term "bipolar" because it implies only a duality instead of a spectrum, which is much closer to what manic depression really is like. The entire play is premised on her interacting with a hallucination of hers, named Figment. [Figment] serves as a representation of her insanity and the problems she's dealing

with. He also [represents] a loved one who is trying support someone [suffering from] manic depression. The ultimate decision in the play is whether she should start taking medication or not. This decision comes about because medication would take away a part of herself, namely the part of her identity represented by Figment would disappear in some way. But by taking medication she might make her life a little less chaotic, a little easier to get through, and a little less tiring.

Jumai Yusuf

As the writer and co-directors of *Shiver*, do you have something in particular that you hope the audience gains from the play?

J: We're using projections throughout the show and lights and sounds in interesting ways, so it'll be a multimedia production which can make the audience [have a] more visceral experience of the show. We do want people to get this understanding [about manic depression] through this show that they couldn't get just by reading about it.

A: We want the audience to come out with some sort of understanding of what it might be like without thinking that they know what it's like. [We want to] replicate some of the visual and auditory experiences that you have when you're manic depressive.

What were some challenges associated with producing *Shiver*, considering the sensitivity of its subject matter?

J: Constantly having to be careful because this could be the one thing that someone in the audience sees about manic depression. And it is kind of difficult because this isn't a super realistic play, it is a surreal play, but we're trying to show people that this is what it's actually like. We're hoping to be faithful while also still putting on a production.

A: We like [the] surrealist element. But we also want to make sure that this play is realistic and we don't want to say that this is a sort of problem that's up in the clouds. This is a real problem that real people deal with.

Moving forward with *ST@HC*, do you have further plans for future work?

J: I'm graduating, and most of the people who I started the organization with are graduating, so that's been a challenge making sure that there's other people who want to continue *Science Theater.*

A: I definitely have had things in mind. I think that it's really nice that we have an organization that links performing arts and science, and I am interested in continuing to write plays that deal with an intersection of science and the theatrical aesthetics, especially concerning psychological ideas.

Shiver *will run from April 22 – April 24, at the SciBox (Science Center 302)*

To learn more or get involved with ST@HC, *email sciencetheaterboard@gmail.com*

Cardiopentapus

by Cameron Krulewski

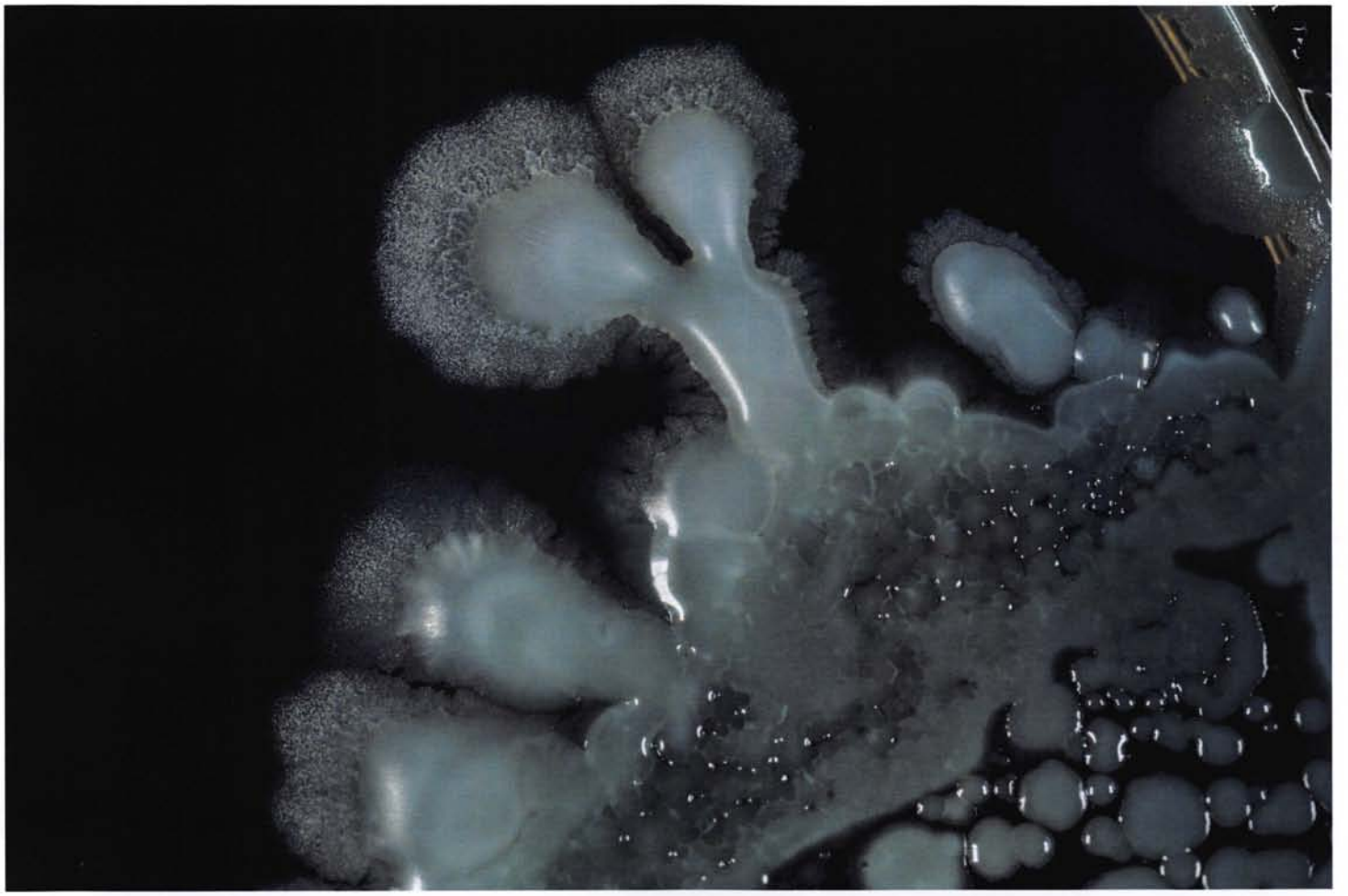
The idea for this piece came to me as I sought a visceral, visual representation of the inner self. Melding an octopus with a human heart evokes a sense of strength and vulnerability—octopi are invertebrates, but their muscular arms are strong, flexible, and incredibly sensitive, while their soft bodies hide a harsh beak, or radula, below the brain.

The combination is also interesting under the biological principle of "form follows function"; it's no coincidence that the octopus mantle and human heart are similarly shaped. The octopus' fastest mode of locomotion is jet propulsion, in which the muscles of the mantle contract to force water out of a narrow siphon, just as the heart contracts to pump oxygenated blood between its chambers and throughout the body. Structurally, both veins and octopus limbs are hydrostatic, lacking stiff material and relying on the incompressibility of water to maintain shape.

graphite pencil on paper, 9" x 13"

Bacterial Isolate No. 2

by Scott A. Chimileski



A bacterial species isolated from the environment grows and migrates across the surface of an agar medium. The blue coloration is due to the presence of the stain Coomassie Blue within the growth medium.

Canon 6D, Canon 65mm macro lens, fan-like structures are 2-3 mm wide

Haloarchaea

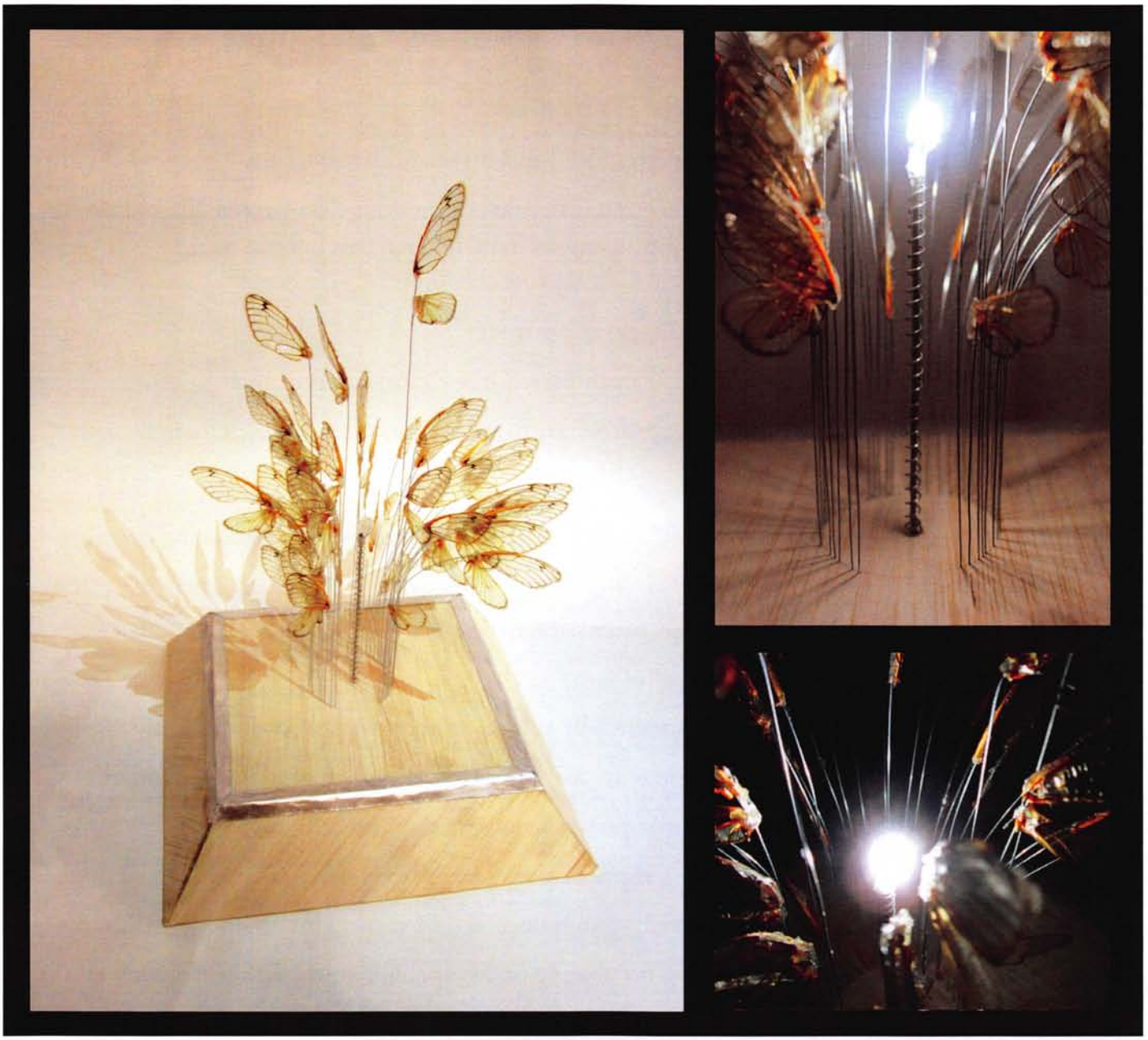
by Scott A. Chimileski

The species Haloferax volcanii *is shown here living within fluid inclusions inside of salt crystals. This species is from the domain Archaea, and is known as a halophile, because it is able to survive and live at salt concentrations that would kill virtually all other forms of life.*

Canon 6D, Canon 65mm macro lens, salt crystals range in size from 1-2 cm

Light and Cicada Wings

by Dennis Zhang



Cicada wings have always captured my attention with their clarity and gossamer-like appearance, so when I saw so many of them one summer, I knew I had to incorporate them into an artwork somehow. In this sculpture, the cicada wings turn toward the light like moths to a flame, casting delicate shadows against the backdrop.

cicada wings, jewelry wire, and balsa wood, 6" x 6" x 10"

Inventory

by Maximillian Prager

- ☐ Class Reptilia
  - ☐ Green Iguana freeze dry
    - ☐ male, about a meter long, full head crest and back spines
    - ☐ three teeth missing from left dentary, long gouge on premaxilla, probably from roughhousing as male iguanas are known to do (middle schoolers)
  - ☐ head of Western Diamondback, fangs intact
  - ☐ Gerrhosaurus flavigularis (African plated lizard) mounted in box
    - ☐ bony scutes serve as protection from predation and the elements
- ☐ Class Archosauria
  - ☐ Ornithiscian verts
    - ☐ possibly iguanodont?
  - ☐ Crocodilian skulls (Alligator mississipiensis and small Gavialis gangeticus)
  - ☐ 6 unidentified theropod teeth
    - ☐ long, conical, dorsoventrally ridged to suggest piscivory, possibly Spinosaurus aegyptiacus or otherwise a member of Baryonychinae.
    - ☐ sharp, lacking anterior-posterior denticulation
    - ☐ adapted for piercing slippery prey rather than slicing through meat and bone, (see Gavialis gangeticus skull for modern analogue) fish rendered powerless, no chance of escape. Geek, the other fish caw at it like
- ☐ skull of Common Raven (Corvus corax)
  - ☐ significant wear on lower beak, crack in right orbital fenestra
  - ☐ Embryonic Mallard duckling (Anas platyrhynchos) in alcohol

- [ ] Classes Chondricthyes (cartilaginous fishes) and Osteichthyes (bony fishes)
  - [ ] Replica teeth, Megalodon and Carcharodon
  - [ ] Redeye piranha (Serrasalmus rhombeus) freeze dry
  - [ ] Spiny Dogfish embryo (preserved in alcohol)
    - [ ] gives mom the creeps
  - [ ] Freeze-dried leopard shark
    - [ ] Caudal, anal fins broken off. Couldn't escape its predators now…
  - [ ] Unidentified Diodontid (Porcupinefish)
    - [ ] most spines intact, excellent defense for middle schooler or tropical fish, kinda derpy and geeky too
    - [ ] Yorick, one of the oldest members of my collection. I knew him, Horatio. We go way back.
- [ ] Phylum Arthropoda
  - [ ] Army of soldier ants, pinned in case
    - [ ] eusocial, rely on community for survival (apparently less exclusive than humans)
  - [ ] Walbergh's Flower Mantis (Pseudocreobotra wahlbergi)
  - [ ] Vinegarroon (aka Whip Scorpion)
    - [ ] possibly starting to decay? Smells more and more like acetic acid
  - [ ] 15 assorted crabs and lobsters (Class Malacostraca)
    - [ ] Christmas Island red crab. Powerful claws for picking apart prey. Top of food chain. King of ecological niche. Makes me feel like
  - [ ] Acheta domesticus, the house cricket
    - [ ] flightless, defenseless, unspecial

- [ ] Class Mammalia
  - [ ] pair of incisors, North American beaver (Castor canadensis)
  - [ ] Splayed out New World chiropteran
    - [ ] Mimon bennettii (?) the Golden Bat
  - [ ] Pair of quills, African Crested Porcupine (Histrix cristata)
    - [ ] plucked from my leg and smuggled home from Mozambique in the pages of a notebook
    - [ ] I keep them right next to Yorick as a representation of convergent evolution.
  - [ ] Raccoon baculum bone
    - [ ] hehe
  - [ ] 1 weirdo (Homo sapiens)
    - [ ] talks to friends, dead in jars and cases.

This poem is an inventory of the specimens in my cabinet of curiosities at home.

Perch

by Ariana Kam

Pet button quail Ofelia, on taxidermy deer.

Canon Rebel T5, 18-55 mm lens

Cicada Exuvia

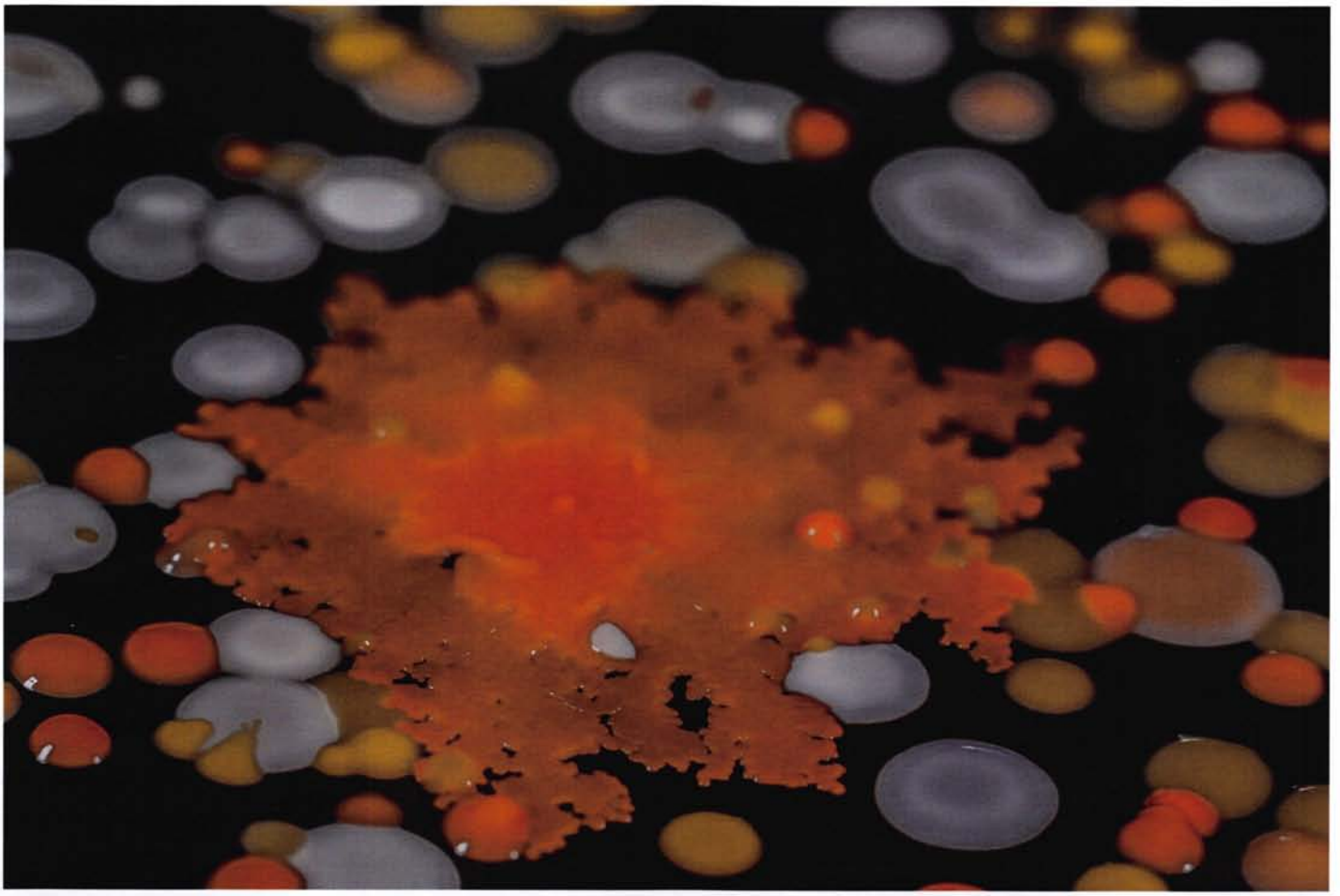
by Dennis Zhang

This is a cicada's exuvia, the exoskeleton left by the insect after ecdysis (molting). Made of a highly rigid modified sugar molecule called chitin, the exuvia preserves the anatomical details of the insect, and, in the case of cicadas, can often be found as ghostly form still clinging to the tree trunk long after the insect has flown away.

ink on paper, 18" x 24"

Cheese Rind Microbes

by Scott A. Chimileski



Cheese may appear to be just another delicious food to eat. However, the rind of all aged cheeses is actually a thriving ecosystem of microbes. Here, a model community of microbes isolated from a cheese rind grows on a simulated cheese medium in the laboratory. All of these microbes are perfectly natural parts of cheeses, and even contribute to their unique flavors.

Canon 5D mark iii, Canon 65mm macro lens, round colonies range in size from 1-5 mm

Watch this cheese in action:

Binturong

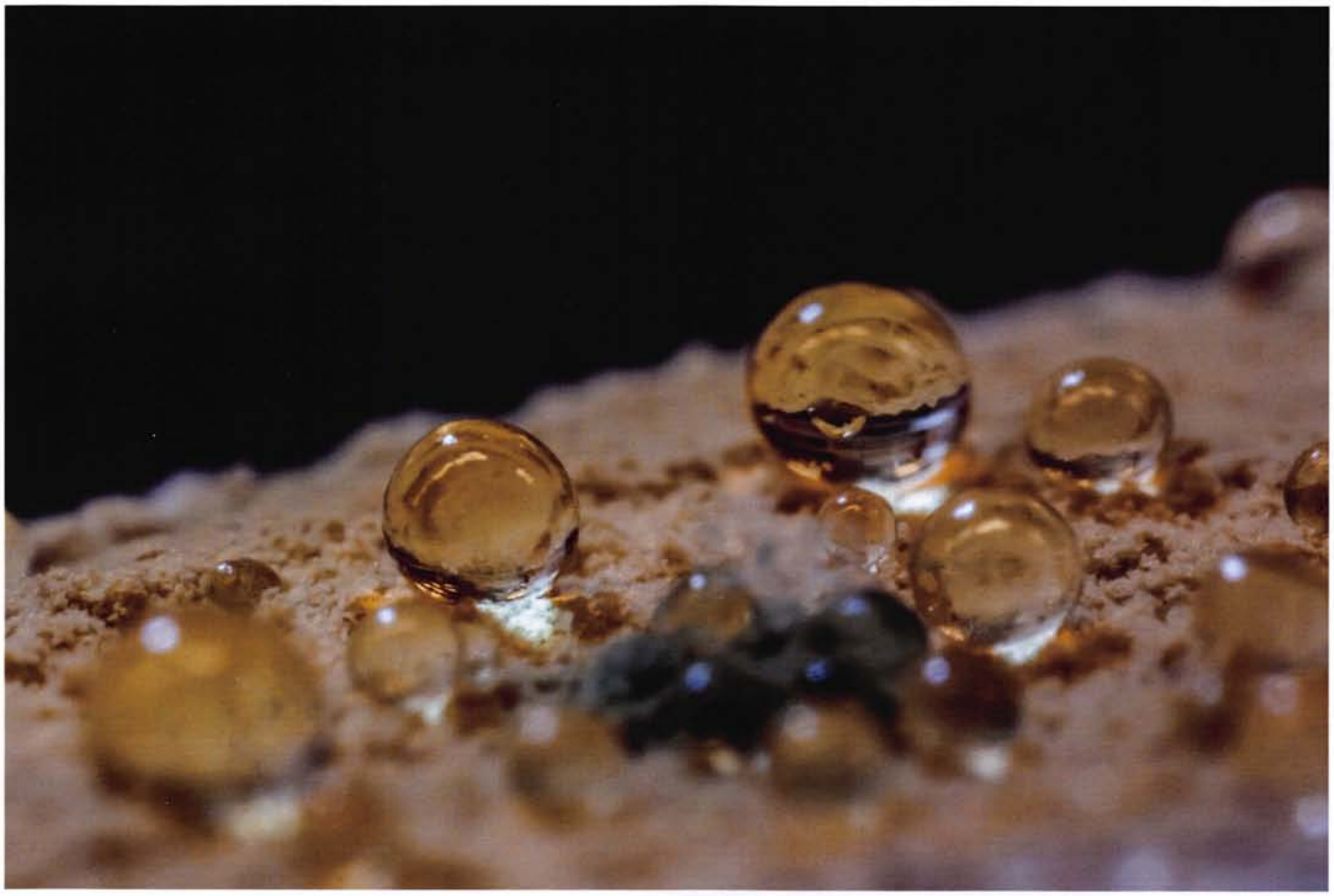
by Ariana Kam

Reads: "1. I Learned that binturongs smell like popcorn. And that their tails can function as built-in leashes."
First in a series of gifts for my research teammates at Southwick's Zoo *in Mendon, MA.*

pen and ink, 12" x 18"

Fungal Isolate No. 2

by Scott A. Chimileski



Water droplets form on the surface of a fungal isolate. These are secreted as a metabolic byproduct of the growing fungus.

Canon 5D mark iii, Canon 65mm macro lens, 3x magnification, water droplets range in size from 1-2 mm

An Interview with Artist-in-Residence Kim Bernard

by Joy Li

Can you tell me a bit more about yourself, your background, and how you first got involved with art?

I've been an artist my whole life, so even as a kid, I knew I would be an artist. I went to Parson's School of Design for my Bachelor's, and Massachusetts College of Art for my Master of Design. I focused in the fine arts—particularly sculpture. That's my education, anyway. I'm 50 years old, so I've been a working artist my entire adult life.

What piece are you currently working on? I know you mentioned an exhibit at the Harvard Ed Portal.

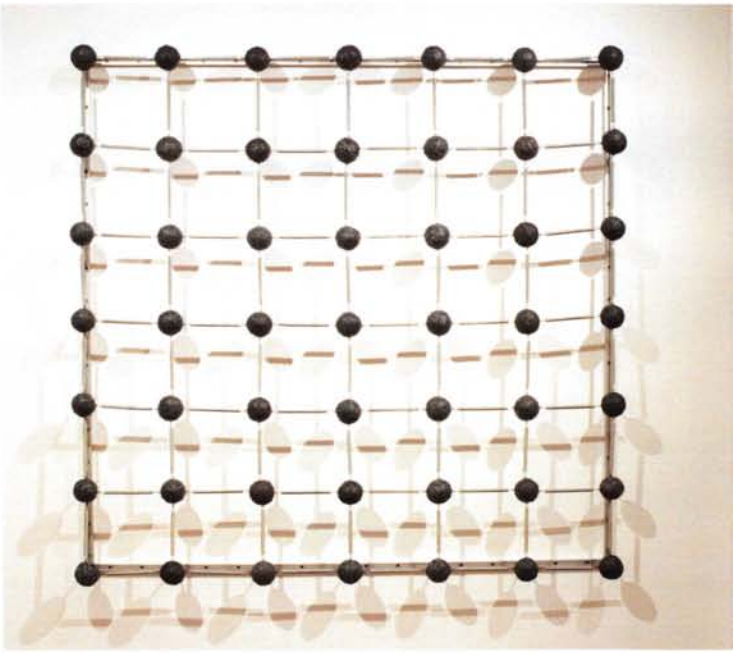
There are several pieces in the show. One is a collaboration with Rob Hart, who's in the Harvard physics department. We'll be working on a wall with 50 springs and balls attached to the springs—each as big as a plum, maybe. The balls will bounce up and down because there's a stepper motor driving them.[1] Imagine a line of balls bouncing around and down, with the frequency of the stepper motor changing over a 20-minute cycle. The balls are all different masses so some balls on one end have a greater amplitude than those on the other end, so it changes—the resonant frequency changes depending on where you are in the cycle.

Another piece on the wall is called "Quiver." You can actually see this work on my website if you're interested. It's about 48" x 48" on the wall, also with springs and balls. The springs and balls move and quiver—it's interactive, so the viewer should touch it and make it move.

All the work in the show is made out of bicycle inner tubes that I've shredded into strips and wound into balls, so there's a lot of organic and hyperbolic shapes.

Where do you get your inspiration for your pieces?

The work in this show is very much inspired by being an artist-in-residence in the physics department. The spring and ball work is similar to a past work—the difference being I hadn't used the motor in that one. So it's following the work I've been doing, but I've had a collaborator to work with who's very knowledgeable with stepper motors and who was able to program the motor's frequencies to change.



[1]an electric motor that divides a full rotation into a certain number of discrete, equal steps.

Stephanie Mitchell/Harvard Staff Photographer

As I work on one work, I always ge**nerate ideas for the next. I'm in the physics department so I look at dem*onstrat*ions they give in physics classes, and inventories of the physics objects. Just being immersed in the department and all the things that I've been taking in—it's all coming out in my work. And often, I'll ask people for feedback about what I'm doing. These are students and faculty and staff, and sometimes they'll have great ideas of where to look for inspiration.**

A common perception is that there's a divide between art and science. At Ecdysis, we're trying to show how this divide isn't as hard as it may seem—that so much of art and science do in fact overlap. That's something that I think is so wonderful about your pieces—on your website, you describe creating "an aesthetic that allows the viewer easy access, and provides a tangible way of seeing physics." I was wondering what your thoughts were regarding this separation between art and science—how to reconcile the two, or if you think there even is a separation.

Well I think there is much interconnectedness. At first glance, art and science seem to be a strange pairing. There certainly are differences that make them seem so. But both are investigations into the nature of reality—both have the ability to challenge and change how we view the world. Scientific and creative processes have in common—and both are based in—inquiry and wonder about how the world works and makes sense. Both begin by asking a question, with a deep curiosity and willingness to go **into uncharted territory. Of course, they're different, but of course they're also related to each other. Because my work is kinetic sculpture, it** moves—it involves physics. There's a natural connection there between physics and my art. Often, artists will view science as inspiration. Science, in turn, looks at art as a way to make the invisible visible. There can be an exchange—they have their differences, but they feed off of one another.

Do you have any advice for students who are thinking about pursuing a career in art, as opposed to paths that may promise more financial security?

Well those can be combined with art as well. There can be pairings that can be very rich, that can be explored. For advice to those who want to be artists—well, I would encourage anyone to pursue a field **you're deeply passionate about, whether or not that's art. But I recognize** people

are passionate about a variety of different studies. To go into any field just for money will not be fulfilling. Follow your interests and what makes you want to get out of bed in the morning, because you'll basically be spending your life involved with that. If you'll be spending your entire life doing something, you should be doing something that has purpose.

Can you tell me about your favorite piece you've made? The most memorable?

I'm really quite pleased with the work that's going into this show. It's so great to collaborate with someone else on a piece of artwork—it's not something that I've done a lot recently. I'm happy with the work that's going into this show in general.

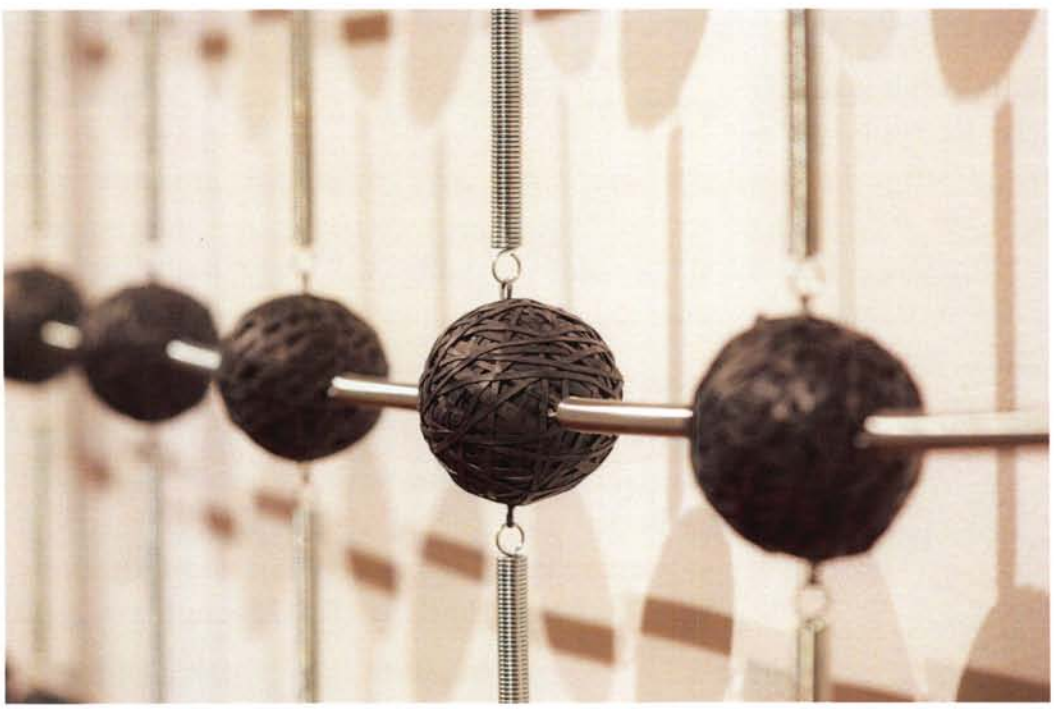
One thing that, collectively, a group of us made in the physics department was a square-wheeled boat last June. Half a dozen people were involved in the building and racing of it.

Sometimes you like **a piece when** it's complete, but then a couple years later, it doesn't sustain its interest. The ones that stand out are the ones that are pivotal—that indicate some kind of shift in a work. Maybe something that is first in a body of work. Something that's new and fresh—that indicates change and development happening with the work. The most important artworks are those that symbolize some kind of shift—a new direction in the work, a change.

Why sculpture?

I also paint—I also work two-dimensionally. I like working with my hands and seeing things come together in three-dimension though, and that lends itself to sculptural work. When I was in my undergraduate years, I decided to be a sculptural major because then I had access to lots of tools and equipment I hadn't had access to before. So I really wanted to take advantage of learning about all these tools and equipment.

The physics department here has a great machine shop. I went through the machine training, not because I had something to build, but because it presented the opportunity to learn about new tools and equipment. I just like to make things.



Dichotomy of Engineered Blood Vessels

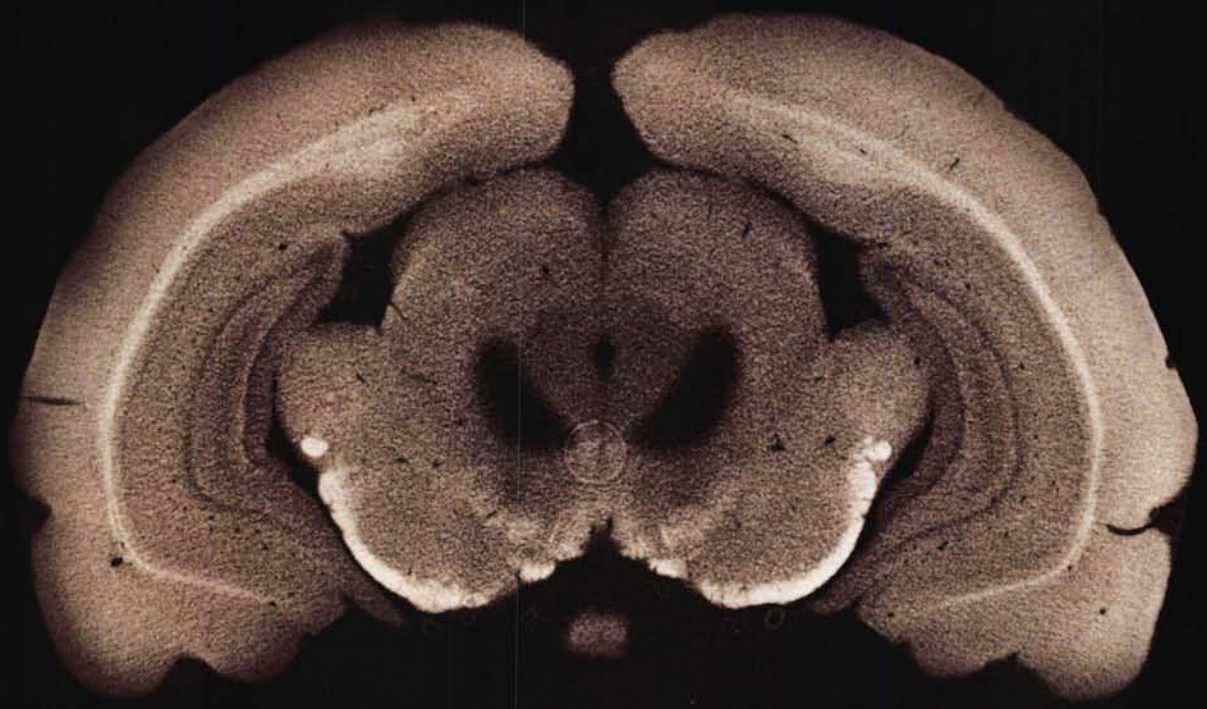
by João Ribas

This painting takes a deconstructionist approach to the concept of artificial creation: blood vessels in a scientific laboratory. The juxtaposition of hard blue lines and warm blurred reds symbolizes the dichotomy between a man-made structure and the organic fluidity of our blood and vasculature.

acrylic on canvas, 12" x 9"

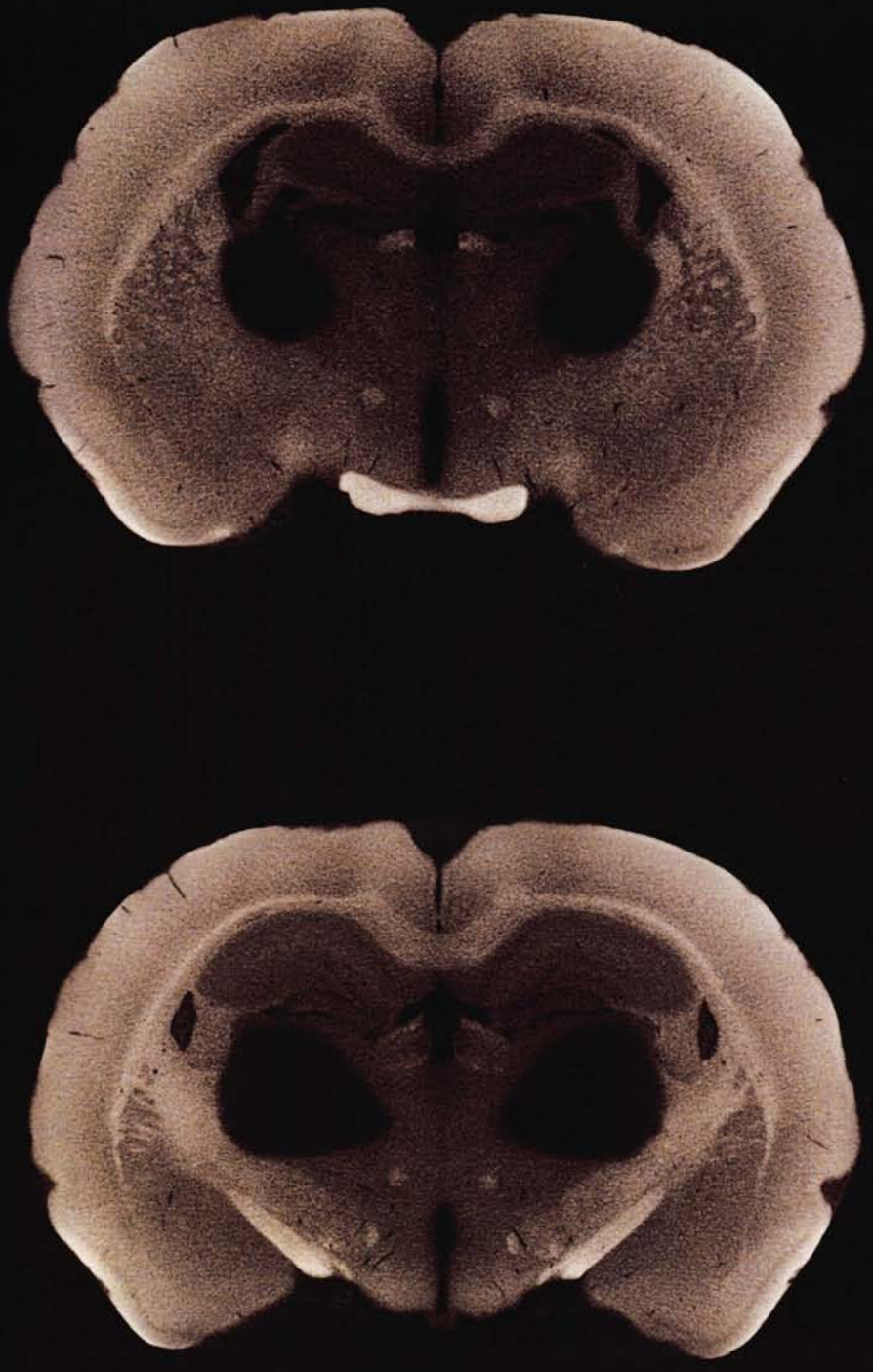
Coronal Slices

by Javier Masis



The study of vision and visual art go hand-in-hand. In many cases, impressive visual art, such as impressionism or cubism, has been predicated on idiosyncrasies and principles of how our visual system works before these idiosyncrasies and principles were discovered by scientists. One of these idiosyncrasies is our uncanny ability to detect faces, even when there are none. In this collection, we are surprised to discover faces in a surprisingly appropriate place — the brain. They span a wide range of emotions and personalities, just as our brain is responsible for all of our emotions and personalities. And yet the pieces are entirely a by-product of our visual system itself, for what lies before you are not faces at all, but incompletely-stained samples of a rat brain.

The brain was scanned on a Nikon Metrology (X-Tek) HMXST225 MicroCT system with a Molybdenum source. The brain was then reconstructed using VGStudio Max, and edited in Photoshop. About the medium: It's kind of a novel interpretation of digital photography that uses x-rays instead of visible light and then requires a computer to turn the projections into a 3-D reconstruction of the sample.



Bent Light

by Rodrigo Cordova

Light is the constant of the universe, the maximum speed of any object, particle, or wave. Here, however, it is juxtaposed with an immovable object: a black hole. Such shifts in the fabric of space have the power to change and distort the movement of light.

oil and acrylic, 11" x 14"

Astral D(ist)ance

by Catherine Zuo

The music to which we move is in the long motions, the loops and tangles of our orbit. One moment an untold time ago, the black hole came too close, the former star it had been shuddering into supernova before its core hunkered down into an invisible disk that devoured light. It tasted of the gases swirling around my atmosphere, siphoned a deep bolt, and next we were caught in each other's gravity. Perhaps it was nostalgia that compelled it to me, the heady scent of elements it no longer could create, nitrogen and iron and the more exotic chemicals in my many shells. For I was born a long time after it was. In the glory of youth, I had such stuff in me as the oldest stars did, elements that were scattered to the stellar nursery when they died.

I think often of death, the core collapse to come, the millisecond when I can no longer hold up the weight of my own self through fusion and I destroy my life's work in instants. Inside me, elements collide into heavier union to support the bulk of my light. I am not a large star; I do not burn bright; I will not go out with an explosion that rocks the galaxy with residual heat and radiation. Nor do I have the mass to become a black hole like my partner (two black holes as companions! Imagine what a chase that would be!). I may puff off my edges, the gases forming a brilliant spectrum of spread color while my core contracts ever more tightly into itself. There it will brace itself for the time to come without generating heat, living only off of the glowing remnants of my collapse.

That is the fate the black hole hurries along as we orbit each other and it draws off ribbons of my atmosphere, swallowing it as I once did the former stars' elements when I was but a babe of dust and lost matter. But the black hole is barren, and nothing will come of it despite what it consumes. Its event horizon ever beckons, an emptiness, a cold infinity, matter packed to a pinch of space. Gravity prevents us from dipping closer to each other than our orbit prescribes, but every time our revolutions bring us near, I wonder at its invisible but demanding presence. A dangerous partner, but I am not afraid. It is devouring me, but I want it like I want collapse, like I want the paltry work I've done fusing elements to spread deeper and farther into this vacuum to compose the forms of the future. Stars, perhaps, but I have too some more distant dream of being seen—by stars-but-not-stars that form in the wake of infinities, and that somehow may see through galaxies the echoes of me and my partner long gone in our slow dance.

This piece was inspired by binary star systems, which are sometimes composed of visible stars and black holes together. I've always wondered what it is to be a star and live that long, burning lifetime, but if we are made of the elements they created, we must have it in ourselves, at least a little, to know them.

Signs of Life in Ancient Oceans

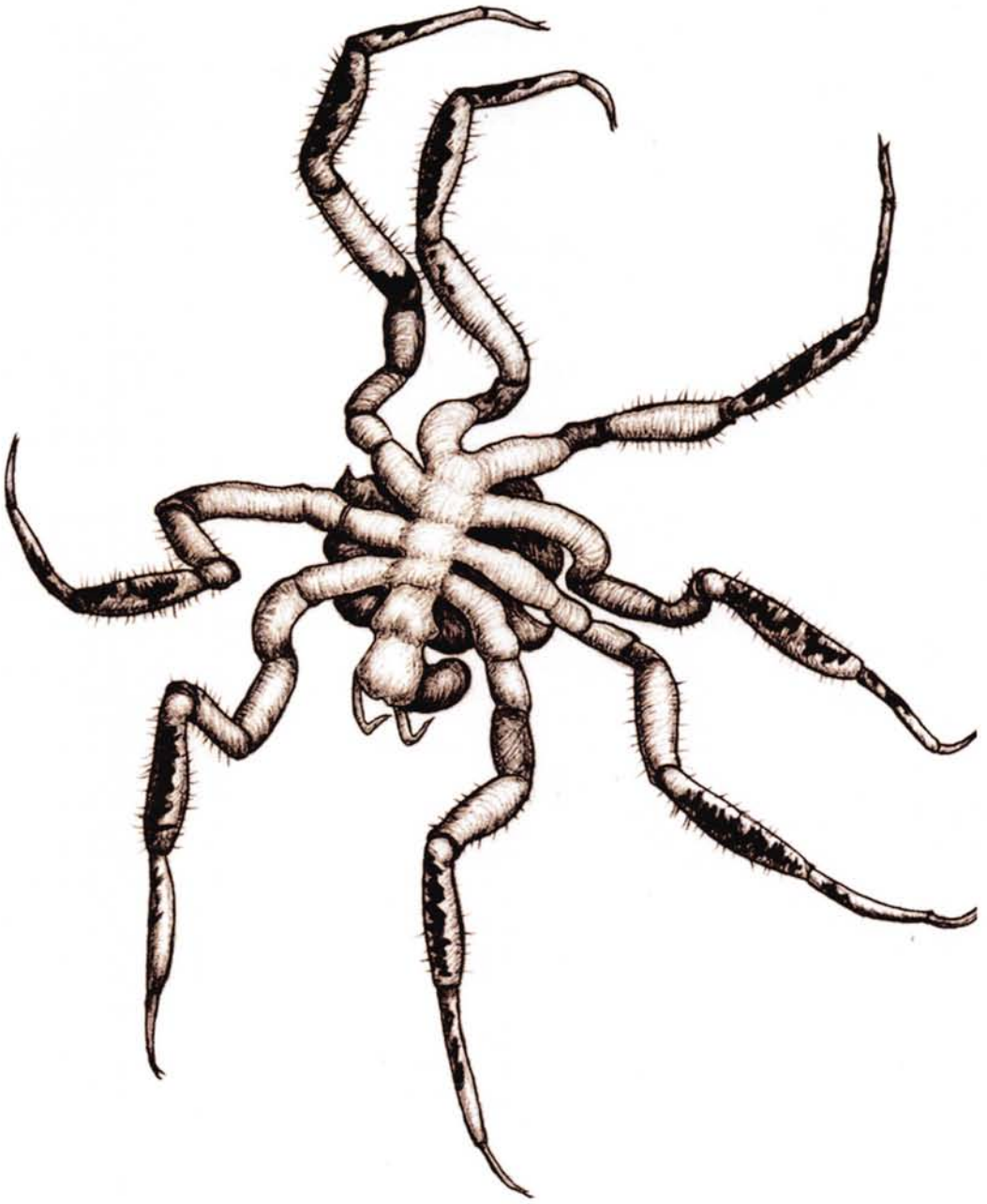
by Scott A. Chimileski

The patterns photographed in this rock from western Australia are known as banded iron formations and are some of the earliest evidence of life on Earth. The dark bands seen here formed over two billion years ago when oxygen produced by photosynthetic microbes reacted with dissolved iron in the ancient ocean, producing iron oxides that accumulated in layers within the sediment.

Canon 5D mark iii, Canon 65mm macro lens, super resolution composite of several photographs, 2 cm wide section

Pycnogonid

by Maya Chung



A few years ago I was working at the Smithsonian National Museum of Natural History *in an invertebrate zoology lab. I was sorting samples from hydrothermal vents, and my coworker found this beauty hidden in the mats of bacteria and tubeworms. This is a pycnogonid, or "sea spider," which lives in deep-sea hydrothermal vent communities. I drew this while examining the specimen under a microscope.*

ballpoint pen, 5" x 7"

For the Birds

by Silvia Golumbeanu

tern, how do i burn half my body
just to return home without crumbling

robin, how do i whistle these lacework trills
above the steel demands of garbage trucks

pigeon, how do i shine like gaspuddle rainbows
without bathing in the street gutters

eagle, how do i fasten my scowl so tightly
that it is not weakened by wind or death

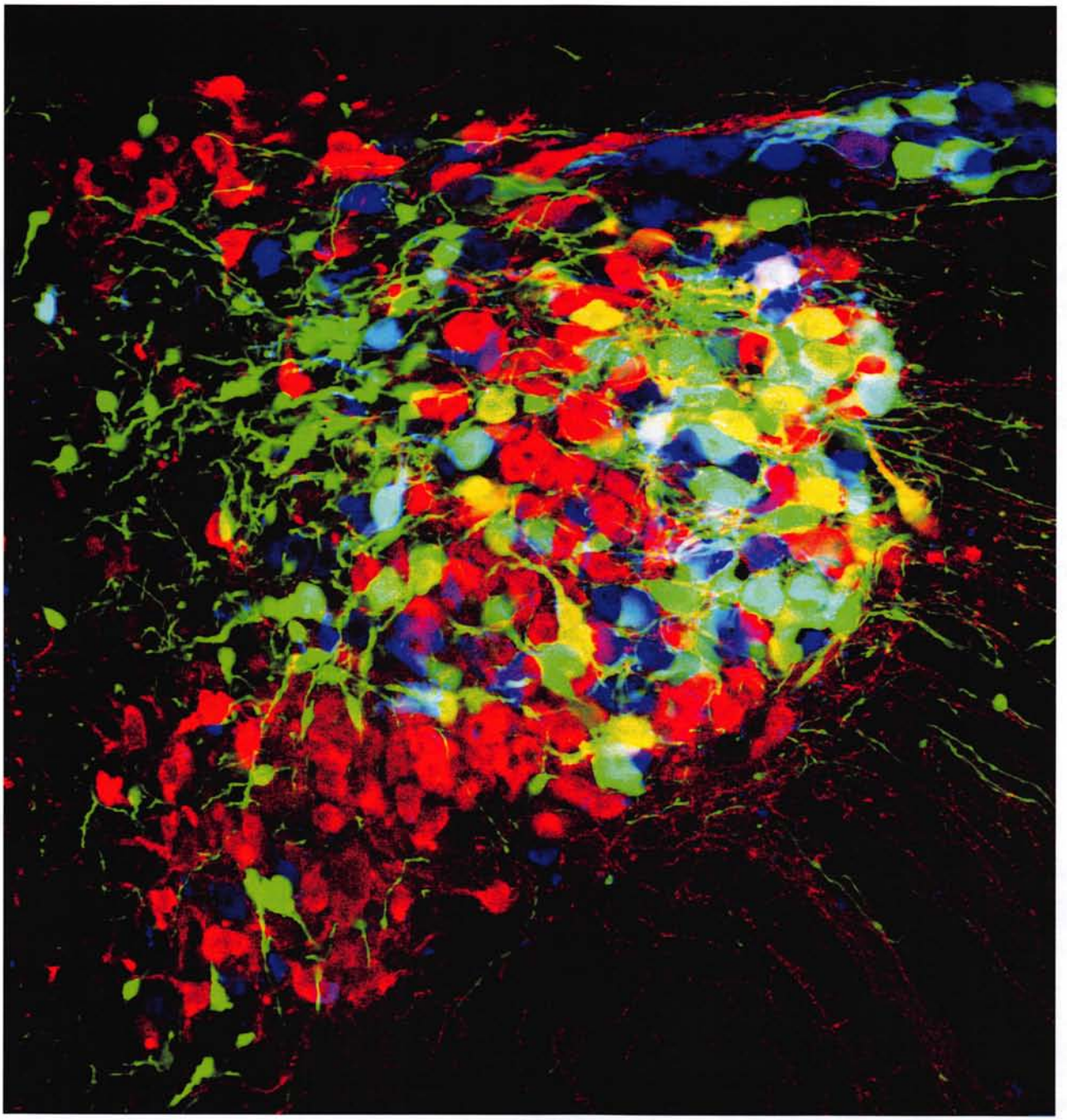
crane, how do i dance on wheatstalk legs
and not bend but to bow graciously

hummingbird, what is the velocity of hunger?

An ode to some of my favorite bird facts. Arctic terns migrate across the entire planet every year and burn half of their body weight in order to do so. Certain songbirds have actually evolved to sing louder (and less delicately) as a response to urban noise interrupting their mating performances. Hummingbirds have to eat about every 5 seconds to keep up with the energy expenditure of their almost impossibly fast wing-beating.

Bird in Flight

by H. Sophie Knobloch-Bollmann



Neurons under a microscope develop a unique beauty. I see a colorful, fluffy bird and wings in motion above its head. What do you see? This picture is a product of fortuity. It was created by the intracerebral injection of modified rabies virus in a laboratory rat to label neurons connecting brain areas. Further colors arise from staining for the identity of neurons. You are looking at half of the PVN, a heart-shaped structure deep in the brain with neurons containing oxytocin (love), vasopressin (aggression) or CRH (stress). Though these chemicals' functions are oversimplified, they greatly fit this storm of colors.

Confocal microscopy, 600 x 600 microns

Dolphin Song

by Sam Wu

"Dolphin Song" is a lamentation on the extinction of Yangtze River white dolphins. Already on the decline since the 1980s, the white dolphins, also known as baiji and *Lipotes vexillifer*, were declared functionally extinct in 2007. As this extinction is a direct result of human activity along the Yangtze River, including transportation, excessive fishing, and construction for hydroelectricity, the baiji is the first dolphin species driven to extinction solely due to mankind. Traditionally, local fishermen had nicknames for the white dolphins, including "princess of the Yangtze" and "protector of the river." Thus, the extinction of the baiji also lead to the loss of cultural heritage along the Yangtze River. "Dolphin Song" attempts to highlight this dual extinction by incorporating Yangtze folk music traditions. Ultimately, I hope that my music will raise awareness on this issue, conveying to my audience the value of this vanished species and the wonder its memory still inspires in us.

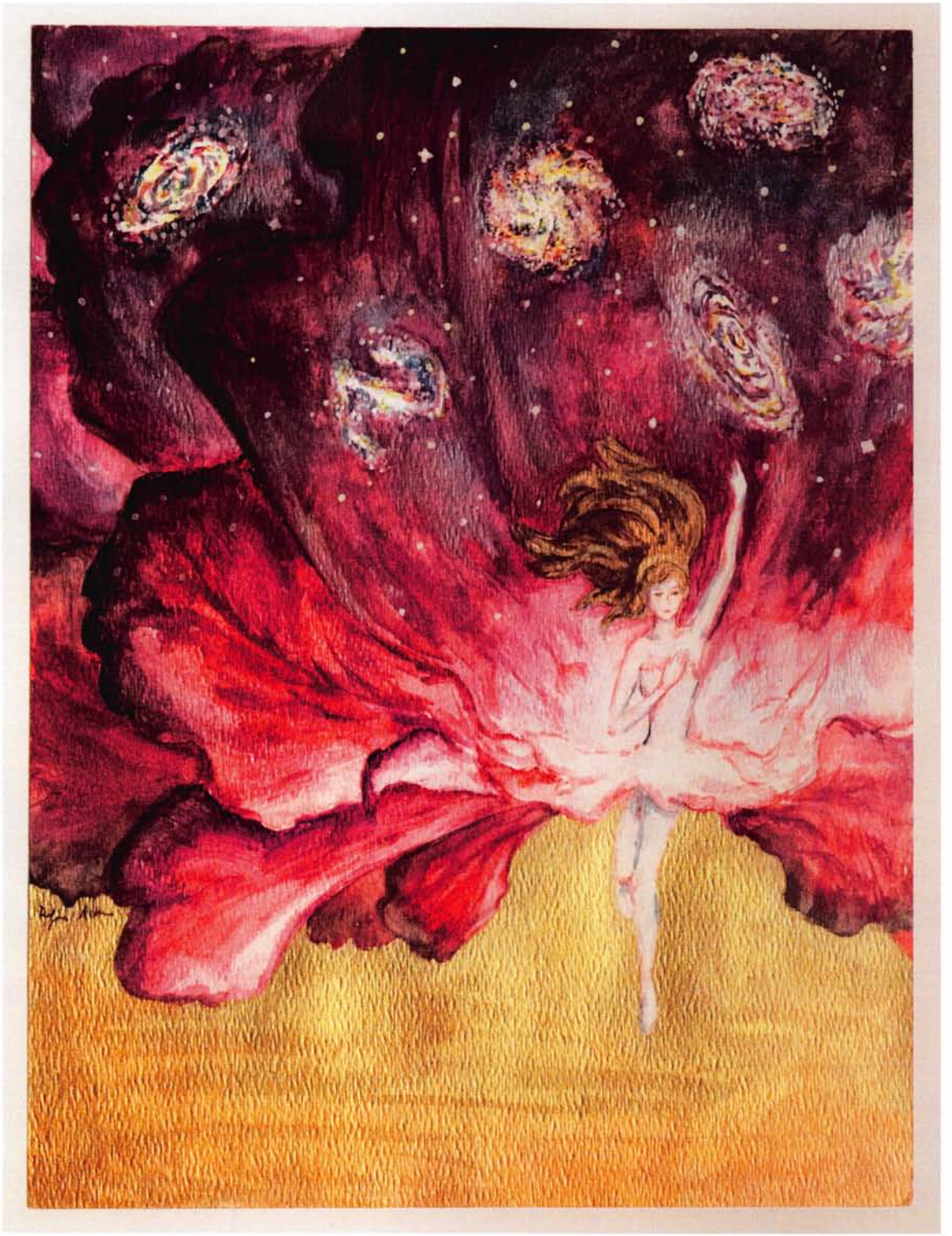
e with a Hint of *pi*

by Jeongmin Lee

More than the first 100 digits of the number e were translated into two octaves of pentatonic scales. A few (~59) digits of pi were converted into notes in a similar fashion. The dings of a high-pitched bell are the notes of e while the more digital voice about 12 seconds in are the notes of pi. These notes were stretched and spaced to fit into a song that sounded more than a random string of notes. Near the end, there is a plucking voice playing 16th notes. This voice plays both the digits of e and pi alternating between each note. The sound tries to explain it by playing the separate streams. This can also elicit a psychological effect where overlapping pitch streams can create an illusion of another melody. This may be demonstrated by how odd the overlapping melody first sounds before it is later forced to make more sense. As this last effect depends on the listener, effects may vary.

The Space Between the Stars

by Defne Altan



Just as the unfurling petals of the magnolia flower layer atop each other, so might we imagine the countless stars and galaxies of each universe existing in parallel. I've always been fascinated by the idea of multiple universes; if we are confined to only one of an infinite number of diverging timelines, how would we possibly know?

watercolor, 10" x 12"

Livingston's Turaco

by Lily Lu

The Livingston's turaco is a member of the Musophagidae ("banana-eater") family of birds, which is endemic to sub-Saharan Africa. Turacos are vibrantly colored, their plumage ranging from blues and greens to purples and reds. They often bear impressive head crests and long tails.

Digital painting, *Adobe Photoshop* and *Paint Tool SAI*

Biological Beats

by Maria McLaughlin, Liza McPherson, Michael Rose, & Larry Guo

"Biological Beats" is written using the algorithm *Conway's Game of Life*, which is a cellular automaton that creates cells, keeps them alive, and kills them based on a set of user-inputted rules. The rest of the "game" continues indefinitely without a player.

Abandoned Laboratory

by Reece Akana

This soundtrack consists of a collection of sounds. The main, haunted soundscape that spans the entire track is created by a sound generator called Space Drone, developed by *Native Instruments*. The sounds are created by a range of pitches spanning the human audible spectrum from 20 hertz to 20 kilohertz. These pitches are modulated so that they are performed at randomized attack speeds and volumes. Attack speeds determine how long it takes for the sound to reach its full volume, and volume simply determines what that maximum loudness is. By altering the pitches as well as the number of pitches that rise and fall at similar times, the sounds generated can range from subtle to intense, from a low growl to a piercing roar.

Viewing Lens, Magnetic Shards, Organisms

by Brandon L. Snyder

From a universal perspective, rigorous physical laws govern the cosmos and galaxies. These same laws also dictate the organization of the an atom's subcomponents at the most minute scale. Yet, somewhere in between those two lenses we also see humanity, subjectivity, and imagination. To some, this is a departure, a gray area, an escape from the laws that govern us. To others (including me), it is one and the same. Atoms and humans and planets all share an origin. Traces of humanity are embedded in the fabric of our galaxies. Essences of the universe also lie in our minds.

A magnetic field is a beautiful organization. Take metal filings dashed on a surface, expose them to such a field. Quite magically, the material snaps into an ellipse-like figure.

This music is a reflection on visual perspectives. A camera captures both the macro and the micro. A satellite in space can capture a frame of the entire earth, yet also zoom in so incredibly far as to read the nutrition facts on a food label. From one distance we identify and relate to an object; from another, we see new and different things. It is profound that between both perspectives, the object under observation remains the same, only appearing different.

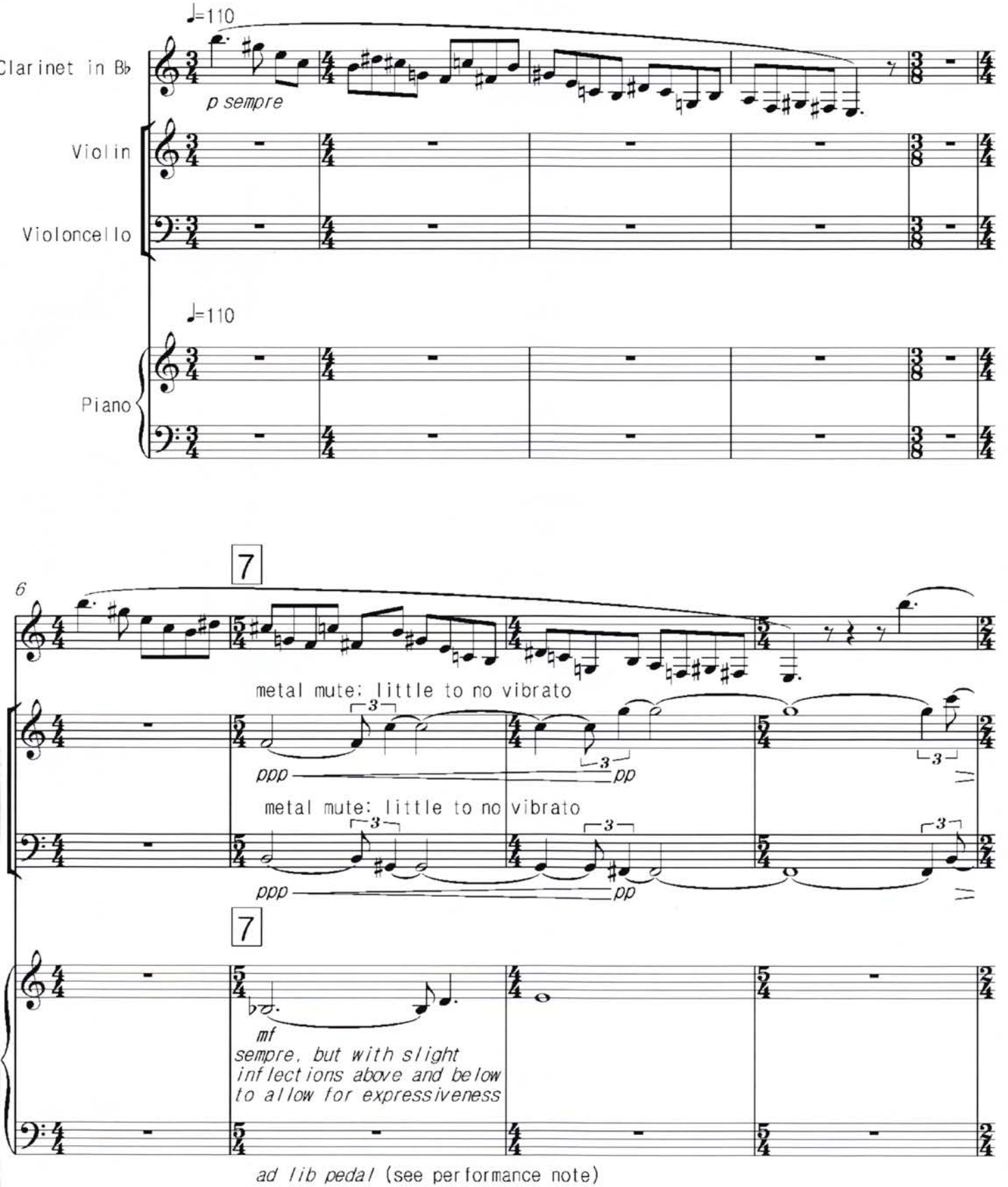
The viewing lens zooms from a planetary perspective, to a human one.

A silly activity I did in elementary school (and occasionally still to this present day) was zooming all the way in and out on Google Maps. It was always so fascinating to me that in this picture of the entire planet Earth my house was present on some very small, specific point. Another activity I like to do is snapchat my friends from far away and gradually zoom in on their face. At first, you see a person's face become larger and more recognizable. And then past that, the human face expands and degenerates into a shaded blob of skin color. The person is unrecognizable at this point.

Past and inside the human, there are planets.

In high school biology class, we learned about the organelles of a cell. I would imagine them to be like a metropolitan city, with various organelle-buildings doing particular things. The nucleus would be city hall, the vacuoles would be the garbage dumps, and so on. Of course, the inner parts of a cell are not living beings that think and make decisions like humans in a city. They are just materials driven my chemical reactions and gradients. None of the sub-parts of our body do any actual "thinking" or "discerning," yet somehow their summation creates a human being.

"Viewing Lens" is a music inspired by such thoughts as these.



First page of the score.

Contributors

Reece Akana is a senior at the college studying chemical and physical biology as well as music. One of his favorite hobbies is going to Guitar Center to play with all of their expensive toys.

Defne Altan is a sophomore in Dunster House studying neurobiology. She enjoys exploring different artistic media, especially watercolor, and is interested in health care innovation and cognitive neuroscience.

Scott Alexander Chimileski is a microbiologist and photographer based in the Kolter Lab at Harvard Medical School, where his research activities are focused on imaging the social, multicellular and emergent properties of microbes. Scott is also working on a microbe exhibit to open at the Harvard Museum of Natural History in 2017 and writing a book that communicates the unseen biology and beauty of the microbial world to a general audience (to be published by Harvard University Press, also in 2017).

Trevor Chistolini is a sophomore concentrating in chemistry/physics and philosophy, aspiring artist, and middle child. He likes getting lost in the woods while running and lost in fictitious stories while reading.

Maya Chung is a freshman studying earth and planetary sciences. She is interested in physical oceanography and climate change, and hopes to continue using art to help people understand complex scientific concepts.

Eamon Corbett is a junior in Kirkland House studying organismic and evolutionary biology. He hopes to spend his life tricking people into paying him to look at birds.

Rodrigo Cordova is a freshman at the college studying astrophysics/physics. He hopes to complete secondary studies in archaeology and still find time to paint once in a while.

Michael Ge is a sophomore at the college studying computer science and statistics. To see more of his digital artwork, visit www.geemichael.com.

Silvia Golumbeanu is a junior in Currier House studying organismic and evolutionary biology. She can usually be found playing music in a café somewhere.

Larry Guo is a sophomore concentrating in computer science. He is a musician and appreciates the intersection of music and the digital realm.

Ariana Kam is a senior in Winthrop House studying organismic and evolutionary biology. She is also working towards a secondary in visual and environmental studies, with a focus on animation.

H. Sophie Knobloch-Bollmann is a researcher at Northwest Laboratories, Harvard, conducting brain research. She's got a passion for science and art and loves this journal for combining both.

Cameron Krulewski is a freshman living in Thayer. She may concentrate in math and physics, but she also loves animals and biology. Her hobbies include archery, bird watching, and reading fantasy novels.

Jeongmin Lee is a freshman at the college who intends to study human regenerative and developmental biology. He enjoys writing music while pursuing a career in the medical field.

Joy Li is a freshman living in Stoughton who is planning to study neurobiology and philosophy. From San Diego, California, she can often be found scouring the Square for cheesecake or acai bowls (or where her next Asian American Dance Team practice is!)

Lily Lu is a freshman at the college who plans on studying organismic and evolutionary biology, with a potential secondary in energy and environment. She is currently pre-med until she finds something better to do, which may involve birds or illustration.

Angelo Mao is a bioengineering Ph.D. candidate in the School of Engineering and Applied Sciences. His creative work has appeared in and is forthcoming in *Web Conjunctions*, *Lana Turner*, *Denver Quarterly*, and elsewhere.

Javier Masis is a third-year graduate student at the Graduate School of Arts and Sciences studying the neuroscience of vision. He spends his free time practicing guitar, playing drums with his band Burne Holiday and soaking up the sun.

Liza McPherson is is a sophomore concentrating in computer science. She is on the board of the Women in Computer Science club.

Maria McLaughlin is a sophomore concentrating in computer science. She is currently pursuing a secondary in visual and environmental studies, and enjoys the intersection of computer design and art. She teaches computer science at a middle school in Boston through the Digital Literacy Project.

Maximillian Prager is a freshman at Harvard hoping to study organismic and evolutionary biology and English. He dreams of publishing scientific papers and poetry books, though he doesn't know which will come first.

João Ribas is a Ph.D. candidate researching ways to engineer hearts and blood vessels at Harvard Medical School. He hopes to finish his thesis before he dies of cardiac arrest!

Michael Rose is a junior studying government with a secondary in computer science. He is also a musician.

Brandon Lincoln Snyder is a sophomore at the college studying music (composition specifically). He enjoys working with other people, and hopes to continue the arts in a spirit of collaboration.

Sam Wu has studied composition with Tan Dun, Chaya Czernowin, Libby Larsen, and Josh Levine (masterclasses with John Adams and George Benjamin). His music has been performed in the United States, France, Portugal, Australia, Japan, and China; his collaborators include the Melbourne Symphony Orchestra, Boston Philharmonic Youth Orchestra, Beijing National Center for the Performing Arts, Shanghai International Arts Festival, pipa virtuoso Wu Man, among others.

Dennis Zhang is a sophomore at the college studying mechanical engineering. He loves insects and sleep, but has found neither to be particularly abundant during the school year.

Catherine Zuo is a senior at the college studying English. She's the waste product of $C_8H_{10}N_4O_2$ and philosophy.

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DID YOU KNOW THERE'S A NEW JOURNAL IN TOWN - AND THAT WE'RE IN IT?
OH QUINCY!
YOU KNOW IT'S NOT US,
BUT OUR SECOND COUSIN
OFELIA...
LILY LU