

INTERVIEW

In Conversation with Golan Levin on Cytographia

by Jordan Kantor



Golan Levin (he/him) is a Pittsburgh, PA-based artist and educator, who has been active professionally in software art since 1995. His work explores new intersections of machine code, visual culture, and critical making in order to highlight our relationship with machines, expand the vocabulary of human action, and awaken participants to their potential as creative actors. Levin's work is included in the permanent collections of the Museum of Modern Art, ZKM Karlsruhe, and the Cooper-Hewitt Smithsonian Design Museum, and has been featured in exhibitions at venues including the Beall Center for Art and Technology, bitforms gallery, the 2004 Whitney Biennial, Victoria and Albert Museum, Ars Electronica, Art Center Nabi, ICA London, La Gaîté Lyrique, and the NTT InterCommunication Center. Levin earned degrees in Media Arts and Sciences from the Massachusetts Institute of Technology. Since 2004, he has held an appointment as a professor of electronic art in the School of Art at Carnegie Mellon University, where his pedagogy is concerned with reclaiming computation as a medium of personal expression. With Tega Brain, Levin is co-author of Code as Creative Medium (MIT Press, 2021), a guide to creative coding for software arts educators.

Jordan Kantor: Hi, Golan. Thank you very much for taking the time to speak with us. Cytographia has been a long time in the making, and we are delighted to have its release so close at hand. You have such a long and deep creative history, within the field of generative art and beyond. Before we discuss Cytographia, can

you tell us a bit more about your background: How did you first get into making art at the onset, and then exploring digital art?

Golan Levin: Thank you so much for this honor. My mom's an abstract painter and my dad is a commercial engraver, and so in a personal context I've been making visual art since before I can remember. But, a formative moment came when I visited Boston in 1980, as a child, and saw an exhibition of artworks produced at MIT's Center for Advanced Visual Studies—Michael Naimark's poignant "Displacements" installation and Bill Parker's responsive plasma sculptures. This awakened me to the possibility that art could be dynamic, interactive, and use science to create perceptual magic. I knew from then that I wanted to push the envelope of art using technology. I experimented extensively with electronic music in high school, and then attended MIT from 1989–1994. I became an undergraduate research assistant at the Media Lab, where I contributed to projects like the ALIVE immersive environment (1992) by Pattie Maes.



Pattie Maes, Sandy Pentland, Trevor Darrell, Martin Friedmann, Pushpinder Singh, Bruce Blumberg, and Golan Levin, ALIVE, 1992. Interactive virtual projection. In this scene by Golan Levin and Pushpinder Singh, a family of blobs follow the participant's outstretched hand.

Even so, it wasn't until my first job out of college that I learned there was even a term—"new media art"—to describe the field I wanted to work in. This was at Interval Research in 1995, where I was employed as an interface designer and where, by incredible luck, I was mentored by none other than Michael Naimark, along with interaction design pioneers Brenda Laurel and Bill Verplank. Around that time I was

also deeply influenced by my co-worker Scott Snibbe, who introduced me to the basic idioms of creative coding, and with whom I created a series of interactive software instruments for dynamic visual abstraction. In 1998 I returned to the MIT Media Lab to pursue graduate studies in John Maeda's Aesthetics and Computation Group, where I was again fortunate to share a workspace with far-seeing peers like Casey Reas, Elise Co, and Tom White. My career was launched on an international stage in 2000 when I performed my master's thesis projects (a series of generative software systems called the Audiovisual Environment Suite) at the Ars Electronica Festival in Austria.



Golan Levin with Lingdong Huang, *Ambigrammatic Figures*, 2020. Series of 55 AI-generated images and NFTs. Edition size variable.

JK: It sounds like a wonderful confluence of your earliest interests and a specific moment in history. Fascinating. When did you first hear about the blockchain as a vehicle for art?

GL: Casey Reas tried to interest me in the blockchain as early as mid-2020, but I resisted; I found early crypto art and culture difficult to relate to. The opening of the Hic et Nunc exchange was a game-changer. For software artists, it was suddenly

clear how the blockchain could address some of the most significant professional challenges we faced—such as finding a venue to present our work during the pandemic shutdown, identifying a mechanism to preserve code-based art, and finding a way to expand our community to include an audience of interested collectors. James Paterson (aka Presstube) generously showed me how to publish NFTs in March 2021, and my genesis token on the Tezos blockchain was a Perlin Noise demo I'd made for my creative coding students earlier that day. I released my first major NFT project on Hic et Nunc in mid-2021, a series of 55 collectible “cards” from my *Ambigrammatic Figures* project. This is a collection of grotesque face images that are legible both upside-down and right-side up, generated using a neural network.

Over the past few years, I've tried to pay James' gift forward by showing my students how to publish NFTs. I'm particularly proud of how far Huw Messie has taken it, with his gorgeous and poetic computational embroidery animations. I walked him through the minting process the day after he graduated, in May 2021, and he's been knocking it out of the park ever since.



Golan Levin, Chris Sugrue, and Kyle McDonald, *Augmented Hand Series*, 2014. Interactive software installation with cameras, touchscreen, custom enclosure. Dimensions variable. Image by Gerlinde de Geus, courtesy Cinekid Festival.

JK: Can you tell us a bit about your creative process?

GL: I'm a "generalist" in new media art: I've made interactive installations, live performances, online interventions, net art, information visualizations, mobile apps, generative drawings, mechatronic sculptures, even graffiti tools. I've made art that incorporates a wide range of computational media, including things like lasers, robot arms, telephone networks, augmented reality, 3D printers, machine vision, speech recognition, physics simulations, and deep learning systems. I've also had sidequests into things like the tactical potential of digital fabrication, and commercial product design as a mode of critical inquiry. But across all of this, my main interests have always been in developing new forms of gestural interactivity and creative feedback, and exploring principles of playful and expressive form through code.

I suppose there are a few things that could characterize my process. For better or worse ... I'm attracted to difficult technical problems. I tinker and tweak parameters endlessly. I make a lot of test programs and failed experiments. I love to collaborate but I'm reluctant to ask for help. And I'm honestly not that sophisticated as a software developer. As a result I tend to work comparatively slowly. So, for example, I've been developing *Cytographia* in fits and starts for more than two years. Because *Cytographia* is a sort of book, I've joked about the protracted process of making it as "working on my novel." You can get a telescopic view into my process of developing *Cytographia* in this [two-year-long Twitter thread](#)!

Until now, stand-alone *generativity* has usually taken a back seat to *interactivity* in my work. A good example of this is my real-time [*Augmented Hand Series*](#) installation from 2014. As one kid described it, "It's a box. You put your hand in it. You see your hand with an extra finger." The extra finger wiggles around exactly as if it was part of your own body. It took me literally ten years to figure out how to achieve this, and only then because I started collaborating with some brilliant friends, artists Christine Sugrue and Kyle McDonald, who had each been thinking along similar lines. But if nobody puts their hand in the box: the screen is blank; there's nothing to see.

Cytographia is not only my debut on the Ethereum blockchain, but also my first major generative artwork that does not depend on user input to exist. From my earlier work, I've retained the premise that an artwork should appear unique at every moment, and that the responsive behavior of the artwork should be unique to every person who interacts with it. But I've shifted the job of producing surprise to my own set of algorithms for synthesizing a design, and I've relaxed my rule that the screen be literally empty until a participant does something.



Golan Levin (at right, in the rear) directing his *Drawing with Machines* course at Carnegie Mellon's STUDIO for Creative Inquiry, fall 2021.

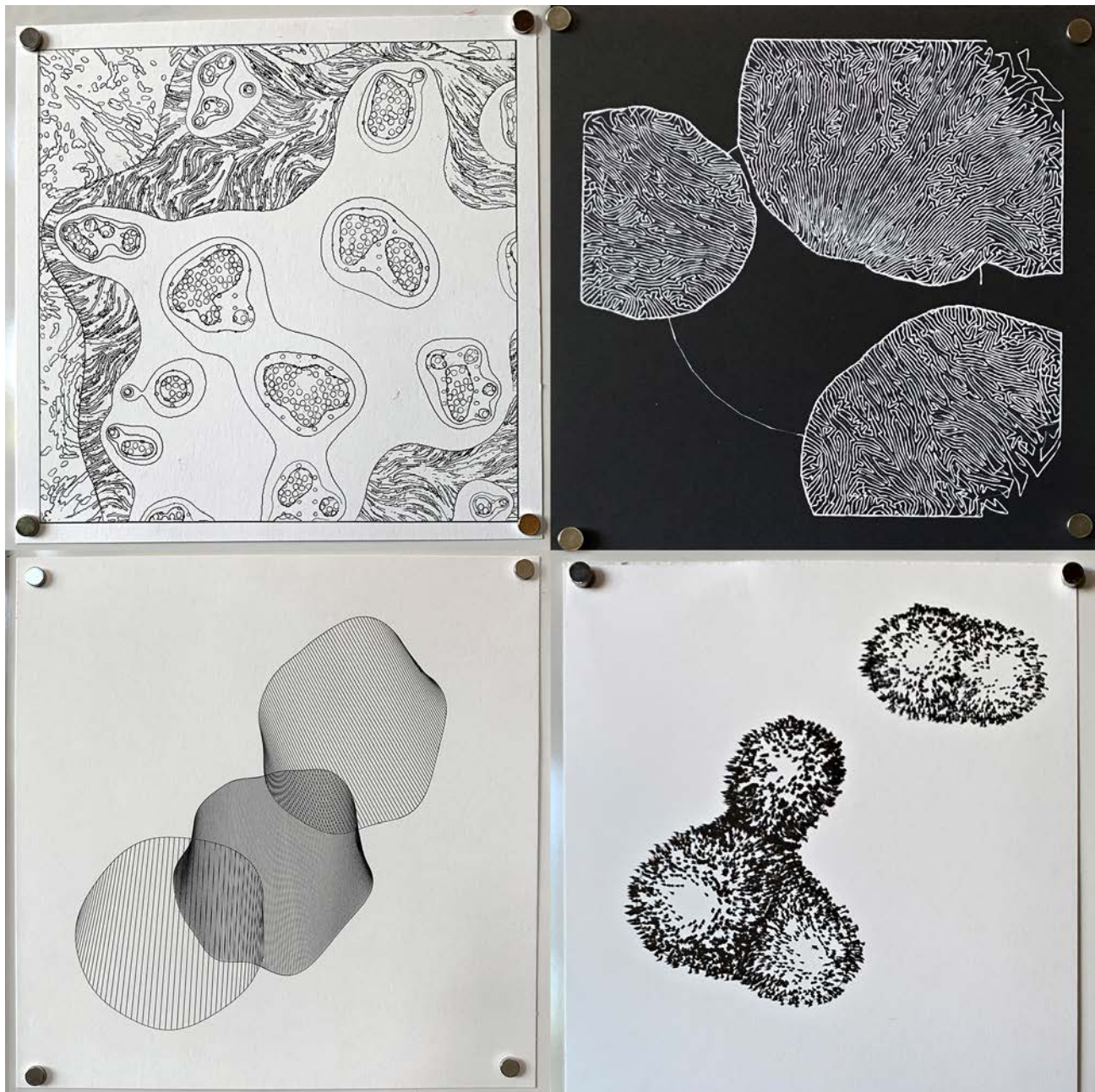
JK: In addition to your art practice, you are a Professor of Art at Carnegie Mellon University. How does your creative work connect to and depart from your teaching?

GL: Teaching is a form of research for me, and my pedagogical practice is very closely intertwined with my creative practice. I try to give provocative assignments to my students as a way of causing interesting things to happen in the world, and to advance the state of the art in how code-based art practices are taught. This has led to things like my educator's handbook with Tega Brain. I reckon that as long as I'm in the classroom, I might as well turn the space into a kind of generative social sculpture.



Golan Levin and Zachary Lieberman with Jaap Blonk and Joan La Barbara, *Messa di Voce*, 2003. Live audiovisual performance/installation software with voice-responsive and camera-responsive projection. This scene shows a blobby “voice-responsive virtual costume” which is shaped by the performer’s body, but altered by their voice.

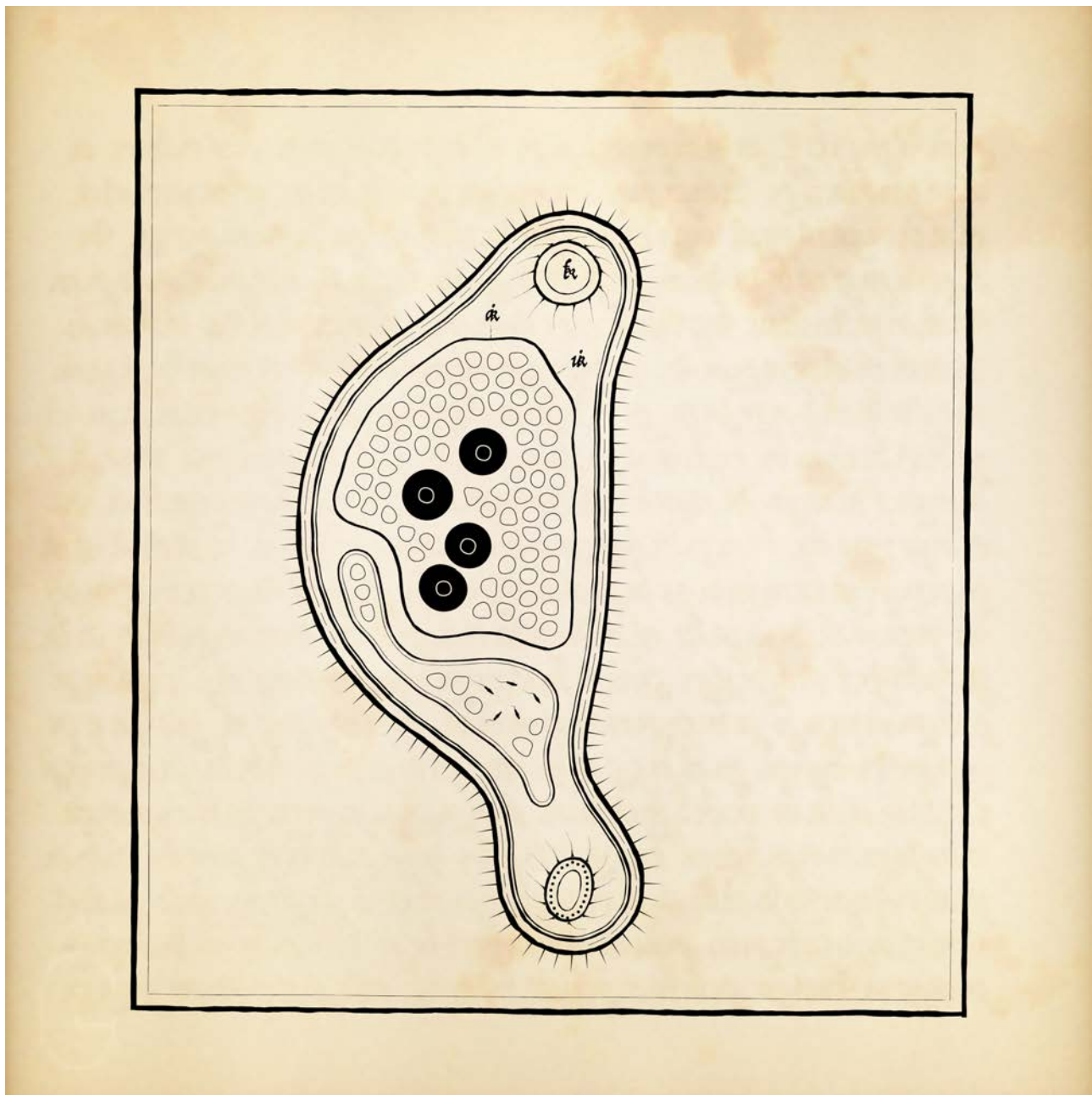
I’ve been privileged to work around some truly extraordinary students, and I can’t emphasize enough how much I learn from *them*. I’ve had incredibly meaningful and productive collaborations with former students like Irene Alvarado, Aman Tiwari, and Lingdong Huang. The brilliant Zach Lieberman, a giant in our field, was my master’s student at the New School, and just after he graduated we collaborated on a number of interactive performance and installation projects together, such as *Messa di Voce* (2003). These projects directed both of us to many fertile new ways of working—with machine vision, graphics, and interactive form.



Student projects from Golan Levin's fall 2021 *Drawing with Machines* course at Carnegie Mellon University. Clockwise from top left: isocontour blobs by Sarah Di; differential growth blobs by Leah Minsky; implicit surface blobs by Himalini Gururaj; Bézier blobs by Jean Cho.

Cytographia actually got its kickoff as part of an assignment I gave to the students in my *Drawing with Machines* class at CMU in October 2021. This was a studio course that introduced students to generative art for robotic pen-plotters, similar to the kind of experiments you might see on the #PlotterTwitter hashtag. One of the course units was on the topic of *shape*, and with a nod to one of Zach's investigations, I asked my students to write a program to “generate a family of blobs.” There's no single solution for this challenge, and coding one's own blobs can be a deeply personal and educational rite of passage for generative artists. *Cytographia* began

as a pedagogical sketch that I made to show my students how I might approach this assignment ... and I just never stopped working on it.



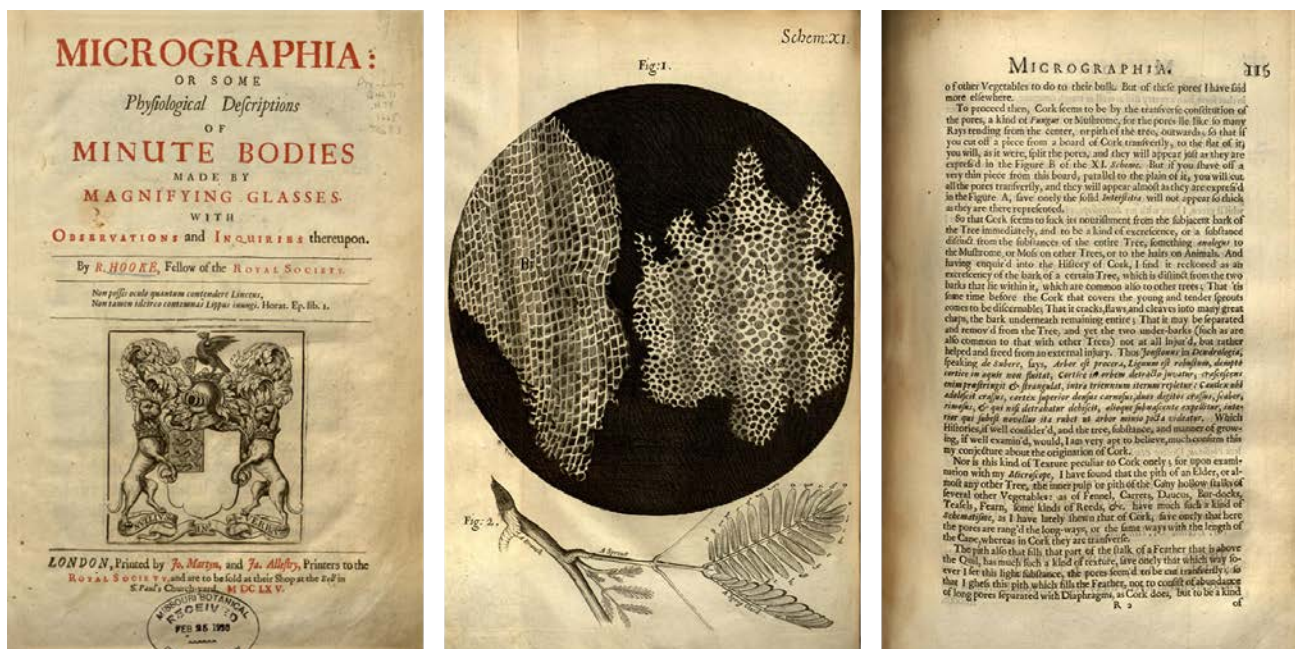
Golan Levin, *Cytographia* #0, 2024. [Live view](#).

JK: Wonderful that this came out of an assignment you did alongside your students. To the finished product at hand—please tell us a bit more about *Cytographia*.

GL: *Cytographia* is a long-form generative artwork that presents illustrations from an imaginary book about imaginary microorganisms. Each page in the book centers an interactive diagram of a one-celled creature, styled to evoke a hand-drawn

engraving. Every aspect of this drawing is generated through custom code, including the anatomy and behavior of the depicted creature, the calligraphic quality of its lines, the nonsense glyphs that label it, and the details of the ground on which it is rendered. *Cytographia*'s organisms grow and move autonomously, but also respond to real-time actions by the observer.

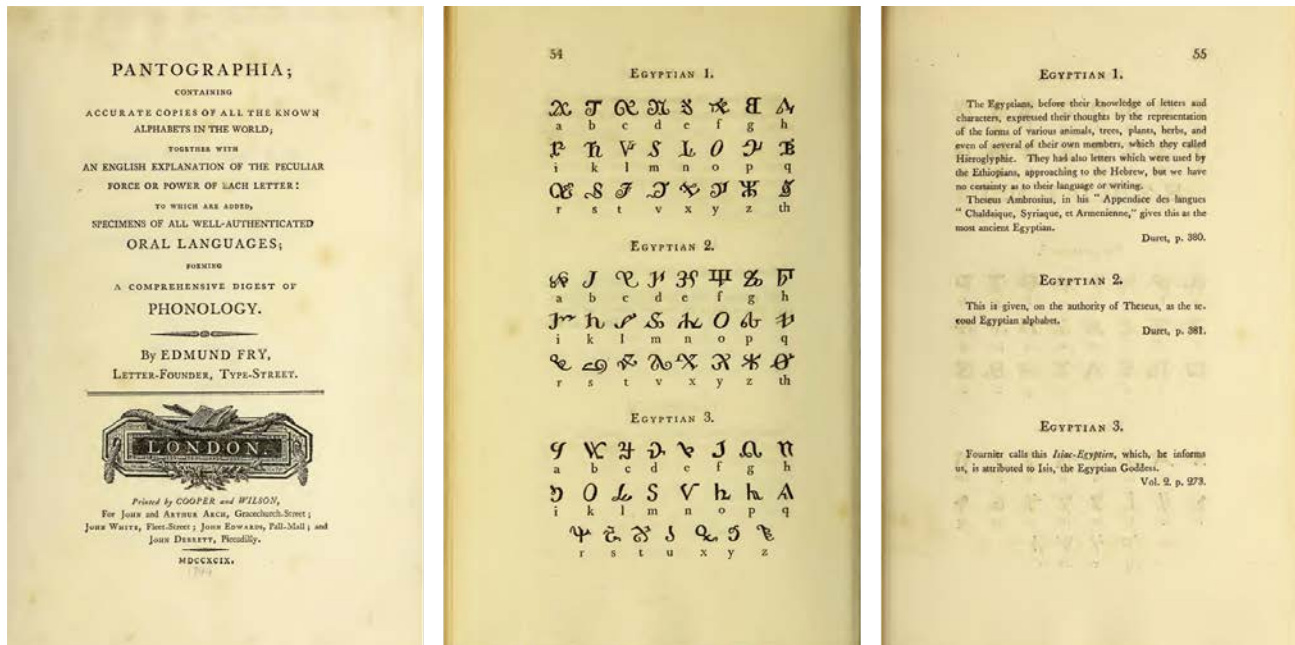
Biodiversity loss has been on my mind. According to a recent estimate, "there are about one trillion species of microbes on Earth, and 99.999 percent of them have yet to be discovered." At the same time, experts estimate that "between 0.01 and 0.1 percent of all species" are now becoming extinct each year, owing to a thousand-fold, anthropogenic increase in Earth's extinction rate. If there are a trillion different species that coexist with us on our planet, then some 100 million species are now becoming extinct each year—the vast majority of which are undiscovered microbes. *Cytographia* offers a Borgesian speculation on what these vanishing lifeforms might have been like to observe and interact with, had we had the chance to study them. It is an elegy for the species we will never know.



Pages from *Micrographia* (1665) by Robert Hooke. Images courtesy of [Internet Archive](https://www.archive.org). At right is the first-ever description and illustration of biological cells.

In developing *Cytographia*, I drew inspiration from several significant books that visually and methodically document encounters with the unknown. These included Robert Hooke's *Micrographia* (1665), a landmark of scientific observation in which living cells were described for the first time; Edmund Fry's *Pantographia* (1799), an attempt to catalog examples of all the world's writing systems; Ernst Haeckel's *Kunstformen der Natur* (1899), a rich exploration of symmetry and structural

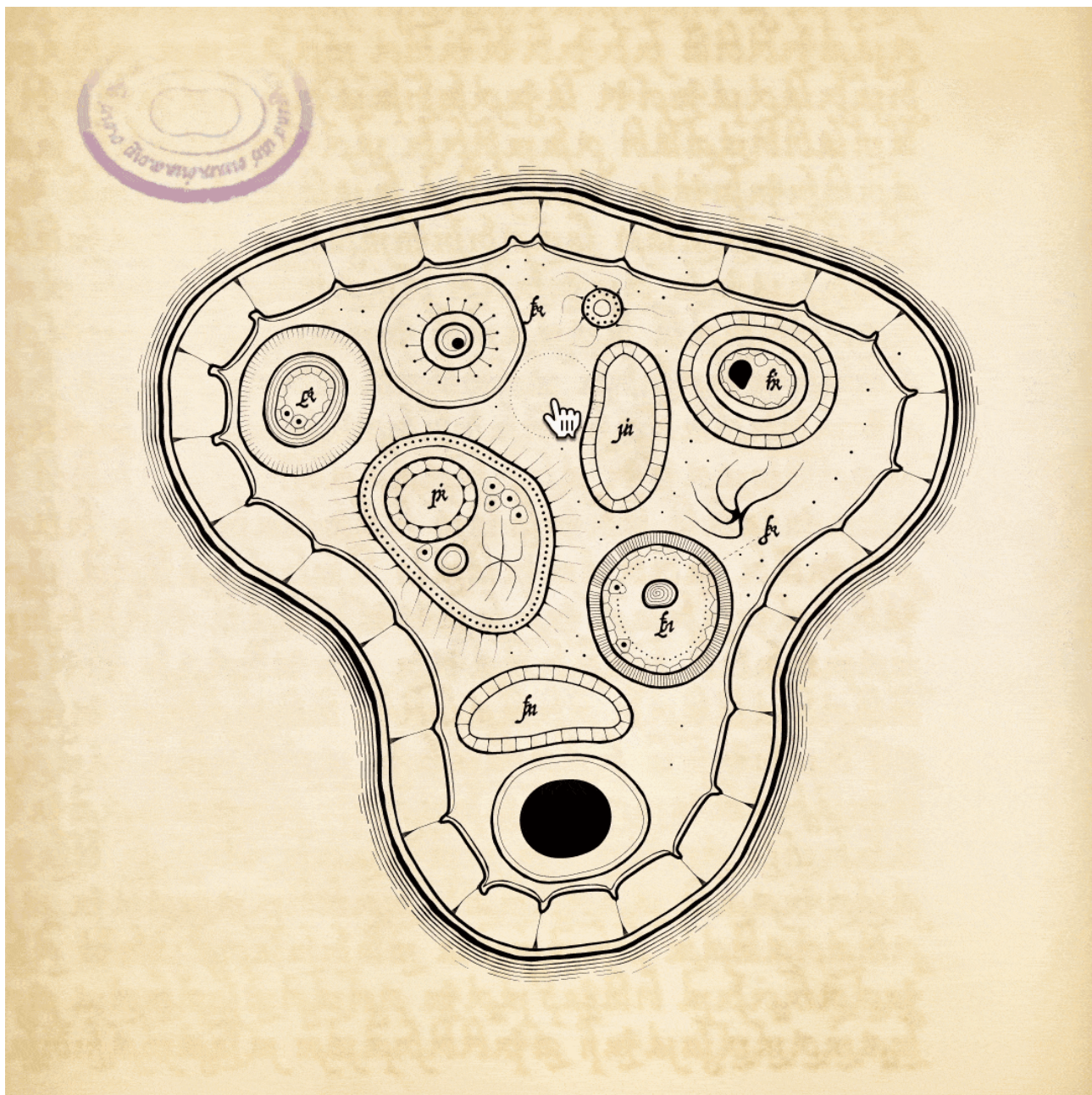
hierarchy in natural forms; and Luigi Serafini's hallucinatory *Codex Seraphinianus* (1981), a visual encyclopedia of an artist's imagined world. The algorithmically generated letterforms in *Cytographia* (which form an asemic writing system unique to each token) are loosely based on 16th-century typefaces by Ludovico degli Arrighi.



Pages from *Pantographia* (1799) by Edmund Fry. Images courtesy of [Internet Archive](https://www.internetarchive.org/).

JK: The research you have done for this project is both deep and broad. Thanks for all the links for those who want to learn more. For those coming to the project without much background, what should they look for in the series as it is revealed?

GL: There are a few things that I think distinguish *Cytographia* from some current trends in long-form generative art. First, it's intrinsically *time-based*, with an indefinite duration. It doesn't accumulate a static image; rather, it evolves and changes perpetually over time. Although a given token's hash will generate the same sequence of glurps and blurps whenever the piece is launched, this hopefully engrossing animation will never otherwise loop, repeat, or come to a standstill. Ultimately, *Cytographia* is executable software: my focus has been less on its appearance, than its dynamic behavior.

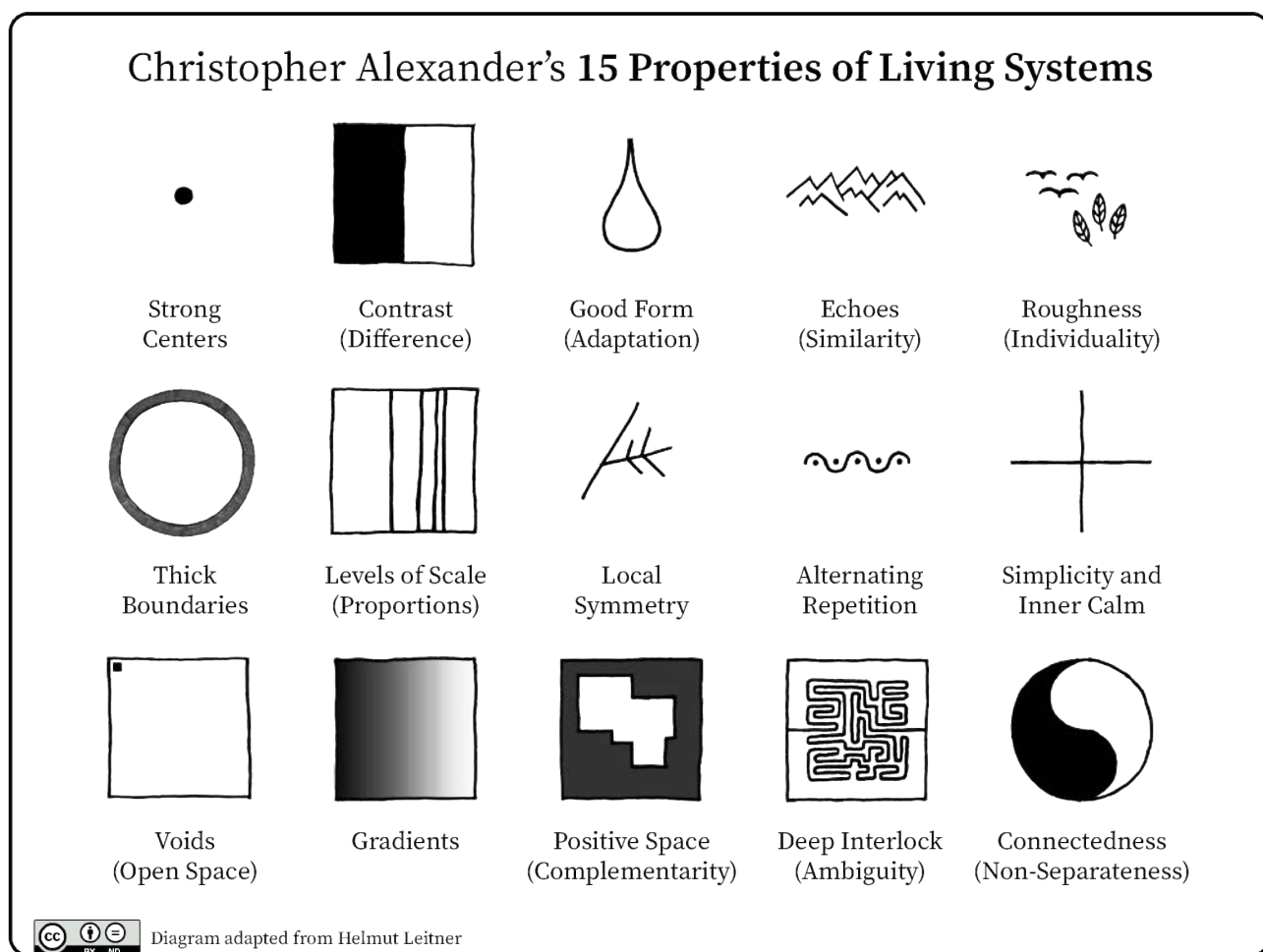


Golan Levin, *Cytographia*, 2024. Sample output screen recording of *Cytographia* interaction.

Secondly, it's *interactive*, and responds to mouse clicks, touch events, and various key commands. Many people are so accustomed to static art, they never discover this about the project! *Cytographia* uses a variety of real-time techniques to produce the illusion of life, such as simulations of flocking, differential growth, elastic physics, and fluid flow. All of these permit creative meddling by a participant, and if prodded, like any living creature, the artwork will do its best to accommodate and restore its equilibrium. Indeed, much of the challenge of developing *Cytographia* was to try to ensure that every cell would consistently behave well in unknowable conditions, and not just look good in one single resting state. For me, *Cytographia*'s

“unstable” nature—the idea that art can be dynamic, responsive, and contingent—is the main aspect of the computational medium that I strive to explore in my work.

A third thing about *Cytographia*, which is probably obvious, is that it was conceived to operate more like a diagram than a painting. The particular problems of full-page composition and color are not my concerns here. There is a central subject, a cell, which is constructed from black lines on a pale ground. In terms of how the different mints are distinguished from each other, my hope is that viewers will tune in to subtle variations in the way each drawing is *structured*—differences in which types of components it has; how they are shaped and styled; how they are grouped and organized; and how they grow, behave, and interrelate over time.



A visual summary of Christopher Alexander's “fifteen properties of living systems” from *The Nature of Order: The Phenomenon of Life* (2002). Diagram adapted from work by Helmut Leitner.

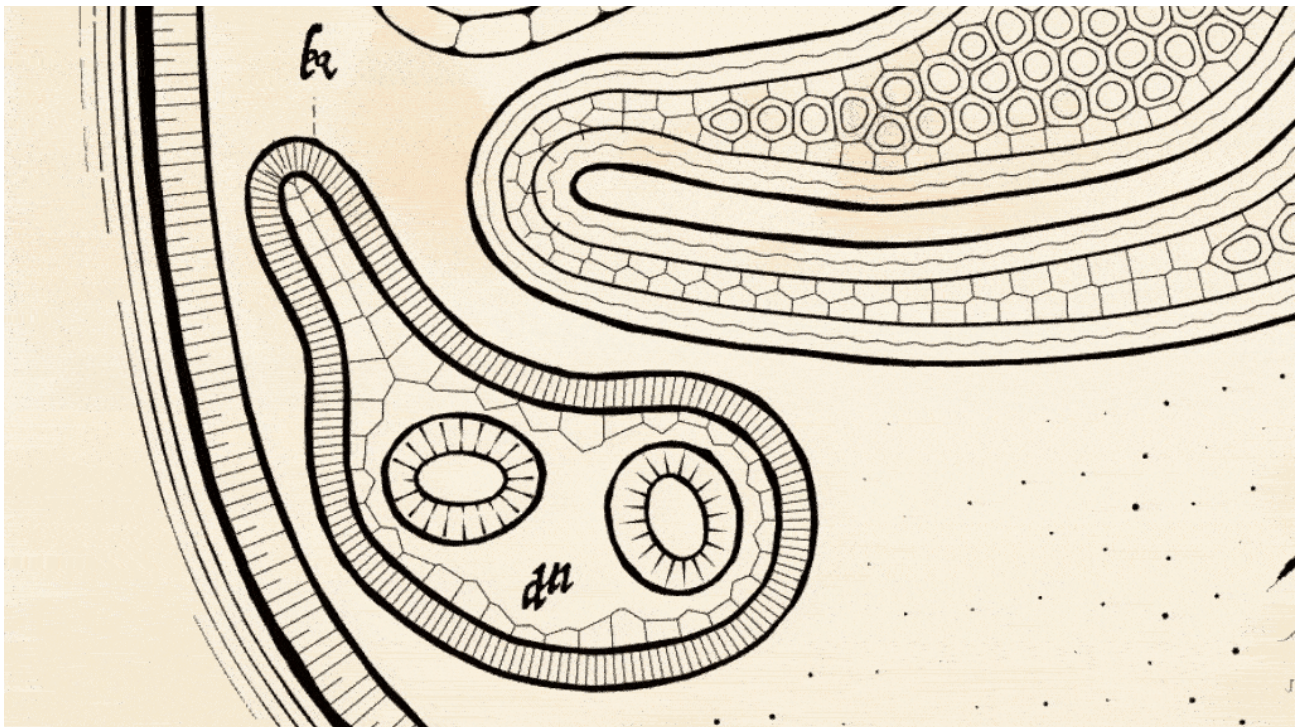
JK: Is there anything further you'd like to share that would help viewers approach and appreciate your project?

GL: Thanks! Right at the top—I've been chasing a vision for dynamic, interactive blobs for more than 30 years. *Cytographia* might be the capstone to this quest. For

anyone who'd like to learn more, I've written some notes about my personal history of generative and computational blob research [here](#).

My quest for lifelike blobs did lead to a funny situation while I was developing *Cytographia*. It turns out that my algorithm for generating the overall shape of the design was creating way too many *phallic* blobs, and I couldn't often predict when this would happen. Not only did the shapes look phallic, but, inherent to their springy structure, they would also move in a really suggestive way. The possibility of a *few* such mints popping up could be fine, but if I wanted freeform blobs to exist at all, it became necessary to devise a "phallus detector" to cull the worst offenders. So ... that's in there.

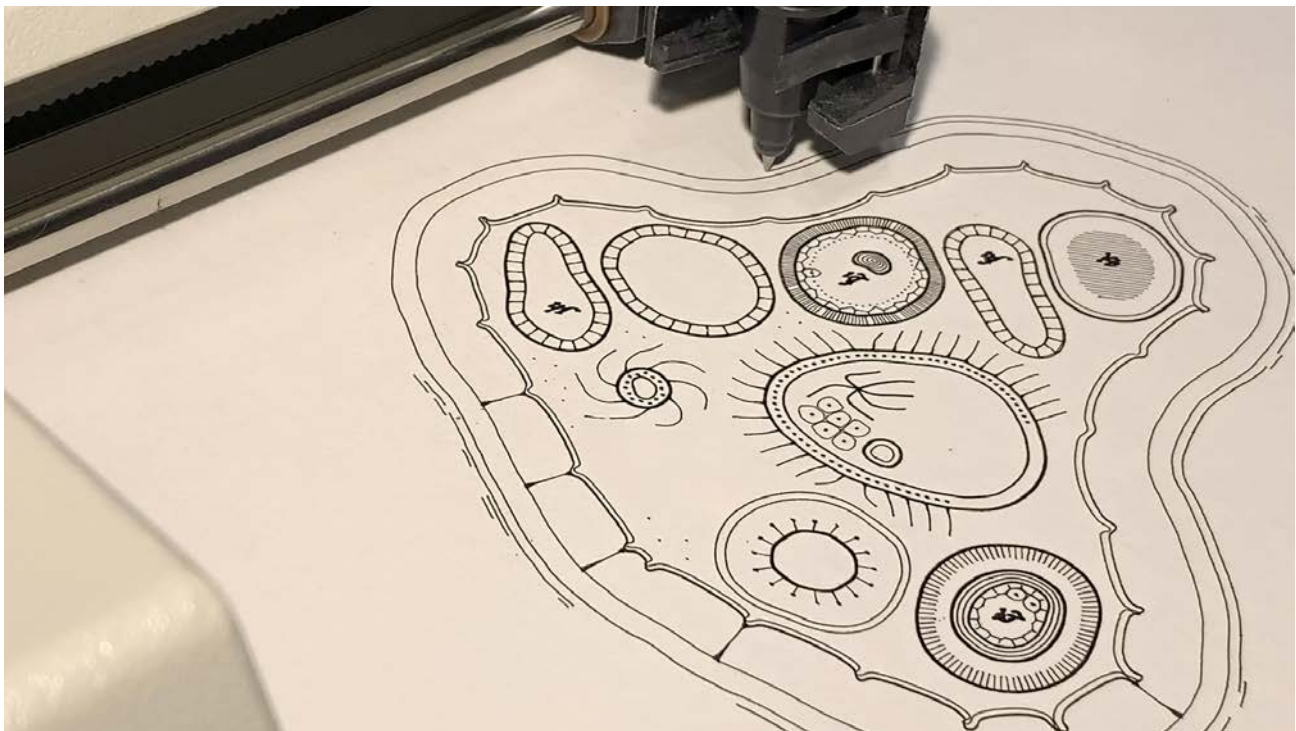
More seriously, there's a kind of design philosophy embedded in *Cytographia*'s code, which was inspired by Christopher Alexander's book *The Nature of Order: The Phenomenon of Life*. In this book, Alexander proposed fifteen fundamental visual properties common to all of the structures that we perceive to have "life"—the geometric qualities of organic wholeness. These fifteen properties served as a constant guide for me while developing *Cytographia*. It's not a stretch to say that *Cytographia*'s recursive layout algorithm literally implements Alexander's design vocabulary—in order (for example) to create organelles with thick boundaries, imbue them with strong centers and voids, populate them with smaller organelles to establish levels of scale, smush them against each other to produce interlocking spaces, and so forth.



Golan Levin, *Cytographia*, 2024. Sample output. Detail showing articulation of animated linework.

There are a slew of less obvious details in *Cytographia* that I hope people will discover. Some of these are behavioral: for example, some mints have tiny “eyes” that will follow your cursor in a curious way. Other features are semiotic—observers may notice that I’ve borrowed from the visual language of Enlightenment diagrams, implementing stylizations like dashed indicators and hachure. More generally, something I’m proud of is the expressive but subtle shaping of *Cytographia*’s lines, which are such a fundamental component of its appearance. It was important to me that every aspect of the *Cytographia* project reflect deliberate choices on my part; I felt strongly that I needed to *make the lines my own*, and not just rely on the expedient but bland `line()` commands provided by p5.js or the browser. *Cytographia* thus uses custom, vertex-shaded lines that I developed to have both good performance and distinctive character.

Last but not least, *Cytographia* is plottable and I’ll be producing signed pen-plots for interested *Cytographia* token owners! Plots will be produced on acid-free paper using a vintage HP7475A pen plotter, and will be available for purchase through [Artfora.com](https://www.artfora.com) through 2024. (More details to come!) While I still regard the dynamic, real-time interactive experience of *Cytographia* as the official version of the artwork, I also know how fulfilling it can be to live with art in more tangible ways, such as on one’s walls. These pen plots will give “mortal coils” to the otherwise virtual and ephemeral *Cytographia* microorganisms.



Partway through plotting a *Cytographia* cell on a 1985 HP7475A pen plotter. Executed with black 0.28mm Uni-ball Signo on acid-free Canson paper. Drawings are approximately 160x160mm.

JK: Can you tell us more about the charity you're supporting with *Cytographia*?

Through CryptoForCharity's *Environmental Conservation Cause Fund*, 20 percent of *Cytographia*'s secondary market royalties will be donated via contract to non-profit organizations that support biodiversity preservation and tackle the effects of climate change, including the World Wildlife Fund (WWF), Waterkeeper Alliance, The Life You Can Save, and the Coral Restoration Foundation.

JK: Thank you for that generous support of the climate and biodiversity. Are there any recent accomplishments you'd like to share?

GL: *Cytographia* is a big one! But I'm also really proud of the book I recently co-authored with Tega Brain, *Code as Creative Medium*. If anyone out there is a creative coding educator, or perhaps someone who is teaching themselves to make art with code, this book was meant for you.

JK: Thank you for the link to the book, which I am sure has been a valuable resource to so many in this space. What is the best way for people to follow your work?

GL: On Twitter/X, I'm [@golan](#); on Bluesky, I'm [@golan.bsky.social](#); and on Mstdn.social, I'm [@golan](#).

JK: Thank you, again, Golan, for bringing *Cytographia* to Art Blocks. We are delighted to help introduce your work to our audience with this project starting on January 10.

Header image by Tom Cwenar, courtesy of Fortune Magazine.

Published on 04 January 2024

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