FIGURING IN THE LANDSCAPE OF IDEAS

Margaret Wertheim

What is art? How does it operate? How does it migrate through our consciousness? And how might this exceptional category of human endeavor help us to know our world more fully?

Art as a species of making, doing, and knowing has been the subject of intense debate by philosophers and theorists throughout much of the twentieth century, but a definition that I find especially resonant comes to us from artist and writer Merrily Harpur. Harpur proposed that the activity of art is tied not to any material practices but to an *ethical* stance: "The duty of artists everywhere is to enchant the conceptual landscape," she has written. Harpur's proposition opens up our conceptions because it suggests that whatever art is, it exists within a wider realm of being, perceiving, and *acting*. The "conceptual landscape," as she terms it, frames the activity of artistry within a totality that, I wish to propose, contains a good deal more than what is usually acknowledged as art.

In 2003 my sister, Christine Wertheim, and I created an organization called the Institute For Figuring, whose mission was inspired by Harpur's insight. The IFF—whose acronym also stands for the formal logic symbol "if and only if"—is an organization dedicated to "enhancing the public understanding of science, mathematics, and the technical arts." I do not know if it is a "duty" of science and mathematics to "enchant the conceptual landscape," but this is a function that both disciplines can and do achieve. The IFF was founded on the principle that the "conceptually enchanting" resources within these fields may serve as a way into these important arenas of knowledge.

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Since its founding, the IFF has been invited to do projects with science museums and art galleries all over the world, including the Hayward Gallery in London, the Science Gallery in Dublin, the Museum of Jurassic Technology in Los Angeles, and most recently, the Smithsonian's National Museum of Natural History in Washington, DC.

The IFF's unique blending of science and aesthetics has proved to be an immensely fruitful way of engaging people in all walks of life with topics that are usually presented to us

purely symbolically, through textbook equations and formulae. Among the tools the IFF has continually drawn on is our belief that there is, literally, *wisdom* in material things, and that the material practices of doing and making usually associated with the arts may serve a genuine pedagogical role in the domains of science and mathematics. It is the IFF's view that material making may indeed be as important a tool of learning in these fields as any symbolic training.

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Since its inception, the IFF has done many projects based around these propositions, but perhaps our most successful endeavor has been the Hyperbolic Crochet Coral Reef project that, at the time of this conference [March 2011], is showing at the Smithsonian's National Museum of Natural History in the Sant Ocean Hall, after an exquisite exhibition at the Science Gallery in Dublin—whose director, Michael John Gorman, is also speaking at this event.

The Hyperbolic Crochet Coral Reef project has its roots simultaneously in mathematics, marine biology, handicraft, and ecology, and it currently stands as one of the world's largest science/art collaborations. To date, more than 5,000 people throughout the world—most of them women—have contributed to the project. At its core, the project seeks to engage audiences as active participants, involving them in the ongoing creation of a simulated coral reef made from crocheted fibers. This unlikely conjunction arises from the fact that crochet is the best medium we humans have for making the hyperbolic surfaces that are so emblematic of coral reef organisms. The frilled and crenellated structures that are so distinctive in corals, sponges, sea slugs, kelps, and nudibranchs are biological manifestations of a kind of geometry that is a mathematical alternative to the two forms of geometry with which our minds are more easily familiar—Euclidean geometry (which is realized on any flat plane such as a piece of paper or a tabletop) and spherical geometry (which is realized on the surface of our earth).

Although human mathematicians only discovered hyperbolic geometry in the nineteenth century, nature has been playing with its permutations for hundreds of millions of years. There is a very real sense in which brainless coral "know"—in the fiber of their being—something that the greatest mathematicians of human culture long thought to be logically and physically impossible.

The Hyperbolic Crochet Coral Reef project seeks to engage audiences with mathematics by activating their hands and eyes, which, as Jean Jacques Rousseau declared at the start of the Enlightenment, are "our first teachers." Through the Crochet Reef project, the IFF has taught tens of thousands of people worldwide about non-Euclidean geometry, the entry point to the mathematics that underlies general relativity and which will therefore eventually describe for us the structure of our cosmos.

Mathematics Play Tank

The Mathematics Play Tank in the exhibition Reefs, Rubbish and Reason by the Institute For Figuring. Photographed at the Williamson Gallery, Art Center College of Design (August 2011). Photo © IFF Archives, by Cameron Allan.

Hyperbolic Crochet Coral Reef

Hyperbolic Crochet Coral Reef, by the Institute For Figuring and Companions. Photographed at the Williamson Gallery, Art Center College of Design (August 2011). Photo © IFF Archives, by Cameron Allan.

The Branched Anemone Garden

The Branched Anemone Garden, by the Institute For Figuring and Companions. Photographed at the Williamson Gallery, Art Center College of Design (August 2011). Photo © IFF Archives, by Cameron Allan.

The Bleached Reef

The Bleached Reef, by the Institute For Figuring and Companions. Photographed at the Williamson Gallery, Art Center College of Design (August 2011). Photo © IFF Archives, by Cameron Allan.

Through an unlikely conjunction of disciplines, the Hyperbolic Crochet Coral Reef project bridges the divide between the sciences and the arts by suggesting that ways of knowing often regarded as categorically distinct may indeed be linked by unexpected, open-ended chains of understanding. Exploration, in the material sense, is a tool that both forms of knowing share at their core.

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The theme of material play aligned with geometry resided at the heart of what is probably the greatest pedagogical innovation in Western history—the kindergarten—and in many respects, the Institute For Figuring is motivated by a desire to provide "kindergarten for grown-ups." What we experience today as kindergarten is a diluted form of what was originally a profound and formalized system of education designed in mid-nineteenth-century Germany by the crystallographer Friedrich Froebel. Through his study of crystals, Froebel became convinced that geometric forms could form the basis for a system of education for very young children and could thereby form the foundation for shaping and developing the human mind. Kindergarten—the system he conceived—was literally intended to be a "garden of kinder"—a place where the infant mind could grow and evolve through engagement with the material world.

Kindergarten, in its nineteenth-century incarnation, was based around formalized play exercises with a set of what Froebel called "gifts"—simple pedagogical toys, such as blocks and sticks and pieces of paper. Each of the sequence of twenty-six gifts opened a door for children to explore the interactions and possibilities in various geometric forms, such as the point, the line, the square, and the cube. In contrast to current thinking, Froebel believed that the smallest children should engage with the most abstract ideas; only when they had gained a firm grasp of geometric forms would children be called upon to make representational images. What is astounding here is the complete reversal of strategy from our thinking today—we train our youngsters now with saccharine modes of representation (cartoons and plastic ponies), and leave introducing them to abstraction until they get to college.

In the latter half of the nineteenth century, Froebel's system of education swept the world, and by the 1880s, Frobelian kindergartens, and the accompanying training colleges for Frobelian kindergarten teachers, had been established across Europe, the United States, and in countries as far-flung as Japan and Korea. Words for *kindergarten* appear in languages throughout the world, and the concept seems as natural as learning itself. For fifty years, children lucky enough to have been educated in these nurturing environments were treated to an education that was unprecedented in its formal richness.

Collector and scholar Norman Brosterman has argued in his book *Inventing Kindergarten* that Froebel's system laid the groundwork for the development of the modernist aesthetic style. By engaging infants in geometrical play, Brosterman argues, Froebelian kindergartens literally reconfigured the Western psyche and set us on the path to all that was so revolutionary in modern art, architecture, and design. As Brosterman shows, many of the great masters of modernism—including Paul Klee, Piet Mondrian, and Frank Lloyd Wright—attended Frobelian kindergartens. If Brosterman is right—and I believe he is—then the seeds of geometry encountered in the science of crystallography helped to bring into being a revolution in both artistic representation and practice. Though kindergarten has now been debased from Froebel's vision, we are all still living today with the fruits of his remarkable gift.

In the ethos and practice of the Institute For Figuring, we hope to reenergize this Froebelian heritage by taking up again Froebel's belief that through material play with abstract ideas, we may all be led along a path of knowing toward the very highest ideas.

FURTHER READING

Brosterman, Norman. *Inventing Kindergarten*. New York: Harry N. Abrams, 2002.
Froebel, Friedrich. *The Education of Man*. Reproduction. Charleston, SC: BiblioLife, 2009.