

Euclidean Reality

A kind of giddiness, perhaps experienced by Renaissance folks, when they figured out the *perspective* trick, is back again—but it is cast in a new light: immersive 3D computer graphics. These new representations of reality take the method of perspective into a new realm—projective geometry is encoded as a real-time animation algorithm. And now people can go *into* these virtual places and look at what lies behind the picture plane that isn't there. It is the newer virtual reality of illusionistic space—and it is tied ultimately to the single viewpoint of the self.

But for me, a more intriguing virtual reality that is emerging in our culture is not about 3-space, computing vanishing points, or being Euclidean. Artificial life renders the complexity of dynamical systems—chaotic realities, where boundaries are blurred, and *viewpoint* may be fragmented or many, or moot. Here, metaphors come from biology and the study of nature, in which myriad living agents are intertwined in an ecological whole which is larger than the sum of its parts.

Virtual reality doesn't have to be a lonely place. Many of us who are building computer-based media have an agenda: to invent and then populate virtual realities with interacting, adaptive, quasi-intelligent entities. The human participant can become one member of an ecological system, not merely a lone wandering self in a space of Euclidean objects. *Real* reality is, in fact, very much about living among—communicating with, eating, and (for some), being eaten by—other living things.

Eukaryotic Reality

Lynn Margulis theorizes that certain bacteria of the early earth evolved such a tight symbiosis that they merged as meta-organisms, composite individuals—the eukaryotes¹. This is one of many critical shifts in biological evolution, where “individualness” blurs. And the cells which physically comprise *you* the individual happen to be eukaryotic cells. What of meta-human systems? Cities, nations, languages, and the robotic civilizations expounded by Hans Moravec². Chris Langton suggests that human culture should be studied with the same lens as that which we use to study nature³. They're both parts of one emergent phenomenon—life.

Then there's the internet: this massive, decentralized organism evolves around us, like a cortex—we are immersed within it. This net is not a visual space that we occupy, as Bill Mitchell reminds us in *City of Bits*⁴. It is cyberspace. And it's an experience about many interacting entities—a plurality of contributors to the swarm. As a network, it has its own emergent properties, like living phenomena. Kevin Kelley calls this a “vivisystem”⁵. And this vivisystem includes both the human and the post-human. In my lifetime I may engage in conversational email with an AI program or have screensaver fish as pets that do my spellchecking. This multifaceted world—where one can practice *gender-bending* for a new experience in vir-

tual sex, or where one can play multi-player videogames with a combination of real friends and artificially intelligent cartoon characters—is the most interesting virtual reality to me.

Behavior

Here I wish to recognize a virtual reality which is not characterized by sleek, surreal polygonal spaces, such as we've seen popularized in the media. It is a virtual reality characterized by *livingness*, which can inhabit many kinds of visual forms, sometimes not visually recognized as familiar objects we've seen in the world—perhaps not having any attributes which would allow it to be rendered in any classical computergraphical sense. But it may exhibit behaviors to an oddly familiar tune, like something we've experienced at some point in our lives as earthlings among other earthlings. Take the cellular automaton known as “Life”⁶. It intrigues, mesmerizes, and inspires the creation of entire periodicals and books, though it consists merely of a rigid square grid of black and white squares blinking on and off, according to a few basic rules. Why such mass interest in such a simple visual world? It has to do with *behavior*. More recently, at a workshop on artificial life at MIT, clunky assemblages of blocks and simple stick figures moving about in sparsely-rendered 3D spaces have gained attention—why? They demonstrate evolution as a way for a population of these sparse objects to learn to walk or swim⁷. It's in the behavior.

DESIGNING EMERGENCE

Another Kind of Paintbrush

I am interested in painting expressions of reality with another brush than the kind offered in commercial 3D modeling, animation, and rendering packages. I am interested in composing computer programs which in turn generate dynamical systems with many interacting parts, buzzing like life, and not being constrained to any particular dimensionality. Ten years ago I made a strong separation from the arts of rendering optical reality. I discovered an entirely new visible language tool—available in it's most basic form only to computer programmers: *recursion*: self-consuming, self-feeding loops which can generate non-Euclidean spaces, chaotic attractors, growing biomorphs, and self-replicating cellular configurations. These ever-changing visual forms spoke to me of something in the world that is deeper than what lies on the optical surface (where classical computer graphics systems texturemap polygons and raytrace shadows).

In the view of some artists, the computer is best exploited not a glorified crayon, nor even as an enhanced, magical canvas to be painted over with intelligent images. It is a process machine. It is about process—more like a musical instrument than a paint brush. And behaving more like a mind, a living system, than like a camera or an airbrush.

Genetic Tweak Animations

Years ago, as I was developing hand-drawn animations, a friend suggested that I should get to know his Amiga computer