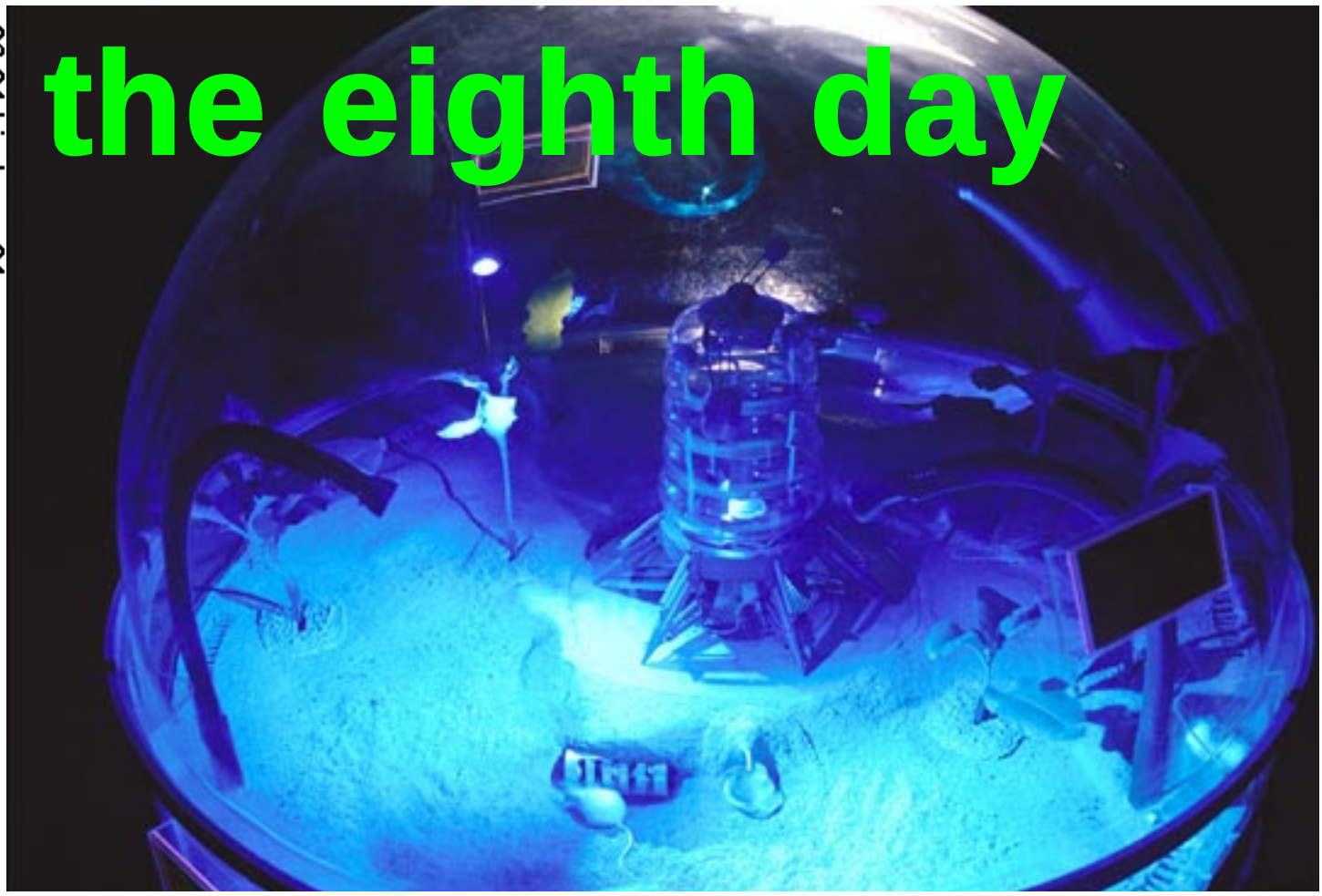
the eighth day



by

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"The Eighth Day" is a transgenic artwork that investigates the new ecology of fluorescent creatures that is evolving worldwide. I developed this work at the Institute for Studies in the Arts, Arizona State University, Tempe, where it was exhibited in 2001. [1] While fluorescent creatures exist in isolation in laboratories, seen collectively they form the nucleus of a new synthetic bioluminescent system. The piece brings together living transgenic life forms and a biological robot (biobot) in an environment housed under a clear 4 foot diameter Plexiglas dome, thus making visible what it would be like if these creatures would in fact coexist in the world at large.

2003.1

TRANSGENIC ECOLOGIES

As the viewer walks into the gallery, she first sees a blue-glowing semisphere against a dark background. This semisphere is the 4-foot dome, aglow with its internal blue light. She also hears the recurring sounds of water washing ashore. This evokes the image of the Earth as seen from space. The water sounds both function as a metaphor for life on Earth (reinforced by the spherical blue image) and resonate with the video of moving water projected on the floor. In order to see "The Eighth Day", the viewer is invited to "walk on water".

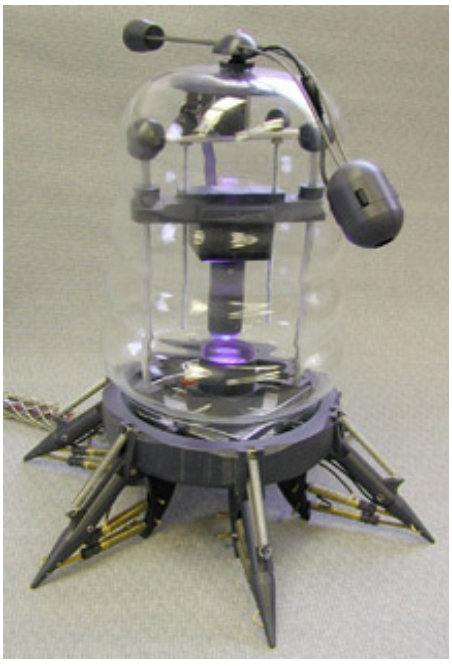
"The Eighth Day" presents an expansion of biodiversity beyond wildtype life forms. As a self-contained artificial ecological system it resonates with the words in the title, which add one day to the period of creation of the world as narrated in the Judeo-Christian Scriptures. All of the transgenic creatures in "The Eighth Day" are created through the cloning of a gene that codes for the production of green fluorescent protein (GFP). As a result, all creatures express the gene through bioluminescence and their glow is clearly seen by all gallery viewers. The transgenic creatures in "The Eighth Day" are GFP plants, GFP amoebae, GFP fish, and GFP mice. [2]

While one might think that "The Eighth Day" is purely speculative (about a hypothetical future), a closer examination of contemporary developments reveals that science fiction has turned science fact. With "The Eighth Day" I draw attention to the fact that a transgenic ecology is already in place. [3] Transgenic crops are cross-pollinated by insects that fly from one place to another. Transgenic animals are found in farms worldwide. Transgenic fish and flowers are being developed for the ornamental global market. Transgenic fruit-as-vaccine are being developed in several countries. New varieties of animals and vegetables are being developed, such as pigs with spinach genes, grapevines with silkworm genes, and potatoes with genes of bees and moths. [4] We do not grasp the complexity of this cultural transformation when driving by a corn field, when putting on a cotton shirt, or when drinking a glass of soy milk.

"The Eighth Day" dramatizes this condition by bringing together beings originally developed in isolation in laboratories, now selected and bred specifically for "The Eighth Day." Selective breeding and mutation are two key evolutionary forces. "The Eighth Day" literally touches on the question of transgenic evolution.

TRANSGENIC BIOROBOTICS

A biobot is a robot with an active biological element within its body which is responsible for aspects of its behavior. The biobot created for "The Eighth Day" has a colony of GFP amoebae called Dyctiostelium discoideum [5] as its "brain cells." When amoebae divide or move in a particular direction, the biobot exhibits dynamic behavior inside the enclosed environment. Changes in the amoebal colony (the "brain cells") are monitored by the biobot and cause it to move throughout the exhibition. The body of the biobot functions as a bioreactor, nourishing and culturing the amoebal colony. The biobot has a biomorphic form and the "amoebal brain" is visible through the transparent bioreactor. These "brain cells" form a network within the bioreactor, ceasing individual behavior and functioning as a single larger multi-cellular organism in response to environmental stimuli. Together with the internal sensing unit [6] and a computer, this amoebal network constitutes the "brain structure" of the biobot. The internal sensing unit is responsible for tracking amoebae movement and the computer issues commands to the biobot legs in response to such movement. The biobot has six legs. [7] When the amoebae move in the direction of a given leg, that leg contracts, causing the biobot to lean forward. Often one leg contracts while another stretches back to its original position, creating a more complex sequence of movements. Ascending and descending, or leaning and stretching motion becomes a visual sign of amoebal activity.The biobot also functions as the avatar of Web participants inside the environment. Independent of the movement of the biobot, Web participants are able to control its visual system [8] with a pan-tilt actuator. The autonomous ascent and descent, leaning and stretching motion provide Web participants with a new perspective of the environment. The overall perceivable behavior of the biobot is a combination of activity that takes place in the microscopic network of the amoebae and the macroscopic human network. Humans and amoebae "meet" in the body of the biobot and affect each other's experience and behavior, producing through their coupling an ephemeral "consensual domain." [9]



Biobot

THE VIEW FROM WITHIN

In the gallery, visitors are able to see the terrarium with transgenic creatures both from inside and outside the dome. As they stand outside the dome looking in, someone online sees the space from the perspective of the biobot looking out, perceiving the transgenic environment [Figure 99] faces or bodies of local viewers. An online computer in the gallery also gives local visitors an exact sense of what the experience is like remotely on the Internet. Local viewers may temporarily believe that their gaze is the only human gaze contemplating the organisms in the dome. However, once they navigate the Web interface they realize that remote viewers can also experience the environment from a bird's eye point of view, looking down through a camera mounted above the dome. They can pan, tilt, and zoom, seeing humans, mice, plants, fish and the biobot up close. Thus, from the point of view of the online participant, local viewers become part of the ecology of living creatures featured in the work, as if enclosed in a websphere. By enabling participants to experience the environment inside the dome from the point of view of the biobot, "The Eighth Day" creates a context in which participants can reflect on the meaning of a transgenic ecology from a first-person perspective.

THE TRANSGENIC HUMAN CONDITION

The tangible and symbolic coexistence of the human and the transgenic shows that humans and other species are evolving in new ways. It dramatizes the urgent need to develop new models with which to understand this change, and calls for the interrogation of difference taking into account clones, transgenics and chimeras.The Human Genome Project (HGP) has made it clear that all humans have in their genome sequences that came from viruses [10], acquired through a long evolutionary history. This shows that we have in our bodies DNA from organisms other than human. Ultimately, this means that we too are transgenic. Before deciding that all transgenics are "monstrous", humans must look inside and come to terms with their own "monstrosity," i. e., with their own transgenic condition.The common perception that transgenics are not "natural" is incorrect. It is important to understand that the process of moving genes from one species to another is part of wild life (without human participation). The best example is the bacterium called "agrobacterium", which enters the root of plants and communicates its genes to it. Agrobacterium has the ability to transfer DNA into plant cells and integrate the DNA into the plant chromosome. [11] "The Eighth Day" suggests that romantic notions of what is "natural" have to be questioned and the human role in the evolutionary history of other species (and vice versa) has to be acknowledged, while at the same time respectfully and humbly marveling at this amazing phenomenon we call "life."

NOTES

1 - "The Eighth Day" team: Richard Loveless, Dan Collins, Sheilah Britton, Jeffery (Alan) Rawls, Jean Wilson-Rawls, Barbara Eschbach, Julia Friedman, Isa Gordon, Charles Kazilek, Ozzie Kidane, George Pawl, Kelly Phillips, David Lorig, Frances Salas, and James Stewart. Additional thanks to Andras Nagy, Samuel Lunenfeld Research Institute, Toronto; Richard Firtel, University of California, San Diego; and Chi-Bin Chien, University of Utah, Salt Lake City.

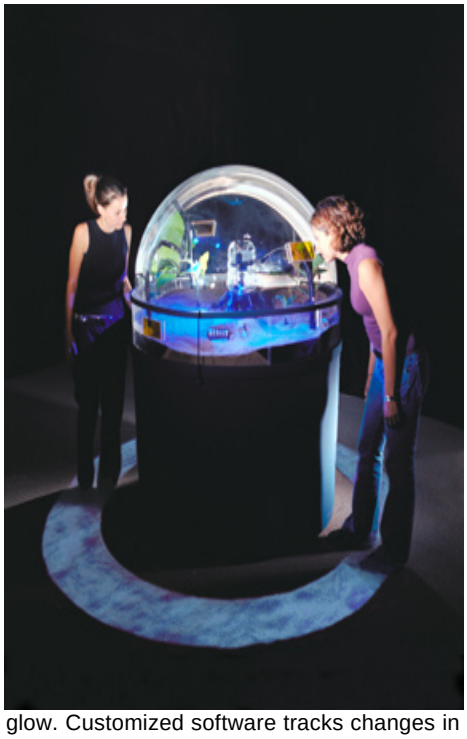
2 - It is important to point out that all organisms were in excellent health and had all of their needs taken care of on a daily basis, before, during, and after the exhibition.

3 - This is true primarily in the USA, since many crops in the USA (corn, cotton, canola, and soy, for example) are transgenic, but also increasingly in other parts of the world, most notably Argentina, Canada, and China. In fact, the American Association for Health Freedom indicated in 2001 that more than 60% of processed food in the United States contains genetically engineered ingredients, including baking mixes, soft drinks, cereals, soups, cooking oils, salad dressings, juices, canned foods, crackers, snacks and baby food. This figure was reinforced by a survey by the International Food Information Council.

4 - The new pigs were created in Japan by a team coordinated by Norio Murata, a professor at the National Institute for Basic Biology. See: "Scientists insert spinach gene into pigs to cut fat." Mainichi Shimbun, January 24, 2002. The grapes with genes found in the silkworm larvae were developed to resist Pierce's disease by a team led by Dennis Gray, a University of Florida professor of developmental biology. On May 15, 2001, the U.S. Patent and Trademark Office issued a joint patent for the technology to the University of Florida and the U.S. Department of Agriculture. The potatoes with genes of bees and moths were developed to fight potato blight fungus, the same that caused the Great Irish Potato Famine of 1845. See: Milan Osusky and others. Cationic Peptide Expression in Transgenic Potato Confers Broad-Spectrum Resistance to Phytopathogens. Nature Biotechnology 17, 01 Nov 1999, p. 45 and Trisha Gura. Engineering Protection for Plants. Science, March 16 2001, p. 2070.

5 - Dyctiostelium discoideum is also known as slime mold. Slime molds are classified in a major group called the eukarya (or eukaryotes), which includes plants and animals.

6 - The internal sensing unit is composed of : 1) blue LED array to stimulate amoebae to glow green; 2) PC17YC microscopic color video camera (1/3" color CCD imager; 450 lines of resolution; 2 lux minimum illumination; 74 degree field of view); 3) a special yellow filter for the camera that enables it to block the blue light and image the green



glow. Customized software tracks changes in the video image and passes the data to another software which instructs the biobot legs to move.

7 - The biobot legs are made of a Nylon variant called Nylatron, a material that contains solid lubricants that impart toughness, low coefficient of friction, and good abrasion resistance. Its muscles are made of shape-memory alloy, a material that undergoes thermoelastic transformation, i.e., that has the ability to return to a predetermined shape when heated.

8 - The eye of the biobot is composed of a PC63XP monochrome mini video camera (70 degree field of view; 380 lines of resolution, 1 lux low light rating).

9 - A "consensual domain" does not imply consensus; rather, it signifies consensuality, a coincidence of the sensuous. See note 13 in the previous chapter.

10 - See Brown T. A.. Genomes (Oxford, UK : Bios scientific publishers, 1999), p.138; and Baltimore, David. "Our genome unveiled," Nature 409, 15 February 2001, pp. 814-816. In private email correspondence (28 January 2002), and as a follow up to our previous conversation on the topic, Dr. Jens Reich, Division of Genomic Informatics of the Max Delbruck Center in Berlin-Buch, stated: "The explanation for these massive [viral] inserts into our genome (which, incidentally, looks like a garbage bin anyway) is usually that these elements were acquired into germ cells by retrovirus infection and subsequent dispersion over the genome some 10 to 40 millions ago (as we still were early apes)." The HGP also suggests that humans have hundreds of bacterial genes in the genome. See: International Human Genome Sequencing Consortium. "Initial sequencing and analysis of the human genome," 15 February 2001 Volume 409, No. 6822, p. 860. Of the 223 genes coding for proteins that are also present in bacteria and in vertebrates, 113 cases are believed to be confirmed. See p. 903 of the same issue. In the same correspondence mentioned above, Dr. Reich concluded: "It appears that it is not man, but all vertebrates who are transgenic in the sense that they acquired a gene from a microorganism."

11 - This natural ability has made a genetically engineered version of the agrobacterium a favorite tool of molecular biology. See: Herrera-Estrella L. (1983). Transfer and expression of foreign genes in plants. PhD thesis. Laboratory of Genetics, Gent University, Belgium; Hooykaas P.J.J. and Shilperoort R.A. (1992). Agrobacterium and plant genetic engineering. Plant Molecular Biology 19:15-38; Zupan J.R. and Zambryski P.C. (1995). Transfer of T-DNA from Agrobacterium to the plant cell. Plant Physiology 107 : 10