Schwartz's *PIXILLATION* and Conway's *Game of Life*
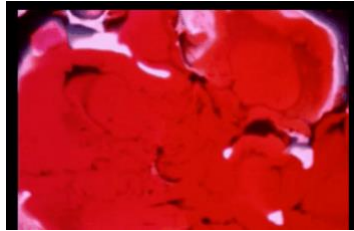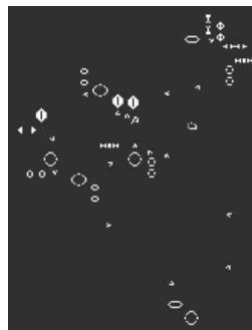## —— The Emergence of Artificial Life from Cellular Automata

Figure 1 "PIXILLATION" - 1970, 16 mm, Color, Sound, 4 min. © Lillian F. Schwartz.

Figure 2 John Horton Conway (British, b. 1895), Game of Life, 1970.

How do life and consciousness originate? The emergent phenomena in artificial life shown in the artworks of Conway and Schwartz may provide the answer, referring to the self-organizing behavior inherent in complex systems. Both mathematician John H. Conway and computer-mediated art pioneer Lillian F. Schwartz have studied cellular automata as a matter-independent framework to model the self-replicating behavior of biological systems. Schwartz's *PIXILLATION* and Conway's *Game of Life* both use CA as tool, in which the evolution of images is human created (underlying rules) and seems to take on a life of its own (emergent patterns), reveals that emergent phenomena in nature can be generated in machines, and inspires the creation of a broader meaning of life.

To begin with, *PIXILLATION* is a computer-generated animation completed by Schwartz in 1970 that uses the results of simulations of cellular automata in the Explore programming language and includes emergent phenomena. The film is a mix of computer-generated patterns, shot on black-and-white film and colored through filters, and hand-drawn time-lapse photographs. She uses a montage of juxtaposed clips of organic forms such as crystal growth and

corresponding computer-generated forms, gradually intensifying audio and color to the point where the viewer feels the screen is about to explode, to show computer-generated forms imitating organic forms, learning from assimilation, and eventually gradually organic forms being completely subsumed and replaced by computer forms.

In addition, the *Game of Life* is a game designed by Conway in 1970 in the form of a Cellular Automaton, whose initial state determines the evolution of algorithmic self-organizational generation, which is an emergent phenomenon that reveals new artificial life with the characteristics of natural living systems. One interacts with the game of life by creating an initial configuration and observing how it evolves. A few living cubes controlled by a few simple rules of life can self-organize into a variety of coherent structures that multiply, grow, divide, and reorganize in complex ways, emerging with endless possibilities for evolution.

Comparing the two works, the differences lie in the form of the medium, experiential nature and attitudes towards new technologies, while the similarities lie in the fact that both are generative arts that use CA as a tool for algorithmic self-organization of emergence. Formally, *PIXILLATION* is multi-media art with a strong audiovisual experience, incorporating CA generated images and painted frames, with output as animation. In contrast, the *Game of Life*, which is itself a CA, is interactive and the player's experience changes the state of the game, so the player can continuously participate in the creation of the artwork. Conceptually, *PIXILLATION* 's computer-generated forms correspond to a montage of real matter, expressing concerns about the assimilation of geometric algorithms and organic forms. However, the algorithms and new technologies in Life do not pose a threat to the natural beauty and humanity in art, but rather strengthen the human connection to the natural world and its foundational systems. Next, in terms of sameness, both works use the initial state of the non-human autonomous system CA to determine the evolution of algorithmic self-organizational generation, in which the evolution of the image is human created (underlying rules) and seems to have a life of its own (emergent patterns), revealing that emergent phenomena can occur in machines that are not fundamentally different from natural emergence. Once this is recognized, how can life, art, beauty, and creation be viewed? If postmodernism reveals that beauty and form are social constructs and have no absolute value, emergence enables artists to bypass arbitrary social and cultural inertia and artificial influences and to explore new forms from the original creation of the universe. This also inspired a broader meaning of life: in addition to the carbon chain life that

evolved naturally, life can also take the form of software, robots, etc. The material differences that make up life do not matter, because the essence of life is not matter but the organization of matter. This inspired Langton to create the new science of "Artificial Life".

In conclusion, *Game of Life* and *PIXILLATION*, by giving CA an initial state so that its algorithm generates self-organized evolution, were pioneers in emphasizing the science of "emergence" in machines, showing the possible connotations of the nature of life. The two works, which differs in form, medium and attitude, should be exhibited together in the art exhibition, since the comparison of these two emergent works of art will allow to see the connection between computational algorithms and the natural world, and will force us to re-examine the place of human beings in the universe and the role we play in nature.

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