

Pherographia

In recent times, artificial life, evolutionary computation and, in general, complexity, are providing a new conceptual framework in which art and science are cooperating and surpassing the gap identified by C.P. Snow in his famous lecture *The Two Cultures* (1959). And, like photography helped Eadweard J. Muybridge (1830-1904) in his quest for understanding animals' movements, complexity and the extraordinary technological burst of the last decades are guiding us on a journey through worlds, both natural and artificial, that were kept hidden until very recently. Pherographia, which means *drawing with pheromones*, is a term coined to describe a process that is born of this new science, and that imitates the behaviour an ant colony, simulating pheromone as a mean of communication between the ants (one of those "mysteries" that entomology, complexity and technology helped us to understand). From the model, pheromone drawings emerge around the edges of black-and-white images. Based on a model by Dante Chialvo and Mark Millonas¹, Vitorino Ramos and Filipe Almeida² worked on the equations and proposed the first version of the artificial swarm back that evolves on gray-scale images back in 2000 (to which I also contributed in its late stage of development, helping to design this final version³, which merges the stigmergy⁴ of the original model and evolution).

Photographia — drawing with light — inspired the term. In fact, there are some resemblances between pherographia and photography⁵. Ants reinforce the "lines" by depositing more pheromone — just like the chemical developer enhances the exposed silver —, while evaporation eliminates that pheromone that is no longer useful in the process of self-organization — like the fixer removes unexposed silver. Grain, in a film, appears as the result of the aggregation of silver salts when developing time is increased; the lines in this *camera obscura*⁶ for ants are enhanced by the constant reinforcement of pheromone over desired regions — as grain emerges from "reinforcement" of silver clusters, created by a longer developing time.

My first "experiment", with satisfying results, with pherographia was presented at P4Photography Gallery (Lisbon) in 2008 with the title *Timor Mortis Conturbat Me*. This

¹ D. Chialvo, M. Milonas, "How Swarms Build Cognitive Maps", Luc Steels (Ed.), *The Biology and Technology of Intelligent Autonomous Agents*, No. 144, NATO ASI Series, pp. 439-450 (1995).

² V. Ramos, F. Almeida, "Artificial Ant Colonies in Digital Image Habitats A Mass Behaviour Effect Study on Pattern Recognition", Marco Dorigo, Martin Middendoff and Thomas Suetzle (Eds.), *Proceedings 2nd International Workshop on Ant Algorithms*, pp. 113-116 (2000).

³ C. M. Fernandes, V. Ramos, A. C. Rosa, "Self-Regulated Artificial Ant Colonies on Digital Image Habitats", *International Journal of Lateral Computing* Vol. 2, No. 1, pp. 1-8 (2005).

⁴ The term *stigmergia* was introduced by Pierre-Paul Grassé in 1959 and describes indirect communication through the environment: P.-P. Grassé. "La reconstruction du nid et les coordinations interindividuelles chez *bellicositermes* et *cubitermes* sp. La théorie de la stigmergie: Essai d'interprétation du comportement des termites constructeurs", *Insectes Sociétés*, No. 6, 41-80 (1959).

⁵ Carlos M. Fernandes, *Pherographia: Drawing by Ants*, Leonardo, the Journal of the International Society for the Arts, Sciences and Technology, MIT Press, to appear, 2010.

⁶ *Camera obscura* is the optical device that preceded the photographic camera. It was used in the late Renaissance by notable painters as an assisting device, in order to improve the realism and enhance the details of their masterpieces. The image was projected, through the lens, on a panel, and then the artist just had to "follow the lines" in order to attain a draft. Only later, the *camera* was used to project images over a light-sensitive medium, and then photography was born.

set of 41 pheromone drawings was attained by evolving the swarm on negatives of anonymous man (...*the anonymous men I kept inside little boxes*) that were found in a flea market. Those negatives and artificial life were the basis for a reflection on (natural) life,

*Throughout the years, since we bought that huge box, I looked at those negatives many times. I classified them, separated men from women, and children from adults. (There was even enough material to gather military and police officers in a case of their own.) I was experiencing again the urge to collect. I imagined how they lived and how (or if) they had died. I had this unsettling notion that the older the person in the photo, the lesser the probability of them still being amongst the living. However, the negatives gradually fell into oblivion. They got older inside the improvised small boxes. (Like people, photographs age, and sometimes die.) The smell of fixer invaded the room whenever I opened them, as if it was the formaldehyde of dead photos. But I never gave up trying to resurrect those faces.*⁷

and on (the lack) of talent,

*When I began to draw, at a tender age, I revealed some "talent" for reproducing whatever I saw, whether it was a photo or another drawing, as long as it stood still. I never had much (or any) ability to depict a living scene, as if the third dimension – suggested but absent from photos – was an unsurpassable obstacle for my limited skills; moreover, I never made any interesting drawings from my own imagination. All I was capable of was to "copy and paste".*⁸

Timor Mortis Conturbat Me recycles old and forgotten photographs, maybe even characterless, "drawing them" with pheromone. However, there is more in pherographia than just pheromone drawings. For instance, we may extract from the system the drawings that represent the ants' positions in the environment (which is the image in which the swarm evolves). In addition, the swarm is self-adaptive and a change in the environment (that is, *swapping* the images) will result in a collective reaction that alters not only the distribution of the swarm but also the pheromone maps, which will gradually converge to the edges of the new image. *The Horse and the Ants* exemplifies these features.

The Horse and The Ants

In 1872, Eadweard Muybridge (1830-1904) was commissioned by the ex-governor Leland Stanford (1824-1893) to photograph his horse Occident while galloping. Stanford wanted to prove that there is an instant in which all four of a horse's hooves leave the ground at the same time, and he hoped that Muybridge, who had an established reputation as a photographer, could help him in his quest. Although he used the fast shutter he had invented, Muybridge was not able to go beyond the limitations of the wet-plate collodion process and he could not provide a proof for Stanford's theory. Nevertheless, there was sufficient evidence that Stanford was right and in 1878 Muybridge tried again, but this time he used twelve cameras, attaching their shutters to cables that allowed the horse to activate them. The resulting photos proved that the hooves do leave the ground at the same time (but not outstretched, as it was the common belief). Photographing animal locomotion became then Muybridge's main interest. For that purpose he received a grant from the University of

⁷Carlos M. Fernandes, about *Timor Mortis Conturbat Me* (See http://carlosmfernandes.com/index_archivos/Page768.htm)

⁸ See previous footnote.

Pennsylvania, where he stayed until 1887, when he published his eleven volume *Animal: Locomotion: Electro Photographic Investigations of Consecutive Phases of Animal Movements*.

Since its invention, photography, given its nature, has always been privileged mean of communication between arts and sciences, and Muybridge's experiments are just an example of this prolific cooperation. Its own genesis had already gathered a mixture of creative impulses and thirst for knowledge of various origins. Photography is a blend of both fields, in which the practice of the art implies understanding the science.

Pherographia's characteristics — being a kind of bio-inspired version of photography and belonging to the family of complex systems that are being used in order to better understand *how nature works* — inspired *The Horse and the Ants*, a set of "snapshots" of the ants' positions when the environment changes, that is, when a frame of Muybridge's experiments, towards which the colony had already converged, is swapped with a later frame of that same experiment. The result is a gradual (self-)reorganization of the swarm, which, by means of pheromone deposition and sensing, and with the crucial role of evaporation, is able to readapt itself to the new environment. Images that were once used to study a horse in motion are now the base of an experiment/artwork that investigates the behaviour of artificial ants. *The Horse and the Ants* is my tribute to Eadweard Muybridge and to his invaluable contribution to both art and science.