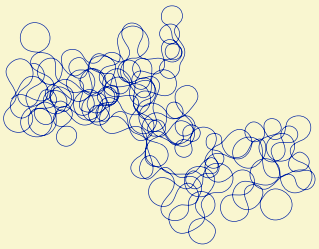
THREE MILESTONES IN THE RELATIONSHIP BETWEEN ART AND COMPLEXITY: INDISTINGUISHABILITY, STATISTICS AND CONFRONTATION

ABELARDO GIL-FOURNIER



INDISTINGUISHABILITY
THE AGENCY OF THE CROWD

The mere presence of an individual as the product of an exercise of combinations immediately places it in a singular relationship with all other possible combinations. An example of this can be seen in the exercise of imaginary recombination and ramification to be seen in Dutch artists Driessens & Verstappen's work *MORPHOcarrots*[1] (1997), where an ordinary carrot is lined up beside a series of carrots based on combinations of possible deformations (Fig. 1). Nothing can prevent us from seeing the common tuber on display in this context from looking like some specimen that might at any moment spontaneously mutate into one of its quasi-monstrous neighbours; by its mere presence alongside its mutations, the observer discovers in the common carrot such a latent capacity that the specific features of its outward appearance are relegated to second place.

As if it were a matter of reproduction, a devaluation of the specific occurs when there is a collectivity that is capable of containing series of elements that are unequal, but undistinguishable from the configuring criterion of collectivity. A simple but categorical piece of generative art by Jared Tarbell, *Fractal Invader*[2] (2003), will help us to understand better this indistinguishability. In *Fractal Invader* (Fig. 2) the area of the screen is divided into four parts which are in turn di-

vided into another four parts, and so on, so that each of the fragments resulting from the dense fractal division is occupied by the pixelated image of a Martian from the classic video game *Space Invaders*. The key is that these Martians are generated as symmetrical combinations of a grid of black and white pixels, so that what is shown on the screen is all their possible permutations, i.e. all the possible Martians. The surface knocks back the image of the abundance of the combining algorithm, and its inability to distinguish the results: despite the fact that many of the Martians are recognisable, they are only there because they have been generated by a permutation of pixels, like all the rest. And so, as happened with *MORPHOcarrots*, when the spectator sees it, he or she is challenged to find or work out the condition they all share, i.e. the existence of a generating code, and more importantly, that code's capacity to generate multiplicity.

In these two works, the same generative strategy underlies the tension between the multiplicity of combinations and the spectator's habit of distinguishing between individuals. Other approaches on the same terms, however, have used techniques such as documentation and visualisation. One of the most eloquent examples is the astonishing work by photographer Arie Versluis and the analyst of sociological profiles Ellie Uyttenbroek (both Dutch) who for over 14 years have been systematically documenting the different identities that arise in the modern metropolis. Their work, *Exactitudes*[3] (1994 - present), is a grid-like composition consisting of a series of twelve photographs each of people with the same dress code, presented with an identical background and in the same posture (Fig. 3). In this way, the various series offer a portrait of different groups and subcultures (hipsters, geeks, yuppies and so on) through an exhibition of twelve representatives. The large-format plates achieve the disturbing effect of showing collections of individuals instancing like permutations a single social archetype, together with the possibility at the same time of seeing the details of each of these individuals. The title, *Exactitudes*, questions the type of relationship that groups these subjects shot with «exact attitudes», a relationship which, beyond the issue of identities in the present, is notable for the way in which the archetypes are created in the individuals, i.e. the phenomenon whereby a set of given codes is capable of generating collectivities that are sufficiently varied as to contain and catalogue many —if not all— contemporary individuals, including the spectators of the work. It is an abstract area of organisation that contains a considerable statistical component, and which regulates our everyday experience of the crowd.

In practice all of these works find in combinations a resource with which to intensify the strangeness of the relationship between an object or individual and the objects or individuals that are statistically near or similar to it. It is an implicit contract whereby the mere appearance of an instance is an expression of a whole collectivity or system that may involve even the spectator. In this regard, it is important

to distinguish these works from the many artistic experiments conducted during the first three quarters of the twentieth century related to combination and chance. Whereas in those cases the combination of elements mostly involved a break with inherited structures and a strategy with which to disassociate the artist from the creation, in the examples we are looking at here we see an obsession to highlight the properties and capacities of the statistical collectivities that form a given object, individual or event: the question as to the agency and power of the crowd (a pressing one in these works) which already announces that of the emergence at the heart of complexity.

Before continuing with the shift from combinations to complexity, one last work will help illustrate this last point. This is *The Sheep Market*[4] (2006) by Aaron Koblin, and its use of the tool developed by the online store, Amazon, called *Mechanical Turk* (a reference to von Kempelen's famous mechanical chess player). The tool, which has been online since 2005, is intended as a market for companies to hire human intelligence for developing software or digitising content: anyone connected to the Internet can access a list of simple tasks —such as transcribing a fragment of an audio recording, recognising objects in images or filling out fields in a database—, and receive a minimum payment (about 2 cents) for each action carried out. These tasks are farmed out by companies that need the work done —because it can only be performed by humans— but want to save money by avoiding hiring temporary personnel. Projects for digitisation, database-building and verification of automated processes are consequently being launched on the Internet, to be carried out by hundreds of users who are paid a pittance in return. Amazon's initiative —a highly questionably one in terms of its respect for workers' rights— exploits and makes money on the capacity to carry out work distributed amongst the collective of Internet users; moreover it makes it statistically profitable for companies to use the tool, since it operates from an assumed guarantee that there will always be groups of workers prepared to carry out the tasks.

In *The Sheep Market* Aaron Koblin employed *Mechanical Turk* users to make 10,000 drawings of a sheep in profile (Fig. 4). Once the drawings had been obtained, the results were displayed on the project website: the image of thousands of sheep drawn in every way possible. Indeed, to some extent the resulting flock of sheep reflects the way an employer who hires services on the *Mechanical Turk* might see the workers. There is nothing to distinguish the sheep on the screen from a sheep the spectator would probably draw. More importantly, the mechanism that underlies this new way of achieving intelligent work from such a simple tool is also represented in *The Sheep Market*. The fact that the workers appear only as instances of a set of combinations like that of all the possible sheep reflects the statistical reduction on which the tool operates. To this extent the *Mechanical Turk* limits the possibilities of the worker, who is ultimately seen merely as one

element in a previously defined statistical variety; a collectivity which includes nothing more than combinations of possible users, yet which manages well enough each one's retributions and freedoms —in short, which is capable of extracting a net yield from the crowd. Once again, the individual is brought to the fore merely by belonging to a pre-existing collectivity of combinations. As in *Exactitudes*, *The Sheep Market* is another case of visualisation, correlative to the combinatory generation of individuals in *Fractal Invader* and *MORPHOcarrots*.

COLLECTIVE PHENOMENA
STATISTICAL PHYSICS AND GENERATIVE ART

As we shall see, the study of statistical collectivities of equivalent elements and the use of their overall characteristics is nothing new in scientific disciplines such as physics. It involved the introduction of abstract entities that helped explain the phenomena of the world, to the point where the world became unintelligible without resorting to such abstractions. Statistical groupings (or collectivities) to some extent came to form part of nature with the same rights as the particles from which they arose.

It was the late nineteenth century Austrian physicist, Ludwig Boltzmann, who introduced the idea that although a system consisting of a vast number of particles could not be studied from a mechanical perspective —given that an equation would have to be written for each particle— it could however be examined from the position of statistics. Thus a gas represented as a finite set of molecules with given initial positions and velocities would on average develop in the same way as the statistical complex defined by all the possible positions and velocities of its molecules. In other words, analysis of a specific unstudiable case, could be replaced by an analysis of the totality of possible cases, for which statistics provided some useful tools. Conceiving the set of all possible combinations of particles thus provided an access to information of physical value on specific cases that could not be studied using mechanics.

The step was so audacious that soon the very concept of the well-defined particle with a given initial position and velocity ceased to be relevant for the techniques and reasoning of a great number of disciplines of physics. In its place, abstractions were conceived and used that expressed the entire potential resulting from deploying these arrays of possible cases; abstractions such as statistical and canonical ensembles and probability clouds, which further fostered the gradual application of modes of reasoning and operating that were already in use in statistics[5] to theoretical and experimental scientific problems.

Among the first phenomena studied using statistical physics, one of the most important, given its relation with contemporary generative art, was one analysed by the generation of scientists that succeeded Boltzmann: the phenomenon of fluctuations. When in the very image of nature the concept of the particle surrendered its priority position to that of a statistical system of particles, the theory was capable of developing out of the very characteristics of these systems. Peculiarities such as the fact that there are greater concentrations of particles in one region than in another, i.e. density fluctuations, occur spontaneously in nearly any system of particles; wherever there is an agglomeration, one will always find areas of greater clustering than others. This property of systems —not of their component particles— is essential in explaining (among other phenomena) Brownian movement, the constant random movement of a microscopic body in a liquid. Although such movement could not be explained by the body's colliding with the particles in the liquid —since in that case there would be as many in one direction as in the contrary— collisions by the body with the density fluctuations did, in contrast, predict a net and visible movement of the same kind as seen under the microscope. The reality of fluctuations, in a world that accepted statistical uncertainty as a principle, was confirmed, hitting the Brownian bodies in the experiments like a billiard ball.

These same fluctuations today constitute one of the most common visual devices in algorithmic or generative creation. The ease with which it is now possible, using computers, to apply something that has been programmed for one element to hundreds or thousands of them goes some way to explaining the profusion of systems of elements being developed by artists working in the field of generative abstraction. As one can see by looking at their results[6], the fluctuation in the density of lines and points, as an emerging visible characteristic, is part of the language deployed in the final surfaces. Despite its role in intensifying the retinal experience sought and championed by some promoters and scholars of computational visuality[7], fluctuation as a phenomenon in these images nonetheless inevitably refers back to its algorithmic condition and thus to the code's capacity to produce by itself fluctuations and complexity; an aspect of these works which brings them into direct contact with what we have just seen, and which, as we will see, also provides some of the characteristics of the work on complexity.

One of the leading exponents of generative imagery at this time, the American artist Casey Reas, expressly discusses in his explorations[8] the priority of the process over the image, and text as a basic part of the image: the set of instructions in ordinary language —not quite programming code— forms the nucleus of a generative process that first a programmer, and then a machine, interprets and implements, leading to the final image. Due to this intermediation between interpreter and computation, the presentation of an image, *Process #4*[9]

(2005) for example (Fig. 5), together with the generative text —«A rectangular surface full of Elements 1 of variable sizes. Draw a line that joins the centres of the elements in contact...»— makes the fluctuations and other emerging phenomena dependent not so much exclusively on the text —as might be the case in Sol Lewitt's *Wall Drawings*— or the image, but on a capacity implicit in certain systems of generating organisation in themselves, once they have been implemented (in this case on a computer). This capacity has to recognise the spectator as an attribute of those systems in general, and not of a specific set of printed strokes or lines of text in particular. The interpretation, therefore, is not of what is expressed but of what occurs in the system of relations imagined by the spectator, who is capable of producing, like a simulator, that which singularises the image.

COMPLEXITY
THE INEVITABLE COEXISTENCE

In conclusion, the power and the agency of statistical collectivities, of systems of elements linked by a code or a common condition, is an inescapable issue when discussing certain major studies, such as those we have examined here, at the heart of contemporary creation. Equally inescapable is the more general issue of emergence in systems of interrelated elements. In terms of Zeno's paradox, why does a sack of sand make a noise when it is poured out when a single grain makes none? Led by a set of scientific subdisciplines grouped under the name of complexity sciences, since the 1960s there has been a regular study of the systems in which collective phenomena of emergence and self-organisation take place —generally, though not only, the spontaneous appearance of order or structure. These include mechanical phenomena such as the separation of phases into mixtures subjected to vibration, chemical phenomena such as the extraordinary geometric shapes which a simple reaction can generate and biological phenomena such as that regulating certain behaviour by colonies of arthropods. All of these systems out of equilibrium in which elements, without conforming to any masterplan, exchange energy and matter between each other in such a way that the whole acquires properties and capacities that cannot be reduced to a description of the individual elements. They are constructive systems, capable of creating order, novelty and structure by themselves, which therefore go one step beyond the collectivities of combinations we have seen examined[10].

From the direct illustration of phenomena such as emergence[11] to the use of mathematical complexity generating techniques for collaborative actions in the city[12], via kinaesthetic simulations of fractals[13] and games with artificial life[14], many artistic projects are packed with

concepts taken from the field of complexity. In some of the most significant ones, the complex regime acts by inciting organised behaviour among the components of the works, which highlight the existence of a system of constitutive relations that also includes the spectator's capacities for cognition and interaction. In other words, there are projects that require from the spectator an immersion that goes beyond intellective distancing; a participation analogous to that of a player who has to make decisions. The systems, equipped now with poietic capacities, interrogate the spectator: even his or her inaction becomes just one of many possible options.

Luci[15] (2007), by the Catalan intermedia artist José Manuel Berenguer, an interactive installation made up of LEDs, loudspeakers and electronics, reproduces a phenomenon similar to the behaviour of a type of glow-worm from Malaysia whose flashes of light go from a regime of unordered and independent emissions to one of synchronised pulses. In the installation (Fig. 6), the synchronised pulse and sound of a set of LEDs and loudspeakers in a darkened room is interrupted, leading to randomness whenever the room is lit or a visitor switches on the devices, revealing the network of connecting cables between them. The order of the rhythmic pulses seems to disappear with the visitor's intellective intromission. When the ambient light is dimmed, the LEDs slowly return and gradually recoup the synchronised rhythm of a single joint pulse. The mechanism underlying the entire installation is remarkably simple, and yet prodigious in its behaviour: each artificial glow-worm has a light sensor which raises the frequency of the pulses as it detects greater amounts of light. When the ambient light lies beneath a certain threshold, the glow-worms only «see» the flashes emitted by their neighbours; in these circumstances, with the same inertia whereby scattered applause ends up homogenising after a time, the flashes tend to fall into step with each other, like paired pendulums. While the dynamic of the system is characterised by these two stable phases, that of the random pulses and the paired fluctuations, it is in the transition between one and the other that the complexity and its profusion of behaviours and appearances takes place. In the time taken by that transition, the system becomes extremely sensitive to light variations and pulsing groups, paths and other recognisable structures can clearly be seen to form. A small universe of light exchanges is created which the spectator recognises as such, as an active state and one of unpredictable novelty; autonomous and in dialogue with what they are observing.

The work at those moments is a system containing the spectator. It predisposes them to an immersion in which their capacity to predict and imagine comes up against a similar creativity in the behaviour of the installation. Not surprisingly, the autonomous and artificial turmoil of emergences leads us back to the ocean of the planet *Solaris*, home to a material and unknown form of intelligence, in Stanislav Lem's novel of the same name. The confrontation of processes, pro-

vided both by the spectator and by the system-installation, is the field of performance of complexity.

Other studies of the poietic capacity of systems remind us that it can also be found in the gigantic systems we encounter every day. One such system is the media information area, which sometimes takes on a life of its own, amplifying or annihilating certain messages or contents. This autonomous behaviour is evoked by the Japanese artists Daisuke Ishida and Noriko Yamaguchi in their installation *Decryptopattern* (2009). In this work, the impetus to compose the unique image of the truth of an issue based on the constant and uncontrolled flow of sources, opinions and information, is expiated in an invitation to participants to rip up pages from newspapers into small pieces and roll them up into little balls to be thrown onto a horizontal metal plate. The plate, raised a few centimetres from the ground, is subjected to mechanical vibrations. The movement is transmitted to the pellets of paper which begin to move slowly, continuously and at random. A state of complex behaviour then takes place, in which clusters, lines and other paper structures start to form (Fig. 7). This complex phase ends when equilibrium is reached and the vibrations of the whole system are synchronised in the well-known and spectacular Chladni acoustic patterns[16]. In the interim, as in the case of *Luci*, we have a regime of transition, an image of self-organisation beyond any master plan[17], characterising this time the media ecosystem.

We recognise these regimes from the first time we are immersed in them. If the system involved a human community, we would probably identify it with those contexts of high communication density, participation or synchronicity. These are more or less habitual situations in closely inter-related communities, which have turned the collectivity into an essential support for survival. It is precisely at these communities that the last of the works we shall look at is aimed. In its many stagings, Antoni Abad's project, *Zexe.net* (2004-present) has worked with groups of taxi drivers in Mexico, gypsy communities in Spain and displaced people in Colombia. The project (Fig. 8) consists of providing the members of the community with mobile phones fitted with video cameras and training them in the use of a set of tools with which to upload the photographs, sounds and videos from the phone to a dedicated feed on the Internet. As well as offering images and sounds of these utterly neglected groups, the project spontaneously records the high degree of inter-relation within these communities, which immediately emerges in the videos, which are full of cross-references. Each feed is a disordered collection of subjective views which, nonetheless, given the space of relations in which they are conceived, provide a coherent overview to spectators who have agreed to collude with the reporters. As in a conversation, the decoding and the subsequent tension take place through a sort of empathic immersion.

In conclusion, the collectivities and the systems highlighted in works such as the ones we have discussed related to combination, ac-

quire an autonomy of their own, capturing the spectator when they examine their regimes of complexity and self-organisation. These regimes can be perpetuated in systems of life or artificial intelligence —precisely the path travelled by much of the work on complexity carried out to date. While it is not within the scope of this article to examine these regimes, we can, however, say what their strategy of action is, shared as it is with the works on complexity we have examined here: to confront the participating spectator with an inapprehensible process, with which he or she necessarily has to interact. To foster an intellection based on coexistence, beyond reading and representation.

Notes

1 → www.xs4all.nl/~notnot/morpho/MORPHOcarrots.html

2 → www.levitated.net/daily/levInvaderFractal.html

3 → www.exactitudes.com

4 → www.thesheepmarket.com

5 On the highly interesting context against which the position of statistics as a legitimate resource of reasoning was consolidated, see Ian Hacking, *The Taming of Chance (Ideas in Context)*, Cambridge University Press (1990).

6 See for example the collection of images by the *Processing* group on Flickr: → www.flickr.com/groups/processing/pool or the collections of *patches* written in this programming language: *OpenProcessing* → www.openprocessing.org and *SketchPatch* → www.sketchpatch.com

7 Susanne Jaschko, *Process As Aesthetic Paradigm: An Observation Of Generative Art*. Metamedia Conference, Québec City, Canada, March 2007 → http://bit.ly/3QtiCc

8 Casey E. B. Reas, *Process Compendium*, → http://reas.com/texts/processcompendium.html (2004), updated on 24 February 2008.

9 → http://reas.com/iperimage.php?section=works&view=&work=p4_s&id=0

10 Nonetheless, we should not forget that combinations and complexity are profoundly related. In the first half of the twentieth century, the explanatory power of statistical physics and the abstractions mobilised in its equations, such as fluctuations, led Austrian physicist Erwin Schrödinger to conceive the approach of certain similar physical bases for biology based on mechanisms of local reduction of entropy —of the type of fluctuations— in his well-known book, *What is Life?* (1944). His inspiring intuitions still echo all these years later in the work of scientists of the complexity of Ilya Prigogine (see, for example, *The End of Certainty* (1996), who saw in the behaviour of matter out of equilibrium an active and even creative nature).

11 *Urban Mobs* (2008), by Orange and faberNovel → www.urbanmobs.fr

12 *dot.walk* (2003) by Socialfiction.org → www.socialfiction.org/dotwalk/dummies.html

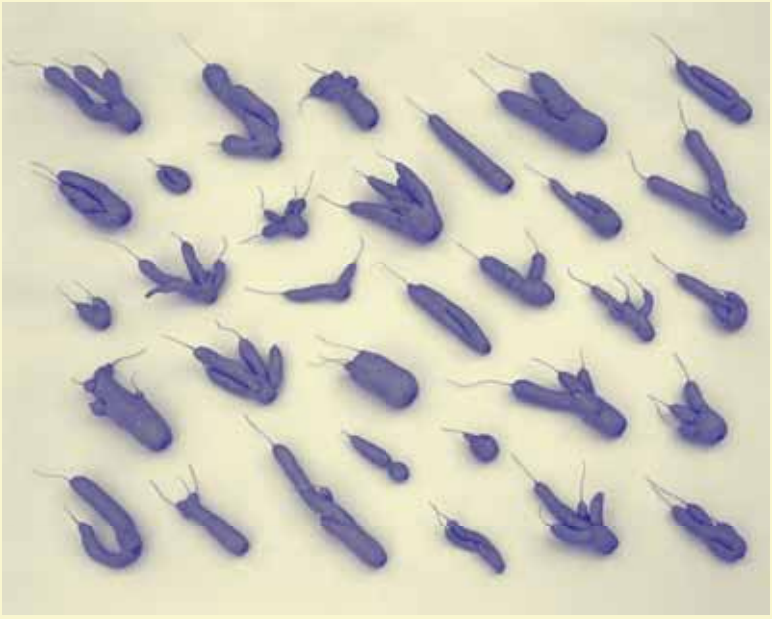
13 *Gestalt* (2003), Thorsten Fleisch

14 *L.A.2* (2007), Kenta Cho

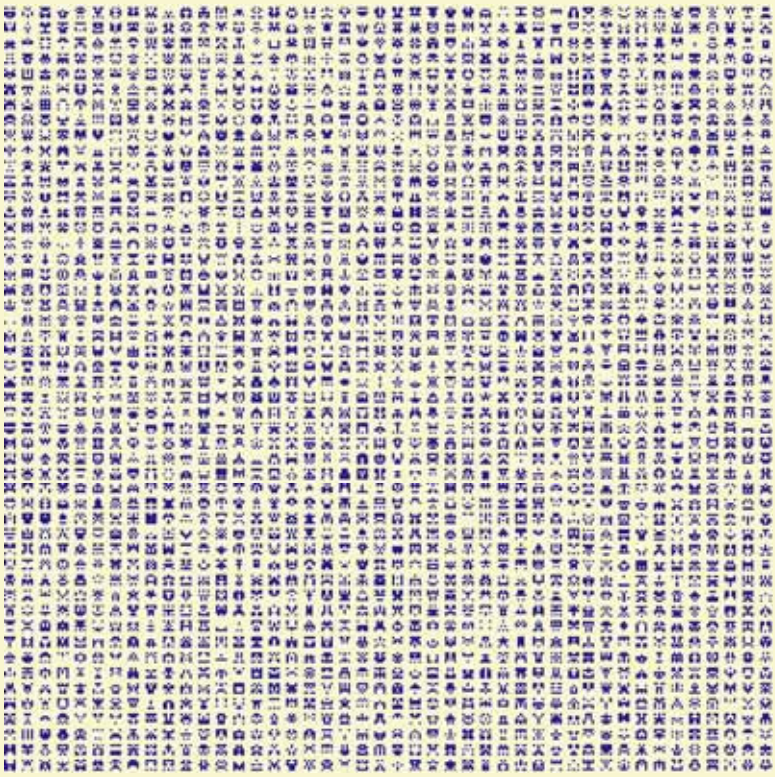
15 → www.sonoscop.net/jmb/lucy/index.html

16 Used, for example, to study the acoustic properties of the sound boxes of musical instruments, such as violins.

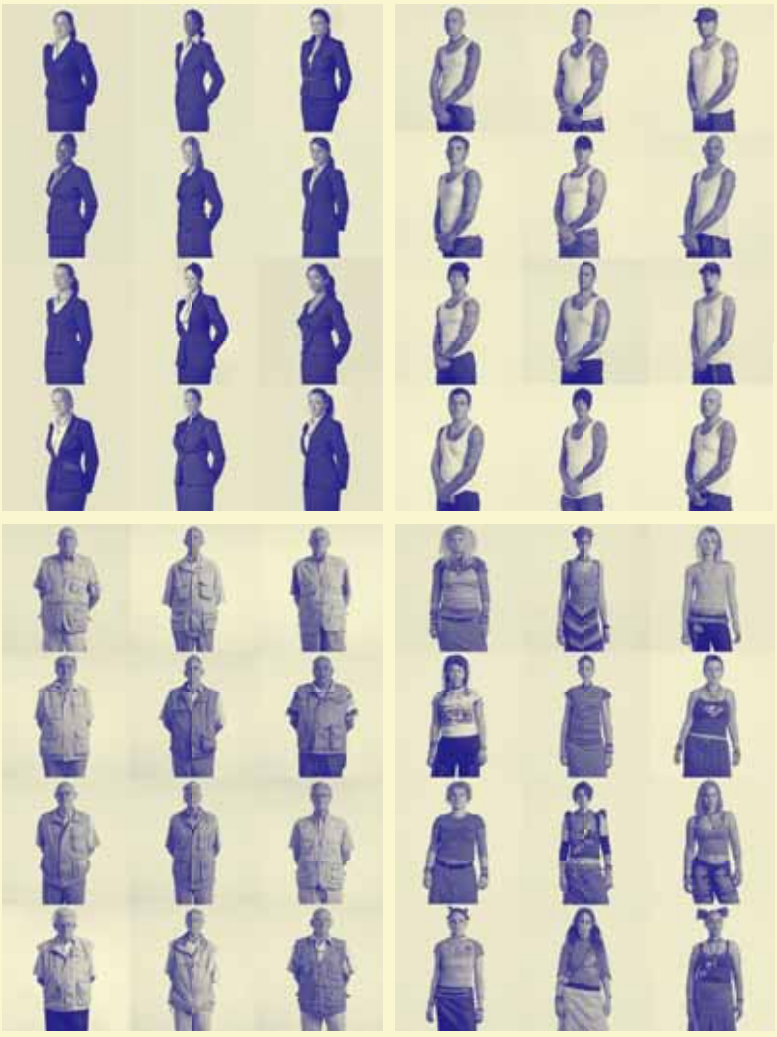
17 Note too that, in this aspect, the work operates vaguely as a disassociation from the Japanese tradition of origami.



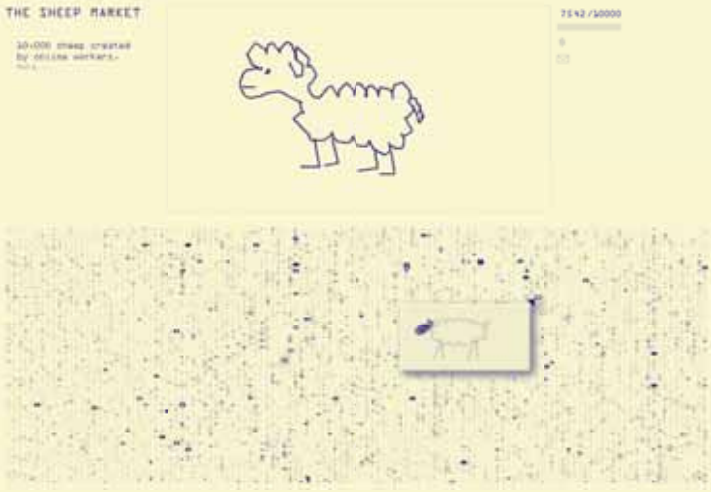
-FIG.1-
MORPHOTHEQUE #9
DRIESSENS & VERSTAPPEN
1997



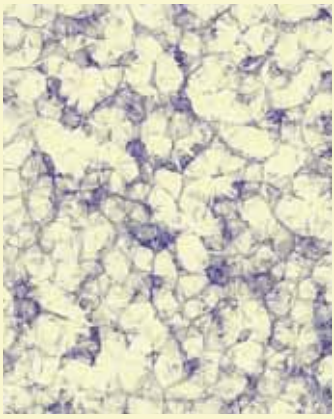
-FIG.2-
FRACTAL INVADER
JARED TARBEL
2003



-FIG.3-
EXACTITUDES
ARI VERSLUIS + ELLIE UYTTENBROEK
1994-2010

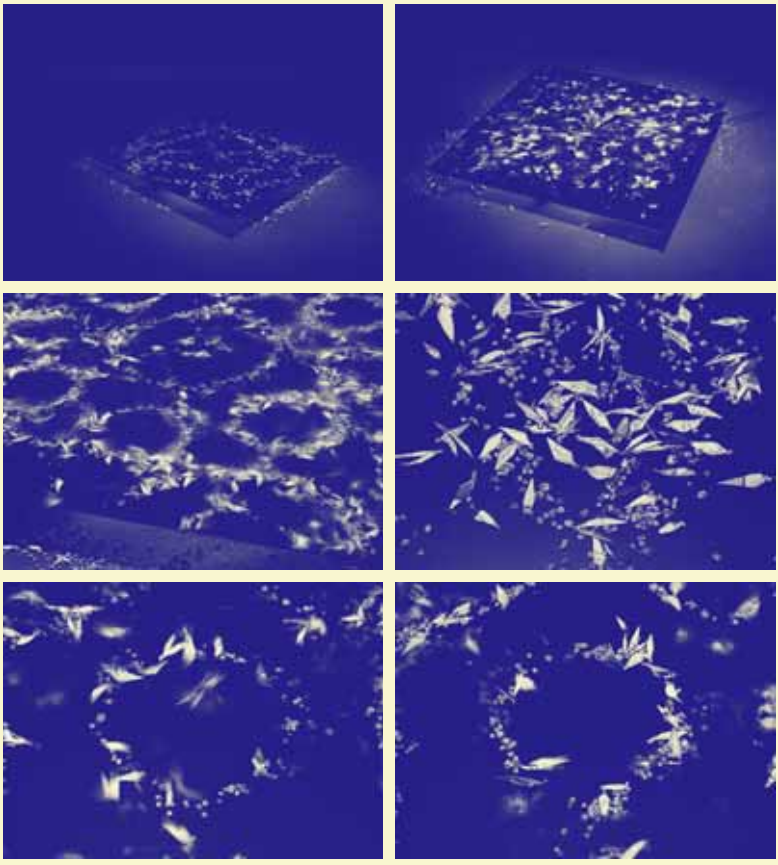


-FIG.4-
THE SHEEP MARKET
AARON KOBLIN
2006



-FIG.5-
PROCESS #4
CASEY REAS
2005

-FIG.6-
LUCI
JOSÉ MANUEL BERENGUER
2007



-FIG.7-
DECRYPTOPATTERN
DAISUKE ISHIDA NORIKO YAMAGUCHI
2009

-FIG.8-
ZEXE.NET
ANTONI ABAD
2004-2010