Intensive Science

by Luc Steels

In October 1996, the Sony Computer Science Laboratory of Tokyo opened a sister laboratory for fundamental research in Paris with a symposium at the Galérie de l'Evolution. The symposium was on the question of the origins of language, one of the themes that the laboratory is still exploring today. Thus began an intellectual adventure which I had the privilege to guide and which was made possible by the vision of Mario Tokoro and Toshi Doi and the unusual openness and trust in scientific research of Sony top managers, in particular Nobuyuki Idei. A few years ago, Scott Lash, professor at Goldsmith College London, and Hans-Ulrich Obrist, curator at the Musée d'Art Moderne de la Ville de Paris, declared after a visit to our laboratory to have witnessed intensive science at work. So I became curious, what is intensive science?

One meaning - the most obvious one - is science conducted with great intensity; and this is surely what we have been doing in our lab. A lot of scientific research is rigid and highly disciplined. It follows a narrow path of investigation that is chosen to guarantee that the desired result is reached. This mode of operation is necessary to maintain high standards and quality and is indeed an effective way to get the most value for the money. Today it is the dominant mode of working for most scientists because almost all science funding has become top-down managed and demand-driven, particularly in the field of computer science. But this kind of standard science normally does not lead to big breakthroughs. It squeezes creativity out of the process. If one has to plan months or years in advance when the breakthrough is supposed to come and what it will be like, we are no longer talking about a `real' breakthrough. It

can only be the application of known methods and techniques to a well delineated problem.

On the edges of science there are pockets of avant-garde activity where research takes place in a more disordered and creative way - even though this does not mean that discipline is relaxed. Experiments are still carried out rigorously, mathematical proofs still have the same standards, and strict requirements still hold for constructing arguments. What it means is that the scientist explores a terrain which is so new that no prediction can be made about potential success and the investigative path cannot be mapped out in advance. We let ourselves be guided by intuition, accept sudden changes in direction when a dead end is reached or a new more interesting problem appears, seek multidisciplinary input to change perspective and become aware of hidden problems, and, most importantly, take enormous risks possibly even to look like a fool because the hypotheses are too bold or the experiments still half-baked. Scientists who operate in this mode usually do it with great dedication, driven by a vision, a mad dream, to crack a problem that nobody has been able to solve before. They often come under intense criticism and are at first rejected by the established powers. But they are motivated by the joy and flow that comes with their discoveries. This is one meaning of intensive science and it is what we try to do in our lab.

A key success factor in creative science is to keep an open mind, so that a web of ideas and associations can be woven that then may lead to unusual jumps and new ideas. Having a multi-disciplinary team is one way to achieve this, and our small team indeed brings together physicists, mathematicians, engineers, computer scientists, biologists, musicians and linguists. Another way is to integrate artistic influences and practices, and we have been doing that as well in terms of dialogues with artists. These dialogues were not really planned but just happened through personal contacts. They have often been going on for many years, possibly but not necessarily, leading to visible artistic or scientific output.

The present exhibition is intended to evoke some of the dialogues between lab members and artists. They are not just window-dressing or an after-thought. We solidly believe that science-art interactions help to

stimulate intuitive thinking that is not reachable by pure rational inquiry. They help to enrich the communication of scientific insights and translate them in a way that directly stimulates a non-scientific audience, often at an emotional level. Contemporary art has been able to preserve much better a zone of total creativity. Artists are more free, and there is a strong infrastructure with museums, galleries, and publications to spread, record and document their activities. Science has now been harnessed almost completely by bureaucratic processes at the service of short-term goals and there is almost no infrastructure for the communication of contemporary science to a broader public. Consequently a big gap has appeared between contemporary society and its scientists. Through the kind of dialogues evoked in this exhibition, scientists are able to enter the free zone at least temporarily and carry the spirit of open invention back into their own work. They are able to reach audiences that they could not reach otherwise and communicate their ideas at an intuitive level.

There is a second meaning for the term intensive science. It has been elaborated by Manuel de Landa in his book `Intensive Science and Virtual Philosophy' [2] which is a remarkable reconstruction and summary of Deleuze's post-modern philosophy. This meaning is also highly relevant to what has been going on in our laboratory and to the artistic dialogues shown in the exhibition. At the beginning of European science, through Galileo and Newton, Nature was viewed through essentialist eyes. Scientists attempted to identify the Platonic timeless essences of objects and describe them in a mathematical way. This worked remarkably well, particularly to describe the physical world. But this view began to be overturned in the 19th century by biologists and particularly Darwin. It is counterproductive to define a species as an essence with necessary and sufficient properties because it is for ever in the making, it is a multiplicity in Deleuzean terminology. The goal of biology hence shifted to understand and describe the intensive processes that create extensions (the forms we see) rather than catalog the end product of these processes. This is how evolution by natural selection was discovered. Since Darwin's revolutionary paradigm shift, this dynamical viewpoint of Nature has began to invade all corners of science. Even physical structures such as galaxies that used to be viewed as eternal and static are now studied as evolving systems. Computer Science, which initially studied on algorithms as static mathematical

objects, is now totally focused on creating artifacts that are all the time changing. An arsenal of new complex tools has developed building on the theory of dynamical systems, differential geometry, network theory and agent-based simulations as originally developed in artificial intelligence research.

Almost all the investigations in our laboratory have been driven by this profound paradigm shift and the impact is also observable in the dialogues shown at the exhibition. A first example is the lab's research into language. The study of language in mainstream linguistics is still largely dominated by the Cartesian essentialist tradition. This research program originally set out by Chomsky in the nineteen fifties tries to identify the immutable essence of universal grammar and describe it statically as a formal system (generative grammar). But as part of the founding themes of the laboratory, I proposed to shift attention instead to the origins and evolution of language, in other words to the processes by which new linguistic form originates and changes rather than the present state of the language competence of an idealized speaker. This approach turns linguistics into an intensive science. It studies language as a multiplicity that is forever on the move.

This new viewpoint on language has resonated strongly with issues and sensibilities in contemporary art and led to some fascinating art-science dialogues. The first ones took place at the Laboratorium exhibition in Antwerp (Belgium) in 1999. As a contribution to that exhibition, I created the Talking Heads experiment which showed in a networked installation how a new language could emerge in a population of embodied agents. The installation was shown again in the year 2000 as part of the N01SE exhibition, connecting the Kettle's Yard Gallery of Cambridge University and the Wellcome Gallery in London in 2000, as well at the the Palais de la Découverte in Paris and the Neuer Kunstverein in Aachen. It was seen in total by half a million people and many more participated through the web. The ``Look into the Box'' installation which I conceived together with Olafur Eliasson is a continuation of these experiments. It was first shown at the Musee d'Art Moderne de la Ville de Paris in 2002 and came out of discussions held at the Bridge the Gap symposium in 2001 in Kitakyushu, Japan between myself and Eliasson. Eliasson is an artist who has also emphasised process in a lot of his work, instead of final form as indeed

many artists do today, and his preoccupations are therefore a perfect fit with the research on grounded language evolution.

A second example of intensive science is the lab's work on developmental robotics. Sensori-motor intelligence allows an embodied being to move around and handle objects in the world. In the research carried out by CSL researchers Frédéric Kaplan and Pierre-Yves Oudeyer, this type of intelligence is no longer studied as a static competence that is innate or acquired once, but an evolving process. They have been studying how the affordances of objects can be constructed and thus learned autonomously by artificial agents without prior models and driven by curiosity. New behaviors spontaneously arise in their experiments and they are molded and adapted in an on-going developmental process. Their work has recently led to another art-science dialogue engaging the highly creative design students of the ECAL design school in Lausanne and the industrial designer Martino d'Esposito. In the exhibition, the results of these dialogues are shown in the form of an intriguing set of objects making up `AIBO's playroom'. They were designed in intense collaboration to be challenges to the curiosity-driven learning processes devised by Kaplan and Oudeyer. One of them is a swimming suit that a robot can use to discover how to move around in water, solely based on curiosity-driven exploration.

A third example of intensive science is the lab's research activity in the domain of semiotic dynamics on the web. Everybody today agrees that the future of information access requires ontologies and there have been extensive efforts (known as the semantic web) to design such ontologies. But in the spirit of the lab's orientation towards dynamical processes, we have naturally taken the view that ontologies cannot be fixed once and for all by designers but have to be emergent and for ever adaptive and changing. The recent trend towards collaborative tagging confirms this intuition. CSL researchers Melanie Aurnhammer and Peter Hanappe have been experimenting with these processes and created systems and interfaces to orchestrate a semiotic dynamics process, in which the meanings of tags or features emerges out of the interactions of a large number of users. This has led to an artistic dialogue with photographer Armin Linke. Linke has a vast collection of pictures and is keenly interested in the question how coherent selections can be made from this collection, including by the viewers

themselves, for example by creating infrastructure in his books-on-demand project. He views his pictures as resources for navigation and browsing. So an experiment was done to marry technologies of social tagging and emergent semantics with Linke's collections, involving art students from the Venice University. Some results of these processes are shown as part of the exhibition.

The emphasis on becoming instead of being, on creating a process instead of capturing an essence is also present in the music-oriented work shown at the exhibition. CSL researcher Francois Pachet has been working for years on the dynamical processes that underlie the selection and creation of music. The Continuator, a real-time computer based music system, is a spin-off of this research, designed to support improvisational interactions through a musical instrument like a keyboard. The system is able to pick up the playing style of an improviser and respond with musical phrases of its own so that a dialogue develops in which the musician gets the feeling of playing with herself. The final piece does not consist of a fixed score. The Continuator does not determine what the music will be. The music evolves and changes in interaction with a human player but is not solely determined by him or her either. Pachet has engaged in several dialogues with top musicians to explore the consequences of this approach, both in the domains of `classical' contemporary music (with Gyorgy Kurtag jr. and sr.) and Jazz (with Bernard Lubat, Alain Silva, and Albert Van Veenendaal). The pieces were performed at major prestigious music festivals such as the Wiener Festwoche and public radio (such as VPRO radio in the Netherlands).

CSL researcher Atau Tanaka has been bridging the gap between artistic practice and scientific and technological developments for many years. His original creative work and performance practice focused on music steered by body sensors. More recently he has been exploring various networked technologies in order to orchestrate dynamic music creation by social groups. The piece NetDérive produced for the present exhibition is the result of a dialogue with Sydney-based artist Petra Gemeinboeck and is another clear instance of the process-oriented view that is associated with the notion of intensive science. Their work sets up social interactions, supported by mobile phones and internet technologies, within a loose network of people that are exploring a city,

in this particular case the urban environment around the exhibition space near the Bastille in Paris. From the paths they take and the experiences they have, a collective narrative emerges which is fed back through audiovisual means to each participant and thus shapes their evolving experience. Tanaka and Gemeinboeck thus attempt to create a new kind of space at the interstices of existing spaces, a space that is fluid and transversal. All of this is not possible without the most up-to-date technologies: wireless internet, advanced mobile phones, real-time sound synthesis, location positioning, etc., but they are hidden and not the key point of the piece.

Process-oriented designs for novel user interaction are also shown by some of the designers from the CSL Interaction laboratory in Tokyo. Jun Rekimoto and his team have been on the forefront of new interface design for nearly two decades and they have built up a tradition to integrate creative practices in their work. The exhibition shows three pieces: Smartskin (Jun Rekimoto) which is a surface that is sensitive to human hand and finger gestures through capacitive sensing and a mesh-shaped antenna, BlockJam (Henri Newton-Dunn) a system for creating musical compositions as dynamical structures by arranging tangible blocks, and Lumen (Ivan Poupyrev) a device for generating slow, organic animations based on an array of movable light guides.

The final contribution to the exhibition is in the domain of theatre. Theatre is a unique art form because it can integrate emotional and esthetic qualities with literary and philosophical depth. It is inherently live and embodied as opposed to virtual, and therefore a fresh antidote to the great obsession of contemporary culture with the abstract and the digital. Jean-Francois Peyret is a French theatre maker who has become famous for tapping scientific personalities, like Turing or Darwin, as inspirational sources for theatrical performances. The uniqueness of his method lies in the salons, the improvisations by actors based on scientific and philosophical input, and the original scientific and philosophical texts that form the source material of the activities on stage. A particular performance is a temporary snapshot of an ongoing process rather than an absolute final statement. What makes all this so interesting from the viewpoint of scientists is that it shows how the theatre can appropriate itself of subjects that are normally only addressed in a closed scientific circle. It is therefore a refreshing and

effective method to approach these subjects in non-rational intuitive ways. It plays with the seriousness with which they are normally tackled and introduces new viewpoints that could lead to breakthroughs. For the prestigious Avignon theatre festival in 2005 and the French national theatre Chaillot (Paris) during the 2006 season, Jean-Francois Peyret collaborated with Luc Steels on a piece inspired by the 19th century Russian mathematician Sonya Kowalevskaya, whose field of research (predictability and chaos in dynamical systems) helped to create the mathematical foundations on which intensive science rests. The nature and results of this unique art-science dialogue are invoked in the exhibition through live improvisation and documentary film.

Intensive science is a way to revitalize science by unleashing its original creative powers. It is of course unruly, risky, and unpredictable, but also rewarding and touching all of us. The impact and depth of results will only be clearly visible decades from now. But it is obvious from the present exhibition and from the scientific results that have come out of the laboratory during the past decade that this focus and mode of working has been enormously productive.

[1] Akiko, M. and H.U. Obrist (2002) Bridge the Gap? CCA , Kitakyushu.
[2] de Landa, M. (2002) Intensive Science and Virtual Philosophy. Continuum, London.
[3] Obrist, H-U, and B. Vanderlinden (2001) Laboratorium. Dumont Verlag, Cologne.