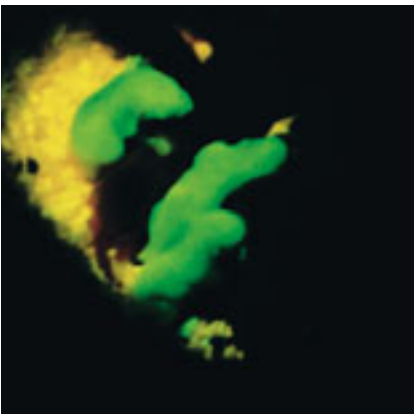
Reinhard Nestelbacher

# Green or How a Light Turns the World Upside Down

***Science has its own rules, rules that do not necessarily coincide with the views of laypersons. With the help of the GFP molecule* (green fluorescence protein), *for instance, unusual new creatures have recently been created—glowing mice, fish or plants. The* Green *Project takes what is an everyday scientific phenomenon in the form of a cautiously compiled exhibit and exports it beyond the confines of the lab; this alone makes it seem to be something between unusual and bizarre. Organisms as image-generating "apparatuses."***



*GFP Mouse—In the case of mice, the GFP protein* works *and they glow in* Green.

A green glowing mouse is unusual. And the image of yeast glowing on its own is also not something one sees every day. Nevertheless, these images of living creatures are not fantastic inventions, but rather everyday images for one group of people: microbiologists. The glowing creatures are products of their genetic engineering research; the glowing is caused by a particular protein known as GFP and was integrated with scientific intention into the genetic make-up of these organisms.

## Art as Mediator

The life sciences have not only become a tool for mankind; they also pose a challenge to our society. The consequences of the genetic modification of life have hardly even begun to be investigated. In this discussion, many conventional concepts and established principles in the field of ethics have increasingly proved to be inappropriate or at least inadequate. Furthermore, there is an additional problem inherent in the consideration given to the consequences of the biosciences, the discussion of ethics for the 21st century and thus the definition of the limits of research: the rapid pace of research means that the social discussion often lags far behind. Actually, it ought to be the task of scientists to critically and consistently reflect upon what they do. But most researchers prefer to pass along the task of confronting and dealing with the new sciences to the non-scientific community and thus to, among others, artists. However, this raises the problem that a critique of this technique requires detailed and comprehensive knowledge of it, whereby becoming familiar with this complicated material is almost impossible for a layperson—one reason why the few thinkers who have dealt with this topic do indeed come from the world of science—Maturana, Chargaff, and Monod, to name just a few. This basic problem of the lack of a scientific background also evidences itself in the artistic encounter with these issues. Nothing short of the emergence of artists from the world of science or the collaboration between researchers and artists results in an acceptable confrontation, a process that was promoted by the 1999 and 2000 Ars Electronica festivals.

In such a symbiosis, artists possessing the required background can address this theme and begin to reasonably describe and investigate the new social structure saturated with the scientific reductionist way of thinking.

## The Image in Science

*Andi—The first genetically engineered primate has a GFP gene and should glow.*

But the new technologies not only specify the topic; they also make the use of new materials and methods possible. And this too is possible only when science and art draw much closer to one another. Living human cells, bacteria, embryos or whole organisms are becoming part of a new art. This takes place, for example, through the use of cell tissues to form little dolls or figures. Or the use of a bacterium as a carrier and transformer of genetic information introduced into it. Or through the announcement and planning of the genetic modification of a dog with the help of the GFP.

One of the aspects that the *Green* Project confronts is the process of questioning scientific images and their effect on society. After all, bioscience communicates about itself and its results primarily through the media, and much of this information is transported above all via symbolic pictures of science. The images include those of mice bearing human ears, or of a laboratory reminiscent of the clean atmosphere of a hospital. Most people are familiar with the barcode-like depictions of genetic material, but only a very few can perceive what they mean or how these pictures come about. So it is with the depiction of genetic information as well: the four "letters," A,C,G and T, symbols for the four chemical bases of DNA, have come to symbolize the decoding of the genetic code of life. A gene is thus portrayed in a language that does not appear dissimilar to the binary code of the computer. Meanwhile, this has become associated with the view held by laypersons that with the decoding of the "databank of the human being"—that is, the genome—the concept of life can also be technically explained in such a digital fashion. This is a reductionist view that strengthens the concept of scientific omnipotence. One reason why the effect of such images is to spread misconceptions is that neither the media nor scientists seriously reflect upon their consequences. *Green* confronts this phenomenon in that it indeed demonstrates the capabilities of biological knowledge with the organisms presented, but also simultaneously admonishes those who see such images to think about this work. It does this with a simple means: it reveals an image—for example, the green glowing mouse—from the world of science without cosmetic enhancements or the attempt to hide something unpleasant.

The second aspect of artificially fluorescent creatures is the encounter with the cell as a living system or with the organism as an "image-generating apparatus." These creatures are thus not the objective of art; rather, they are the end product and the material. Not that it would be something novel to "use" organisms as part of a work of art, but it nevertheless reaches a completely new dimension. The animals, plants and bacteria are indeed the products of a process of scientific inquiry, but they are above all living systems. This means by definition that they are capable of independent metabolism, that they have the ability to reproduce themselves, and that they have the possibility of changing their genetic make-up. Indeed, this implies that they are considered a self-contained system, but of course they possess the capacity to be able to respond to signals from the environment with a reaction that is suited to their nature. Here, they can be subjected to variation by external factors, but by no means can their own essential nature be completely reversed; they do not, as it were, react to the signal from the environment, but rather ultimately follow only their own consistency initiated by the signal.

Unless, of course, the change is a change of the system — that is, an act of intervention in the creature's genetics, a possibility that molecular biology has offered since the mid-'70s. But here as well it is impossible to fully depart from the genetic framework made

available by the system; rather, this must remain in the zone of tolerance prescribed by the genetic and biochemical structure. If its organization is knocked out of equilibrium, the creature is de facto dead or considerably impaired. Since human beings now have the possibility of provoking changes with the help of molecular biology, living systems are now being even more rapidly adapted to the needs and conceptions of human beings. Certainly, the results of this intervention elude the total control of the human will. The creatures whose appearance has been altered in an unusual manner through the use of GFP, for example, raise the following question: What results from the act of the researcher (or artist) and what is an expression of the system employed (mouse, yeast or human being)? The pattern of the images is indeed initiated by humans, but the final form they assume—that is, the structure to which this gives rise—cannot be controlled to the exclusion of all other factors.

Through the use of pigments in living systems, the processes that take place within a cell—which have actually been schematically described—can be shifted into a new world of imagery. The phenomenon of "life" is thus in a very unusual way given a face and a graphic presence that are no longer as abstract as the sequence of letters of the genetic code or the images of a biochip, the creation of which is shunted off into a diffuse area of science—and thus the impact of the image too. Here, GFP and *Green* only symbolize the use of methods to modify living systems. The creatures presented in *Green* are also the results of science, but they irritate the public's sensibility the same way that some works of art do, and provoke a discussion about society, values and the 21st century.

The *Green* Project presents a number of organisms as examples of genetic modification with GFP—unusual messengers from the world of science.

The green fluorescence protein (GFP) is, strictly speaking, the only known fluorescence protein whereby the glow is actually caused by a part of the protein itself. The unusual molecule was discovered in the '60s in the luminescent jellyfish Aequorea victoria. From the very start, the protein's most striking characteristic was that it fluoresced an intensive green color when exposed to ultraviolet light.

One of the most important cell-biological applications of GFP in the molecular sciences is its use as a reporter gene or marker, whereby the GFP gene is attached to a particular gene that is to be investigated. Since this procedure does not disturb the main protein in many cases, the appended gene can be regarded as a "molecular lamp." Wherever the gene being investigated is present, the glowing can be recognized through the use of the appropriate methods. This enables scientists to identify the protein's area of effectiveness and to establish its concentration. This also makes it possible to analyze the new genetic "switches," the so-called promoters, and their activities in organisms. Meanwhile, as a result of these interesting characteristics, the protein has been used to answer numerous questions. Here, one would be quite justified in speaking of a "scientific fashion trend" in the use of this tool—glowing images in all facets—and this has given rise to the creation in numerous laboratories all over the world of a regular menagerie of creatures that laypersons find bizarre.

The aim of *Green* is not only to point out the use of living creatures as image-generating apparatuses, but also to shake things up with respect to the world of science and its images. The diametrical juxtaposition of the world of scientists and that of laypersons shows just how large the gap is, how far removed scientific research has become, and how essential it is now to finally begin closing this gap.

This project is being carried out in collaboration with Dr. Fatima Ferreira, specialist in allergies at the University of Salzburg, Prof. Mathias Müller of the VU Vienna, Dr. Thomas Kolbe of the IFA Tulln and Dr. Bernd Fleischmann of the University of Cologne, et al.