Different and yet alike

Despite a history of different attitudes and approaches, art and science are engaging more often in collaborations of mutual benefit

Last year saw the posthumous publication of Stephen Jay Gould's last volume, *The Hedgehog, the Fox and the Magister's Pox* (Gould, 2003) with the subtitle 'Mending and minding the misconceived gap between science and the humanities'. The two protagonists were chosen to represent metaphorically a stereotypical disparity between two different ways of 'knowing' or looking at nature. The hedgehog, always returning to its one great and effective strategy of rolling up with its spines exposed in response to danger, represents the methodical persistence of science, whereas the cunning fox, always devising different strategies to escape its predators, represents the creative flexibility of the arts.

> The representation of nature has thus been a central problem for both scientists and artists alike

Indeed, throughout modernity, art and science have occupied conflicting positions with each habitually identified as the reverse image of the other, which has ascribed opposing attributes to each enterprise. Whereas science corresponds to progress, methodical rationality, austerity and objectivism, art is recognized as mysterious creativity, ambiguity and joyful idiosyncrasy. This polarized dichotomy of the essence of art and science has been reflected in the manifestos of modern *avant-gardes*. The Futurist or the Bauhaus movements, for example, adopted science and technology as a force to break away from the constraints of traditional fine arts and to become innovative. On the contrary, for Expressionists or Surrealists, art was a means to escape from the alienation induced by science and technology, complicit with industrialist capitalism, and to return to primary human experience and authenticity. This modernist antagonism still persists in contemporary settings, and it may be worth bringing scientists and artists together to explore and overcome the essential oppositions involved.

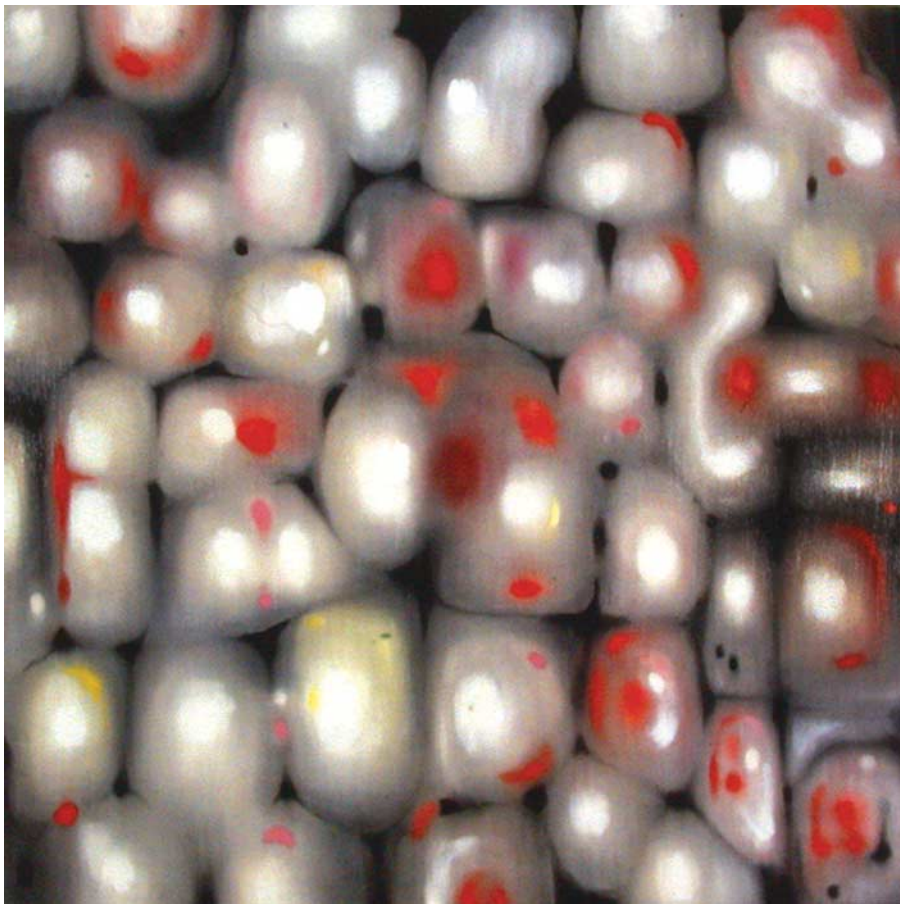

Fig 1| *Inheritance*, by Ross Bleckner (2003). Oil on linen. Courtesy of the Mary Boone Gallery, New York, NY, USA.

Interactions between practising scientists and artists are, in fact, becoming more frequent, as is the depiction of scientific concepts or experimentation in works of art. "Artists, especially visual artists, are increasingly interested in and curious about science, its practices, methods and images," said Gabriele Seethaler, an artist who uses her background in molecular biology to dedicate her artistic production to the concept of identity. "Recent developments in the bio-sciences are taking us into new and unknown domains. Artists pay attention to such scientific achievements and they reflect this knowledge into their work. Some use the imagery of the cellular universe, others raise questions about the ethical, philosophical, social and ecological consequences of these advances in science." Julie Newdoll, a San Francisco-based artist whose paintings draw inspiration from science, recalls electron microscopy images of sensory organs in her latest paintings 'The Evolution of the Senses' (2001/2002). Ross Bleckner's paintings 'Inheritance (Efficacy)' (2003; Fig 1), 'Transcribed conserved' (2002), 'Northern blot' (2002) and 'Overexpression' (1998) resemble patterns of cells, a subject that Helen Storey's 'Primitive Streak' (1997) fashion collection also addresses by

chronicling the first 1,000 hours of human embryonic development. On a larger scale, Simon Robertshaw's installation 'The Errors of Art and Nature' (1994) deals with the troubling aspects and abuse of science, such as eugenics.

This is not a surprising development, given that science and scientific theories are a highly visual affair, which easily plays to the needs of the arts. Visualization has an essential role in scientific experimentation and knowledge production—"there is no thought without an image," Aristotle wrote in his essay *On the Soul.* The representation of nature has thus been a central problem for both scientists and artists alike, and there is an intrinsic notion of beauty and aesthetics in scientific experimentation and image making, as well as in art creation. The mathematician and philosopher Henri Poincaré stated that "the scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful." One of the prime examples of such a fusion of art, aesthetics and science is the work of the German biologist Ernst Haeckel. In 1904, Haeckel published a collection of plates, entitled *Kunstformen der Nature* (Artforms of Nature), a title that displays his intention to mix the two fields together. Indeed, his scientific illustrations can hardly be defined solely as scientific works or as pieces of art. Haeckel methodically classified living creatures, therefore accomplishing the goal of his primary activity, science. But the depiction of the creatures themselves and the layout of the illustrations clearly conformed with the main trends of *Jugendstil* or *Art Nouveau*, the artistic style prevailing in Germany at the time. In the words of the author: "I also wanted to combine these aesthetic concerns with a scientific goal: to open up a deeper insight into the wonderful architecture of the unfamiliar organisation of these forms" (Gould, 2003).

> Science and art are interpretative activities—they are both about meaning and they both use models and metaphors to make the invisible visible, to provide some sort of explanation

Fig 2 | *Shiva as telomerase inside of a telomere loop*, by Julie Newdoll (2003). Oil and mixed media on canvas. Courtesy of the artist.

Art and science at their most fundamental are expeditions into the unknown, in which artists and scientists seek aesthetic representations of worlds beyond appearances (Miller, 2000). Science and art are interpretative activities—they are both about meaning and they both use models and metaphors to make the invisible visible, to provide some sort of explanation. "Science expands the realm of things which can be seen and thought about, the levels of reality we have access to," commented Jean-François Brunet, group leader at the Unit of Development and Evolution of the Nervous System at the École Normale Supérieure in Paris, France, and author of several science documentaries. "Its discoveries are therefore a legitimate terrain for art to explore just like human feelings, the shape of a mountain, or the play of light on the facade of a cathedral," he continued, "except, and it is quite a challenge for the artist, that there is no personal experience to fall back on, on the public's side. It could even be that, contrary to common wisdom, some of these old territories are a little overworked, or used up and that most things, if not absolutely everything, have been done and said (or shown). Science offers a new, virgin territory of contents, visions, spaces to occupy and explore with artistic means, a new frontier for art."

Consequently, both art and science are characterized by innovation, discovery and revolution. "It does not take long in any discussion about science and art before the concept of 'creativity' is raised," said Siân Ede, Assistant Director of the Arts Section at the Calouste Gulbenkian Foundation in

"I' art c'est moi, la science, c'est nous" ("Art is me, science is us")

London, UK. "Both activities require leaps of original thinking in order to progress." Ernst Mach, one of the most original science philosophers of modern times, attributed a pivotal role to imagination in scientific theorization: "Before understanding nature, we need to apprehend it in our imagination, to give concepts a living intuitive content" (Mach, 1905). Intuition may be a scientist's sense for the fundamental problem, or a feel for the correct way to solve the puzzle.

"However, real and important differences between creativity in science and creativity in art can be found," cautioned Ede. Artists bare their hearts and souls to the world in their works, which are intensely personal. By contrast, scientists demonstrate 'aperspectival' objectivity (Daston, 1999), and an ethos of the interchangeable and featureless observer, unmarked by nationality, writing style, personal hopes, dreams, aspirations or by any idiosyncrasy that could interfere with the clear communication and comparison of results. It follows that whereas a scientific paper must have a limited set of interpretations, works of art can provoke many more. Furthermore, the individualism of the artist is opposed to the self-effacing collectivism of the scientists. This is expressed in French biologist Claude Bernard's epigram: *"I' art c'est moi, la science, c'est nous."* ("Art is me, science is us"; Daston, 1999).

As much as science and art may differ in respect to individuality and personality, a working regimen is essential for productivity in both disciplines. Thomas Edison once described genius as the combination of 1% inspiration with 99% perspiration. And the tediousness of repetitive work and the fatigue associated with it is not only relevant to scientific experimentation. "I start a work of art as if I were performing a research experiment, with the same intensity, obsession, curiosity and determination," affirmed Seethaler. Or as French impressionist painter Paul Cézanne once said, "Painting is damned difficult… you always think you've got it, but you haven't…God knows how the old masters go through acres of work…As for me, I exhaust myself, work myself to death trying to cover fifty centimetres of canvas…" (Miller, 2000). For the scientist and the artist alike, brilliant ideas usually come at their own discretion when least expected and not when they are sought. And they may emerge in the most unusual venues or moments, away from laboratory benches or an artist's studio. However, they would not come, "had we not brooded at our desks and searched for answers with passionate devotion" as German sociologist Max Weber said (Weber 1919). At the origin of much of artist Marcel Duchamp's work, Henri Poincaré illustrated his concept of discovery and inspiration. According to Poincaré, we continuously choose from a random set of ideas. These choices are a 'random illumination', a surprise, and we apprehend them as if they come ready-made. But they are not yet complete as they must be tested and "verified by measure and scrutiny" (Shearer, 2000).

More than 25 years ago, philosopher and historian of science Thomas S. Kuhn made clear that a confrontation between art and science is needed not only at the level of their products and activities, but also at the level of the public response (Kuhn, 1977). The general public usually looks to science to find solutions for practical problems in the hope for a better world and to artists to borrow a personal vision of the experience of life. Science is nevertheless unfamiliar and its representation in artworks may make otherwise complex ideas more palatable for public consumption. It is legitimate that a work of art seeks to accomplish such a didactic function. There is a risk, however, that art ends up being a servant of science education, just bringing a decorative aspect to the scientific enterprise, which could also result in a dilution of the science and an increase in misconceptions. "I am drawn to the textures in the imagery and the fascinating concepts in science, which I fuse with familiar surroundings and cultural references. The aim is to create a piece of artwork that speaks to the viewer on an emotional and visual level, appealing to their curiosity to find out more for themselves, never a mere illustration of the science," said Newdoll (Fig 2). "Reproduction of a scientific figure, such as a DNA agarose gel in which the artist has simply altered the colours, may be interesting to someone who has never heard of a nucleic acid, but the work in itself seems superficial," she concluded.

The general public usually looks to science to find solutions for practical problems in the hope for a better world and to artists to borrow a personal vision of the experience of life

It seems that the gap separating science and art is being narrowed. Several initiatives, such as the SciArt programme at the Wellcome Trust in London, UK, have started to institutionalize and fund art and science crossover projects that reflect contemporary scientific ideas and practices and address some of their controversial societal aspects. Their main aim is to explore new modes of enquiry and to stimulate fresh thinking and debate in both disciplines through innovation and experimentation. Indeed, the artistic representation of science has the potential to be a fresh and effective vehicle for science dissemination and a mirror of society's response to science and technology, while offering art an inexhaustible supply of inspiration. Thus, two worlds, with both similar and different attitudes and approaches, may in fact engage in a mutual and sympathetic understanding of one another. This should also encourage a renewed relationship between science and the humanities in general, which increasingly have little to say to one another (Nowotny, 2003). To maintain Gould's initial metaphor, the hedgehog's persistence could only be abetted by a dose of foxy diversity and vice versa.

REFERENCES

Daston L (1999) Objectivity and the escape from perspective. in *The Science Studies Reader*, 110–124. New York, USA: Routledge

Gould SJ (2003) *The Hedgehog, the Fox and the Magister's Pox*. London, UK: Jonathan Cape

Kuhn TS (1997) Comments on the relations of science and art. in *The Essential Tensions: Selected Studies in Scientific Tradition and Change*, 340–351. Chicago, IL, USA: University of Chicago Press

Mach E (1905) Erkenntnis und Irrtum. Skizze zur Psychologie der Forschung (author's translation from a French edition (1908), 'La connaissance et l' erreur', p.113. Paris,France: Flammarion)

Miller AI (2000) *Insights of Genius. Imagery and Creativity in Science and Art*. Cambridge, MA, USA: The MIT Press

Nowotny H (2003) Wish fulfilment and its discontents. *EMBO Rep* **4:** 917–920

Shearer RR (2000) Duchampian science. *Art in America* **88:** 43–47

Weber M (1919) *Wissenschaft als Beruf*. Munich, Germany: Duncker & Humblodt. Originally a speech at Munich University, 1917.

Giovanni Frazzetto

doi:10.1038/sj.embor.7400103