

EXHIBITIONS: ART AND INFORMATION

A Map of Babel

Trevor W. Robbins

The human brain imposes order on the sensory chaos from the physical world by producing perceptual representations, often with technological help from instruments such as electron microscopes, digital cameras, or computers that

work on the binary principle. Through art or language we turn this information back into images or propositions, usually to communicate with other human observers. Our actions result in the reduction, transformation, or control of noisy data. These are the essential themes of *n01se*, a multi-modal and, indeed, multi-nodal exhibition in Cambridge and London.

The exhibits envelop a range of subjects including, in no particular order, a

geometrically correct form of the Japanese game Go, the "pulse" of DNA, the "perfect language," engraving techniques, mapping the sky with the Cosmic Background Explorer, artificial intelligence, and aboriginal art. These topics are imaginatively woven together with the aid of a stimulating book of about 30 essays from such distinguished contributors as Umberto Eco, Merrill Garnett, Lisa Jardine, Malcolm Longair, and Roy Porter.

The arrangement of the exhibition at five distinct sites in Cambridge and London gave it the air of a parallel distributed system almost akin to brains and computers. This unusual arrangement had welcome benefits. The specialized emphasis of each site enabled an integration of the exhibition through an assimilation of features that would have been easy to ignore had everything been housed together. The Fitzwilliam Museum focused on the binary

principle in art with a selection of prints spanning the centuries. These showed how (by scoring, etching, greasing, or plowing into a metal plate) lines, pits, or grease marks are made that will hold ink and print as black while untouched areas give white—the principle behind all intaglio printing. The binary opposites of indentation and surface can therefore, by varying the depth and width of indentation, produce marks of greater or lesser blackness. Artists have exploited this possibility to produce prints of infinite tonal variety, and it is appropriate that the main exhibition at Kettle's Yard begins with a print by Ludwig Von Siegen, the inventor of mezzotint.

Certain installations depended on dispersion across the sites for their impact. The hyper-realist artist and electronic engineer Manuel Franquelo placed 13 small circuit boards on 13 plinths in London, one of which generated a random question with the use of a pre-programmed vocabulary (for example, "Tell me who meditates?"). After a short pause, one of the other units randomly composes an answer based on the verb from the original question. After another short pause, all 13 units chorus the answer with each voice (seven male and six female) singing at a slightly different speed. This chorus is transmitted miles

away to one of the Cambridge venues. A different Cambridge site receives a Morse code version of the same message. Video cameras at both distant locations record the consternation of humans listening to the Morse code and the humor of those hearing the chorus. The humor is underscored by the reflection that the 19th-century invention of Morse code, with

its associated terse telegraphy, often led to alienation and deleterious distortions of meaning, results not unfamiliar to frequent users of electronic mail today. Another "distributed exhibit," Luc Steels's "Talking Heads Experiment," comprised a network of computers, cameras, and humans teaching each other new words to describe visual arrays of objects (*1*). The experiment il-

lustrates the dynamic changes in the lexicon that potentially exist in learning human and artificial languages.

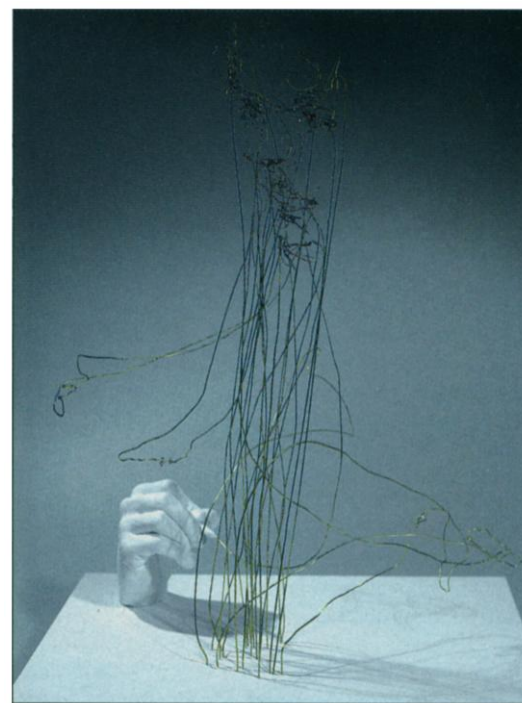
For me, the central theme of the exhibition was the miraculous mechanisms by which information is transformed across sensory modalities, for example, from the model to the artist's eye thence through the hand and to the subsequent drawing, painting, or sculpture. The various modalities have to communicate with one another. Sometimes they get blended in common

n01se
A Series of
Exhibitions About
Information and
Transformation
Adam Lowe and Simon
Schaffer, Curators

Kettle's Yard, Whipple Museum of the History of Science, Cambridge University Museum of Archaeology and Anthropology, Cambridge, 22 January to 26 March 2000. Fitzwilliam Museum, Cambridge, 18 January to 16 April. The Wellcome Trust's Two10 Gallery, London, 27 January to 19 May.

n01se
Universal Language,
Pattern Recognition,
Data Synaesthetics
Adam Lowe and Simon
Schaffer, Eds.

Kettle's Yard, Cambridge,
2000. Unpaged, £9.95.
ISBN 0-90-7074-78-2.



Trace of creative transformation. The movement in space of Humphrey Ocean's hand while drawing the portrait *Luke 2*.

perceptions, as in synaesthesia, that fusing of the senses by which rare individuals (such as the abstract artist Wassily Kandinsky) can hear colors or taste shapes. Although the psychologist Charles Myers (who founded the United Kingdom's first experimental psychology laboratory at Cambridge in 1912) studied cases of synaesthesia before World War I, the underlying mechanisms have yet to be elucidated. Cross-modal mapping of the senses has had several applications, including the development of Braille notation from the "tactile typograph" and the "tactile photography" practiced by the blind photographer Evgen Bavcar. For the *n01se* exhibition, Bavcar created an image that was carved with a digital router into a layered block of pigmented plaster.

The culmination of the repeated sensorimotor transformations displayed in the exhibit comes from a detailed study of the artist Humphrey Ocean. The movements of

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BOOKS: PHYSICS

Professor Newton's Principles

Chris Quigg

his eyes and hands during drawing were tracked by sensors (and video recorded) as he scanned and fixated on the model's face. The hand movements have been captured in a remarkable three-dimensional sculpture that makes one marvel how such a mapping could conceivably help to transform the face into a two-dimensional image. From research begun by Vernon Mountcastle and continued by many neuroscientists, we have known that the mechanisms for such apparently effortless transformations are likely to reside in the parietal cortex of the brain. Crucial to the analysis of Ocean's activities, however, are the periods of suspension of movement when the artist weighs the veracity of his perceptions; pauses and references to the model diminish as the construction of the representation gathers pace.

This special skill of artists is captured in a story of Picasso told by Françoise Gilot (an artist herself):

Picasso stood off, three or four yards from me, looking tense and remote. His eyes didn't leave me for a second. He didn't touch his drawing pad; he wasn't even holding a pencil. It seemed a very long time. Finally he said, "I see what to do. You can dress now. You won't have to pose again." When I went to get my clothes I saw I had been standing there just over an hour (2).

Contrasts between artists (including Ocean) and nonartists in mental processing have been found by John Gabrieli and associates at Stanford University. They used functional magnetic resonance imaging to quantify differences between the two groups in regional brain activity during drawing. The artists showed differences in temporal and frontal areas of the brain, which contrasted with the nonartists' greater dependence on visual areas. The expert knowledge implemented by their neural networks had evidently refined the ultimate process of turning noisy sensation into aesthetic image.

The comments above focus on those elements that find the greatest resonance with my own interests in cognitive neuroscience and art. But the scope and ramifications of *noise* could make someone reading several independent reviews incredulous that each has described one and the same thing. The exhibition and book both make us aware of exciting and creative cross-mappings among science, technology, and art.

References and Notes

1. One can follow or participate in the experiment online at <http://talking-heads.csl.sony.fr>.
2. F. Gilot and C. Lake, *Life With Picasso* (New York, McGraw Hill, 1964).
3. Thanks to R. Bush for advice on technical artistic matters.

An ant making its daily rounds was nearly run over by a centipede that streaked across its path. Awestruck by the larger arthropod's effortless grace and speedy motion on so many legs, the ant inquired, "Please tell me how you know when to move leg number 57 and when to move leg number 62." The centipede's face contorted in thought. Its mouth opened to speak, but no sound issued forth. Then its hundred legs began to convulse in chaotic motion; they became hopelessly entangled, and it fell in a confusion of twitching legs, never to walk again. Perhaps it is fear of the centipede's fate that discourages physicists from thinking too much about what they do.

Indiana University's eminent mathematical physicist Roger Newton harbors no such fears. On the contrary, he argues that time spent understanding "what lies behind the solutions to large problems tackled in the past" makes physicists better scientists—and better problem solvers. In *Thinking About Physics*, a fast-paced and challenging collection of essays, Newton appears as an opinionated yet approachable discussion leader. He exhorts the reader to "use my arguments as starting points for your own thinking." From the meaning of a theory to the nature of quantum-mechanical reality, Newton cuts a wide swath and sprinkles his analysis with provocations that make it hard to be a passive reader. Throughout the book, I found myself wanting to engage him in conversation—to ask, "Just what do you mean by that?" or to protest, "I don't see it quite that way."

Though he is an ardent believer in the power of mathematics as an instrument of thought, Newton takes issue with Galileo's contention that mathematics is the language of nature. "Nature," he writes, "just is; it speaks no language and follows no plan; language and plans are human additions." Mathematics is, however, "the only language capable of describing nature unambiguously." Newton opens a compact treatment of symmetries in physics with a clear statement of the modern view that symmetries "express themselves not in the world as we directly experience it, but in the underlying laws and theories." We seek, in other words, symmetries in the laws of nature and the equations that ex-

press them, not necessarily in the solutions.

Thoughtful discussions of the arrows of time and of the meaning of causality and probability in physical theory illuminate Newton's insightful assessment of the conflicts between quantum theory and everyday experience. "Many of the quantum paradoxes," he writes, "... have a linguistic nature, stemming from the use of the concepts of particles and waves, to which our everyday intuition and language seem to drive us, but the connotations of which, originating from the macroworld, are simply inappropriate to the microworld." He also provides a clear-headed analysis of recent experiments that rule in favor of the probabilistic predictions of quantum mechanics.

Newton argues forcefully that "at the most basic level, nature is best described in terms of the quantum field."

He disagrees with those who think in terms of particles and Feynman diagrams, in part because the cartoon picture of particles interacting through the exchange of a few quanta may in some situations be

uneconomical, incomplete, or even misleading. I am not sure that I recognize the battle lines here. Many of us slide effortlessly between particles and fields, according to the situation, without claiming that the dialect we choose more often is necessarily the more fundamental. A question of greater interest to me is where the essential information lies. I was disappointed that Newton chose not to explain the special nature of gauge invariance and the crucial role of the nonintegrable phase—not the potentials or the field strengths—in the gauge theories that govern the fundamental interactions.

The range of topics and allusions make *Thinking About Physics* a difficult book for an advanced undergraduate to read without encouragement and supervision. Teachers of undergraduates, aided by the useful index, will find many small nuggets of insight with which to enrich their problem-solving lectures. It would be very interesting to organize a graduate seminar around the book for students completing their course work. Practicing physicists will find the book a perceptive colleague's scan on the foundations of the way we work. They may also catch themselves talking back to Professor Newton—which just might be his aim.

Thinking About Physics

by Roger G. Newton

Princeton University Press, Princeton, NJ, 2000. 208 pp. \$24.95, £15.95. ISBN 0-691-00920-1.

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