

The New York Times

## Handle With Care



ANN CUTTING

By CORNELIA DEAN

Last year, a private company proposed "fertilizing" parts of the ocean with iron, in hopes of encouraging carbon-absorbing blooms of plankton. Meanwhile, researchers elsewhere are talking about injecting chemicals into the atmosphere, launching sun-reflecting mirrors into stationary orbit above the earth or taking other steps to reset the thermostat of a warming planet.

This technology might be useful, even life-saving. But it would inevitably

produce environmental effects impossible to predict and impossible to undo. So a growing number of experts say it is time for broad discussion of how and by whom it should be used, or if it should be tried at all.

Similar questions are being raised about nanotechnology, robotics and other powerful emerging technologies. There are even those who suggest humanity should collectively decide to turn away from some new technologies as inherently dangerous.

"The complexity of newly engineered

**'Geoengineering' might head off planetary disaster. But at what cost? And who gets to make the decisions?**

systems coupled with their potential impact on lives, the environment, etc., raise a set of ethical issues that engineers had not been thinking about," said William A. Wulf, a computer scientist who until last year headed the National Academy of Engineering. As one of his official last acts, he established the Center for Engineering, Ethics, and Society there.

Rachelle Hollander, a philosopher who directs the center, said the new technologies were so powerful that "our saving grace, our inability to affect

things at a planetary level, is being lost to us," as human-induced climate change is demonstrating.

Engineers, scientists, philosophers, ethicists and lawyers are taking up the issue in scholarly journals, online discussions and conferences in the United States and abroad. "It's a hot topic," said Ronald C. Arkin, a computer scientist at Georgia Tech who advises the Army on robot weapons. "We need at least to think about what we are doing

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THE PHILADELPHIA MUSEUM OF ART/ART RESOURCE

## While a Magician Works, The Mind Does the Tricks

By BENEDICT CAREY

A decent backyard magic show is often an exercise in deliberate chaos. Cards whipped through the air. Glasses crashing to the ground. Gasps, hand-waving, loud abracadabras. Something's bound to catch fire, too, if the performer is ambitious enough — or needs cover.

"Back in the early days, I always had a little smoke and fire, not only for misdirection but to emphasize that something magic had just happened," said The Great Raguzi, a magician based in Southern California who has performed professionally for more than 35 years, in venues around the world. "But as the magic and magician mature, you see that you don't need the bigger props." Eye-grabbing distractions — to mask

a palmed card or coin, say — are only the crudest ways to exploit brain processes that allow for more subtle manipulations, good magicians learn.

In a paper published last week in the

**Scientists hope magic can accelerate research into perception.**

journal Nature Reviews Neuroscience, a team of brain scientists and prominent magicians described how magic tricks, both simple and spectacular, take advantage of glitches in how the brain

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FINDINGS | John Tierney

## Let the Games Be Doped

Once upon a time, the lords of the Olympic Games believed that the only true champion was an amateur, a gentleman hobbyist untainted by commerce. Today they enforce a different ideal. The winners of the gold medals are supposed to be natural athletes, untainted by technology. After enough "scandals," the amateur myth eventually died of its own absurdity. The natural myth is still alive in Beijing, but it's becoming so far-fetched — and potentially dangerous — that some scientists and ethicists would like to abandon it, too.

What if we let athletes do whatever they wanted to excel?

Before you dismiss this notion, consider what we're stuck with today. The system is ostensibly designed to



VIKTOR KIDEN

create a level playing field, protect athletes' health and set an example for children, but it fails on all counts.

The journal Nature, in an editorial in the current issue, complains that "antidoping authorities have fostered a sporting culture of suspicion, secrecy and fear" by relying on unscientifically calibrated tests, like the unre-

liable test for synthetic testosterone that cost Floyd Landis his 2006 Tour de France victory. Even if the authorities manage to correct their tests, they can't possibly keep up with the accelerating advances in biology. Some athletes are already consider-

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JOHN W. M. BUSH AND MORRIS FLYNN

### Science

#### PORTA-BUBBLE

Water insects that carry their own external air supply.

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#### PAGING HARRY POTTER

Advances in light science could lead to an invisibility cloak.

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### Health

#### TOO MUCH INFORMATION

Well: In prostate screening, the results can mislead.

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#### PERSONAL HEALTH: DISEASE

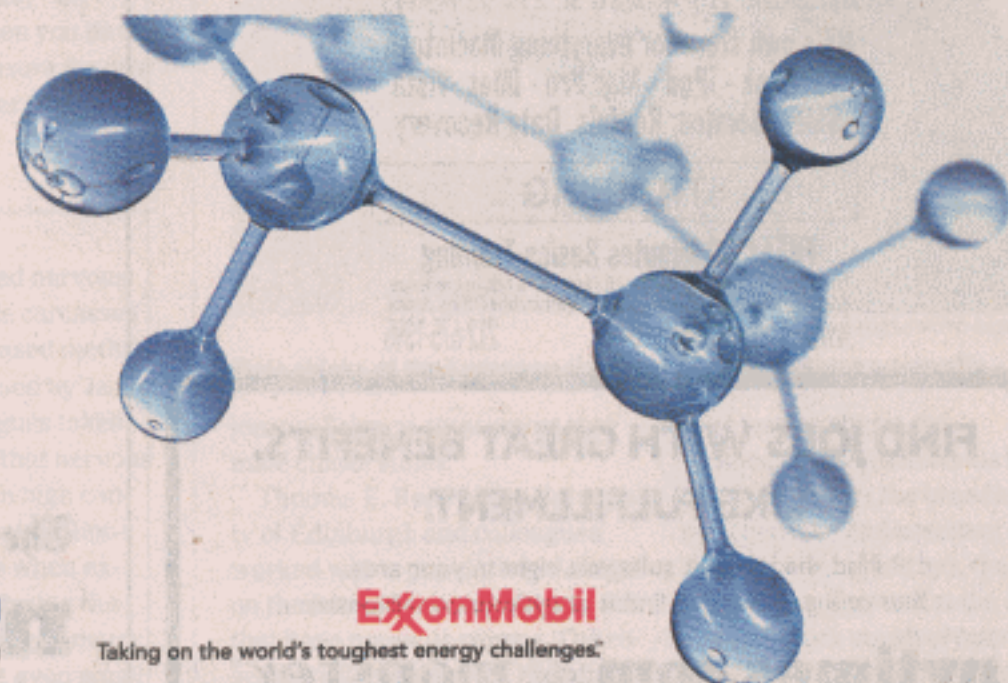
Tailored therapy offers hope on rheumatoid arthritis.

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# While a Magician Works, the Mind Does the Most Spectacular Tricks



ARCHIVE HOLDINGS

From First Science Page

constructs a model of the outside world from moment to moment, or what we think of as objective reality.

For the magicians, including The Great Tomsoni (John Thompson), Mac King, James Randi, and Teller of Penn and Teller, the collaboration provided scientific validation, as well as a few new ideas.

For the scientists, Susana Martinez-Conde and Stephen Macknik of the Barrow Neurological Institute in Phoenix, it raised hope that magic could accelerate research into perception. "Here's this art form going back perhaps to ancient Egypt, and basically the neuroscience community had been unaware" of its direct application to the study of percep-

tion, Dr. Martinez-Conde said.

"It's a marvelous paper," Michael Bach, a vision scientist at Freiburg University in Germany who was not involved in the work, said in an e-mail message. Magicians alter what the brain perceives by manipulating how it interprets scenes, Dr. Bach said, "and a distant goal of cognitive psychology would be to numerically predict this."

One theory of perception, for instance, holds that the brain builds representations of the world, moment to moment, using the senses to provide clues that are fleshed out into a mental picture based on experience and context. The brain uses neural tricks to do this: approximating, cutting corners, instantaneously and subconsciously choosing what to "see" and what to let

pass, neuroscientists say. Magic exposes the inseams, the neural stitching in the perceptual curtain.

Some simple magical illusions are due to relatively straightforward biological limitations. Consider spoon bending. Any 7-year-old can fool her younger brother by holding the neck of a spoon and rapidly tilting it back and forth, like a mini teeter-totter gone haywire. The spoon appears curved, because of cells in the visual cortex called end-stopped neurons, which perceive both motion and the boundaries of objects, the authors write. The end-stopped neurons respond differently from other motion-sensing cells, and this slight differential warps the estimation of where the edges of the spoon are.

The visual cortex is attentive to sud-

den changes in the environment, both when something new appears and when something disappears, Dr. Martinez-Conde said. A sudden disappearance causes what neuroscientists call an after-discharge: a ghostly image of the object lingers for a moment.

This illusion is behind a spectacular trick by the Great Tomsoni. The magician has an assistant appear on stage in a white dress and tells the audience he will magically change the color of her dress to red. He first does this by shining a red light on her, an obvious ploy that he turns into a joke. Then the red light flicks off, the house lights go on and the woman is unmistakably dressed in red. The secret: In the split-second after the red light goes off, the red image lingers in the audience's brains for about 100 milliseconds, covering the image of the woman. It's just enough time for the woman's white dress to be stripped away, revealing a red one underneath.

In a conference last summer, hosted by Dr. Martinez and Dr. Macknik, a Las Vegas pickpocket performer and co-author named Apollo Robbins took advantage of a similar effect on the sensory nerves on the wrist. He had a man in the audience come up on stage and, while bantering with him, swiped the man's wallet, watch and several other things. Just before slipping off the timepiece, Mr. Robbins clutched the man's wrist while doing a coin trick — thereby lowering the sensory threshold on the wrist. The paper, with links to video of Mr. Robbins' performance, is at <http://www.nature.com/nrn/journal/vaop/ncurrent/full/nrn2473.html>.

"That was really neat, and new to me," said Dr. Bach, who was in the audience. The grasp, he said, left "a sort of somatosensory afterimage, so that the loss of the watch stays subthreshold" in the victim. The visual cortex resolves clearly only what is at the center of vision; the periphery is blurred, and this is likely one reason that the eyes are always in motion, to gather snapshots to construct a wider, coherent picture.

A similar process holds for cognition. The brain focuses conscious attention on one thing at a time, at the expense of others, regardless of where the eyes are pointing. In imaging studies, neurosci-

entists have found evidence that the brain suppresses activity in surrounding visual areas when concentrating on a specific task. Thus preoccupied, the brain may not consciously register actions witnessed by the eyes.

Magicians exploit this property in a variety of ways. Jokes, stagecraft and drama can hold and direct thoughts and attention away from sleights of hand and other moves, performers say.

But small, apparently trivial movements can also mask maneuvers that produce breathtaking effects. In a telephone interview, Teller explained how a magician might get rid of a card palmed in his right hand, by quickly searching his pockets for a pencil. "I pat both pockets, find a pencil, reach out and hand it to someone, and the whole act becomes incidental; if the audience is made to read intention — getting the pencil, in this case — then that action

## A team of scientists and entertainers describe how the brain operates.

disappears, and no one remembers you put your hand in your pocket," the magician said. "You don't really see it, because it's not a figure anymore, it has become part of the background."

The magician's skill is in framing relevant maneuvers as trivial. When it's done poorly, Teller said, "the actions immediately become suspicious, and you instantly click that something's wrong."

David Blaine, a New York magician and performance artist, said he started doing magic at age 4 and quickly learned that he did not need any drama or special effects. "A strong and effective way to distract somebody is to directly engage the person," with eye contact or other interaction, Mr. Blaine said. "That can act on the subconscious like a subtle form of hypnosis."

Not that there's anything wrong with a dove, a plume of smoke or a burst of fire. As long as it doesn't break magic's unwritten code: First, do no harm. Frightening neighborhood parents, however, is allowed.