next year, many growers may switch back to non-GM varieties. For instance, the National Corn Growers Association, which unites a minority of U.S. corn growers and has taken a stance against the introduction of biotech, predicts a big backlash. Some farmers are already ordering their soybeans to plant in the spring, says Lynn Clarkson, a corn and soy trader in Serro Gordo, Illinois, because they're afraid that non-GM seeds will have run out by January, when they would normally order. They will do the same to avoid corn engineered to produce a natural pesticide, the *Bacillus thuringiensis* toxin, he says. Policy analyst Benbrook, too, predicts that sales of GM seeds will plunge for the first time next year.

The threat of falling sales has led some companies to rethink more than just their PR strategy. For years, they have resisted mandatory labeling of GM products, arguing that there was no scientific basis for concern, and that consumers might interpret the labels as indicating that the products are unsafe. Together with the U.S. government, the companies branded the European insistence on labeling a form of protectionism. The issue is on the agenda of the next ministerial meeting of the World Trade Organization, starting 29 November in Seattle.

But the tide may be turning. Novartis, for instance, doesn't object to mandatory labeling, a position that was once seen as maverick within the industry but is now gaining acceptance, says Willy De Greef, head of regulatory and government affairs at Novartis Seeds. Labeling, says De Greef, "is also a way to show confidence ... in the safety and quality of our products." And it may not be the consumer turnoff that many fear, he says. In the Netherlands, GM foods have carried the neutral phrase "produced with modern biotechnology" since 1997. "There were some jitters at first, but eventually sales have stabilized," De Greef says.

Within the U.S. government, too, there are signs that a compromise on the thorny issue may at least be up for discussion. "I have a sense that the consumers have spoken, and they say: 'We want the damned stuff labeled,' " said U.S. Undersecretary of State for Global Affairs Frank Loy at a recent meeting at the New York University School of Law, "so one ought to discuss labels."

But there's a catch: Farmers and traders will have to segregate their crops. And although that may work for small markets, it will pose problems for crops such as soy and corn, which are brought together in huge quantities and then shipped by rail or barge. Keeping GM and non-GM crops apart on a large scale, the BIO's Phillips says, would require huge investments in infrastructure. "The Europeans will have to pay for that," he adds.

Meanwhile, the industry is hoping that a new wave of GM products receives a warmer welcome. Most transgenic crops so far have made life easier for farmers and seed producers, but offer little to the consumer. A "second generation" of products in the pipeline may be better accepted. Some plants will lack allergenic proteins, for example, or have a healthier oil composition. They may also provide benefits for developing countries, such as the pro–vitamin A and iron-enriched rice produced earlier this year (*Science*, 13 August, p. 994).

The big question, however, is whether developing countries will carry out their own risk analysis or simply adopt the European angst, says Sheffield's Kinderlerer, who has acted as a biotechnology consultant to governments in Asia, Africa, and Latin America. Already, "people are saying, if Europe is scared, shouldn't we be?" he says. "That's worrying, because we don't really need the technology. They do." **–MARTIN ENSERINK**

ART AND SCIENCE

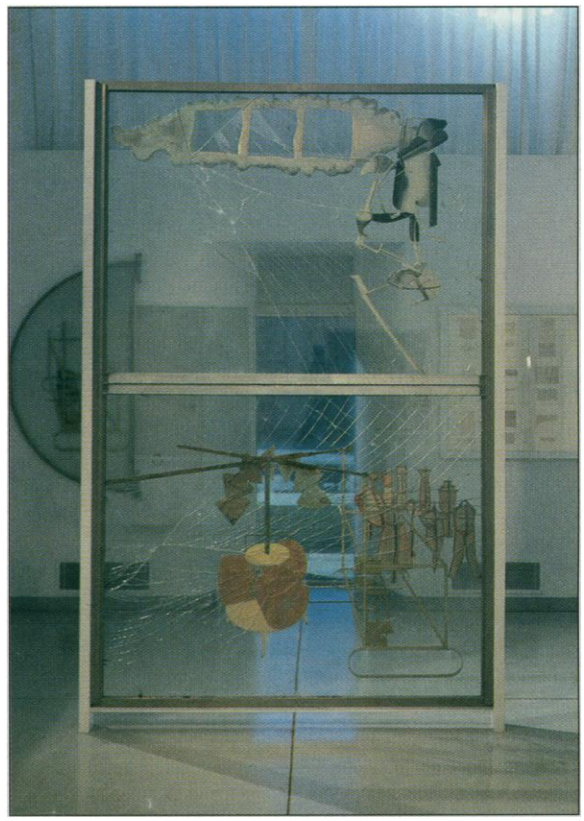
Duchamp and Poincaré Renew an Old Acquaintance

What did the groundbreaking modernist painter learn from the father of chaos? Art historians and mathematicians debate the question

It was not your usual scientific conference. Talks on algebraic topology took turns with passages from Mallarmé's poems. Lectures on Duchamp's Large Glass shared an auditorium with sessions on celestial mechanics. But that's what you get when mathematicians and historians of science lock horns with art historians and postmodern theorists, as they did at Harvard University, 5 to 7 November.

Some 200 scholars crossed higher-than-usual disciplinary walls to attend "Methods of Understanding in Art and Science: The Case of Duchamp and Poincaré," a conference organized by Rhonda Roland Shearer, a New York City–based artist, and her husband, Harvard biologist Stephen Jay Gould. (Gould is also the president of AAAS, which publishes *Science*.) The conference was a coming-out party of sorts for Shearer's recent findings—or flights of fancy, as skeptics see them—regarding the pioneering modern artist Marcel Duchamp and his take on the writings of the mathematician Henri Poincaré. Shearer and Gould, who co-authored a recent essay in *Science* (5 November, p. 1093) on the relationship of art and science, founded the Art Science Research Lab in their New York home to take a fresh look at Duchamp's oeuvre. With colleagues including Richard Brandt, a physicist at New York University (NYU), they have gathered evidence that Poincarean ideas lurk behind several of the artist's most famous works—and as a result, these works are not what they appear to be.

In a way, that's not surprising. Duchamp (1887–1968), widely regarded as the founder of modern art, loved to foil his



"The Bride Stripped Bare By Her Bachelors, Even." Also known as the Large Glass, it may reflect Poincaré's ideas about creativity.

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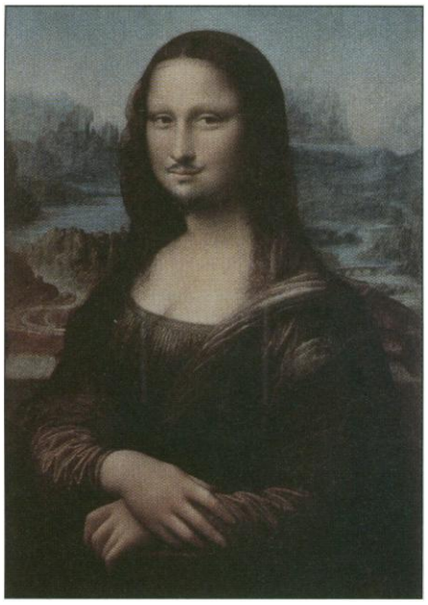


Was that she a he? A new analysis suggests Duchamp altered this postcard image of the Mona Lisa to resemble himself.

viewers' expectations. A work formally titled "The Bride Stripped Bare By Her Bachelors, Even," is actually what its nickname, the Large Glass, implies: a huge pane of glass. Rather, it's two panes, with designs painted on each. The top half, which Duchamp designated the bride, is dominated by a triptych of rough squares inside a dark cloud and a cascade of junk meticulously copied from one of Duchamp's earlier paintings. The bottom, "bachelor" half shows perspective drawings of several mechanical devices, including a chocolate grinder surmounted by an arc of conical sieves.

The Large Glass took up a large chunk of Duchamp's career, from 1915 to 1923. In 1934, he published the *Green Box*, a collection of cryptic notes and sketches pertaining to the Large Glass. But he is most famous for what he called ready-mades: ordinary, commercial objects such as a coat rack, snow shovel, bicycle wheel, and, most notoriously, a porcelain urinal, which Duchamp claimed became art when he selected them.

Shearer thinks Duchamp may have gotten the idea for his ready-mades from a surprising source: Poincaré (1854–1912). Poincaré is best known today for laying the mathematical foundations of chaos theory (more technically called nonlinear dynamics), in a prizewinning paper on celestial mechanics. But he was also widely known for popular essays on mathematics, science, and the mind. And, like many artists and writers in the early 20th century, Duchamp took a keen interest in such scientific ideas. References to Poincaré in the *Green Box* and elsewhere indicate that Duchamp was familiar with the mathematician's writings.

Shearer traces Duchamp's term "ready-made" (*tout fait*, in French) to Poincaré's italicized use of the same word in a famous essay on mathematical creativity. "[I]t never happens that unconscious work supplies *ready-made* the result of a lengthy calculation," Poincaré noted, but he argued that the unconscious plays a crucial role, as a ceaseless sifter of ideas. Shearer thinks the Large Glass can be viewed as a Poincarean creativity machine, with the ready-mades as ironic end products.

Poincaré also wrote about non-Euclidean and four-dimensional geometry, and Duchamp's notes indicate that these ideas intrigued him. He especially liked the notion of getting a three-dimensional perspective on four-dimensional objects, rather like the way a set of 2D representations, such as photographs taken from different angles, can be used to visualize 3D objects. Shearer thinks that these geometrical ideas influenced Duchamp's ready-mades—or, rather, his photographs of them, as most of the originals have been lost.

She and colleagues have analyzed these photographs and concluded that the objects shown involve tricks of perception and perspective. The bicycle wheel, for example, was mounted on a deceptively ordinary kitchen stool—in fact, they claim, one of the stool's legs pointed awkwardly inward and its rungs didn't connect. Moreover, the wheel was not attached at its center point, so that it would have wobbled as it spun. Similarly, the researchers found that a photograph of the four-hook coat rack shows each hook from a different perspective. Either Duchamp bent the hooks, or he doctored the photograph—or both. By combining the different perspectives, Duchamp is giving more information than a single perspective would provide, albeit in a way that isn't immediately obvious.

One of Duchamp's more playful ready-mades, a postcard reproduction of the Mona Lisa on which he drew a beard and mustache, is titled LHOOQ: Pronounced aloud in French, the letters sound like the sentence "She has a hot ass." Far from simply anointing an existing postcard, Shearer thinks, Duchamp created his own and even substituted his own face in the enigmatic portrait! She and NYU's Brandt have compared measurements of facial features on LHOOQ with those on other reproductions; their analysis exposes the Duchamp Lisa as a solid outlier.

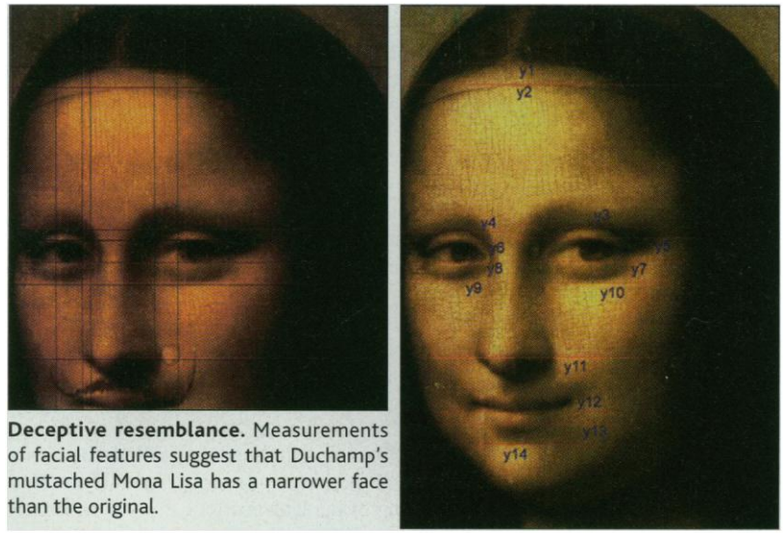
The ready-mades "are altered in much more extensive ways than he let on," Shearer concludes. No one's noticed before, she explains, only because interpretation trumps perception: "You see much more with the mind than you see with the eye."

Most Duchamp scholars remain dubious. "All of these photographs [of the ready-mades] are faded and blurred," notes Michael Taylor, curator of 20th century art at the Philadelphia Art Museum, which houses the Large Glass and other Duchampiana. "Rhonda's theories are theories, not facts," adds Dickram Tashjian, an art historian at the University of California, Irvine.

The stakes are high. By challenging the view of art as something created by the artist, Duchamp's ready-mades brought about a profound change in art, with repercussions that continue to this day. Shearer's theory that he fabricated the objects "turns Duchamp back into a craftsman," Taylor says.

But even her critics think Shearer has done something worthwhile. "She is making us look at Duchamp's works again," Taylor says. In particular, he thinks, her analyses will focus attention on the artist's use of photography. "Duchamp had more of an interest in the camera than we thought," Taylor says. And if she's right about the ready-mades, Tashjian says, "then we have a delicious ironic twist."

–BARRY CIPRA



Deceptive resemblance. Measurements of facial features suggest that Duchamp's mustached Mona Lisa has a narrower face than the original.

CREDIT: (TOP) CAMERAPHOTO/ART RESOURCE; SOURCE: (BOTTOM) RHONDA ROLAND SHEARER