

## Intermezzo: How Science Helped Resolve the World's Greatest Art Scandal

At a creativity meeting in Leiden in 2011, I met an American physicist named Richard Taylor who told me that he was actually an artist as well as a scientist. When I interviewed him, he mentioned his fascination with fractals, and we turned to the gripping story of the role he had played in the “world’s greatest art scandal.” This story is all about the importance of science in authenticating works of art, supplementing the methods of art historians, who use their training to ascertain a painting’s chain of ownership, or provenance, and connoisseurs who apply their intuition, honed by expertise in art history and a great deal of experience.

What role can science play? In using x-rays, infrared analysis, high-resolution multispectral cameras, analysis of digital images, carbon dating, paint pigment analysis, and so on to authenticate works of art, science and technology are tools, nothing more. Taylor’s case was something else. It employed mathematics to explore the authenticity of a work as well as to analyze why a work of art is aesthetic and how it was created by the artist. It offers a glimpse into the artist’s mind.

Born in the UK in 1961, Taylor was attracted to both art and science. A turning point occurred when he was nine, when he came across the catalogue for the Pollock exhibition at New York’s Museum of Modern Art in 1967, written by Francis V. O’Connor, the preeminent Pollock scholar. Taylor immediately became hooked on Pollock’s patterns.

When the time came to choose a career, Taylor chose his other passion, science. He found, however, that he could pursue his interest in patterns while studying processes such as the way electricity courses through electronic devices, like a river splitting again and again into tributaries. Then he came across fractals.

In 1977 the Polish-born mathematician, Benoît Mandelbrot, put together decades of research on patterns that repeat themselves no matter how many times they are magnified—a property mathematicians call self-similarity—and are built up of shapes of incredible complexity. Zooming in on one small part reveals that it is identical to the larger segments. He called these fractals because their dimensions need not be whole numbers. They can be fractions.

Fractals occur in nature. In a mature tree, the branches sprout smaller branches which end in even smaller branches, and so on. Although the self-similarity in a tree and its branches is not exact, it is statistically present—that is, close enough on average, as are the fractal properties of clouds, river networks, mountain ranges, coastlines, and electricity surging through electronic devices. Complex systems such as the nervous system and the blood and lung vasculature can be modeled, and better understood, as fractals.

Taylor studied fractals in the physics department at the University of New South Wales in Sydney, and meanwhile continued to paint. Then in 1994, the urge to pursue his love of art became irresistible and he took a sabbatical for a year to do a foundation course at Manchester School of Art, where he focused on art and photography.

At one point his group was sent to the Yorkshire moors for a week to draw. The weather turned stormy, however, which made it impossible to sketch the landscape. Then Taylor remembered a story about the French painter Yves Klein. In the late 1950s, he was ensconced in a café in Paris with his agent during a rainstorm when he remembered he was supposed to deliver a painting to a gallery in Toulouse. But he had no painting to deliver. He asked his agent to remind him of the subject. “Patterns in nature,” his agent suppos-

edly replied. "No problem," said Klein. A pioneer in performance art and minimalism, he tied a partially painted canvas to the top of his car and drove through the storm. Nature completed the painting and it sold for \$10,000.

So Taylor and his fellow students assembled a contraption out of fallen branches, part of which blew back and forth in the wind like a pendulum. This moved another part which held paint cans, which dripped a pattern determined by the wind's direction onto a canvas placed underneath it on the ground. When the storm forced them indoors, they left their apparatus to paint all night, driven by nature. The irregular pendulum movement produced patterns "similar to Pollock's work," Taylor recalls.

"Suddenly the secrets of Jackson Pollock seemed to fall into place for me. He must have adopted nature's rhythms when he painted." The next step was to use science to find out whether he could identify tangible traces of those rhythms in Pollock's artwork.

Pollock had a major alcohol problem and in 1938, when he was twenty-six, started seeing a Jungian analyst who encouraged him to express his unconscious through his painting. Meanwhile he was also studying Surrealism, inspired by its forays into the fantastic, and the works of Picasso, where he was impressed by the structure offered by Cubism. He settled into a style in which he applied daubs of paint, one layer at a time, using brushes or sticks.

Pollock's great idea was to involve his body in his painting. First he put the canvas on the floor, which gave him greater freedom of movement. Then he had an epiphany: why not pour paint directly from the can? Sometimes he used as many as fifteen clusters of pourings. The resulting "drip style," begun in the 1940s, was the embodiment of Action Painting and of the new art movement, Abstract Expressionism. Imitators popped up everywhere. But Pollock's paintings were not simply random splashes of paint. Even a cursory glance shows a periodicity, a rhythm, in their patterns. Beneath the rhythm there was something else that separated Pollock's paintings from even the most scrupulous imitators: fractals.

Soon after returning to Australia in 1995, Taylor established himself as an expert in the fractal analysis of systems ranging from nanoelectronics to the retina and solar cells. He also completed his master's degree in art history. His thesis was on Pollock, of course. The more he looked at Pollock's paintings, the more the paint splatterings seemed to resemble electricity flowing through electronic devices, with the telltale fractal property of self-similarity. Was this Pollock's fingerprint?

Taylor scanned Pollock's paintings into a computer, and then fitted a computer-generated mesh over them. No matter how much he decreased the mesh size—corresponding to higher magnifications—the patterns remained fractal, statistically self-similar, like the branches of a tree. Pollock had built up these fractal patterns unknowingly, of course, beginning with small islands of paint which he then connected. Taylor studied fourteen authenticated Pollock paintings and they all showed fractal patterns.

He also looked into the fractal dimensions of Pollock's paintings—the fractal dimension being a measure of how patterns fill space. A straight line has one dimension, while the completely filled space of a flat canvas has two. Depending on how filled the canvas is, the fractal dimension can take on values between one and two. The less sparsely filled the canvas, the lower the dimension. Pollock's early paintings have a fractal dimension of around 1.2, and later works vary from 1.3 to 1.5, giving smooth, somewhat sparse images, as in his 1950 painting *Autumn*. Taylor found that when Pollock altered the sequence in which he introduced colors, it changed the fractal dimension.

Some of Pollock's later paintings had a higher fractal dimension and were more complex, perhaps because he wished to “keep the viewer alert by engaging their eyes in a constant search through the dense structure of a high D [dimensional] pattern,” says Taylor. As one of Pollock's friends, Reuben Kadish, noted, “I think that one of the most important things about Pollock's work is that it isn't so much what you're looking at but what is happening to you,” which seems to back up Taylor's analysis.

Taylor—who is now professor of the extraordinary combination of physics, psychology, and art at the University of Oregon—believes that the human eye is a remarkable fractal detector, a reasonable assumption given that we make our way through the world largely by recognizing patterns, such as when individual components of a face—eyes, nose, mouth—instantaneously snap into place and we realize it’s someone we know, or when a master chess player sees not a mass of individual pieces on the board but the overall pattern. It also explains why there is close agreement between the eye of the art expert and Taylor’s computer analysis.

Why do people find Pollock’s paintings beautiful—that is, aesthetic? Taylor used skin conductance tests—measuring the conductivity of the skin using EEG (electroencephalography) and *fMRI* (functional magnetic resonance imaging)—to check neurological responses to psychological and physiological stimuli. He found that people were more at ease and also more attentive when looking at mid-range fractal patterns. So perhaps fractal analysis could reveal a regularity hidden within apparent randomness. This was what made Pollock’s paintings so pleasing.

Pollock once said, “There was a reviewer a while back who wrote that my pictures didn’t have any beginning or any end. He didn’t mean it as a compliment, but it was. It was a fine compliment.” He died in 1956, before either chaos theory or fractals were known.

So how did Pollock create fractal patterns? Taylor explored this question with a pendulum that deposited paint on a canvas as it swung, a sleeker version of the device he had used on the Yorkshire moors. This pendulum did not swing smoothly. It was driven by motors and swung chaotically this way and that, suddenly changing direction. Taylor studied the patterns it produced. “A striking visual similarity exists between the drip patterns of Pollock and those generated by a chaotic drip system,” he wrote excitedly.

A famous photograph shows Pollock at work, leaning way over a huge canvas with his wife, Lee Krasner, in the background. He looks in excellent physical shape, a graceful man. But in fact his alcoholism made him shaky and left him often trying to keep his balance,

especially while leaning. His medical records attest to his problems with balance. Researchers have found that when people try to keep their balance—tightrope walkers, for example—their hands trace out fractals. Taylor found that children aged five, just perfecting their balance, produced Pollock-like paintings. “To fake a Pollock one needs the same physiology as Pollock. It’s not easy to paint a Pollock,” Taylor concluded.

His scientific investigation pointed to a way to authenticate Pollocks. But perhaps it went even further. “Perhaps it may even be able to throw a narrow beam of light into those dim corners of the mind where great paintings exert their power.” Taylor had uncovered a far-reaching result of the interplay between art and science, one that could lead to a better understanding of creativity: we are born with structures in our mind capable of generating practically anything, including fractal patterns and complex mathematics; and our minds are constructed to see beauty in these, to appreciate and respond to them with pleasure.

IN 2006, POLLOCK’S *No. 5, 1948* sold at auction for \$140 million, at that time the highest price ever paid for a painting. It had better have been the real thing. Not surprisingly, threats of lawsuits to prevent experts publishing contrary opinions loomed.

The controversy that involved Taylor began to unfold in late 2002 when Alex Matter, a New York filmmaker, made what seemed to be one of the most exciting discoveries in recent art history. He found a cache of thirty-two paintings in Pollock’s familiar drip style that his father, Herbert Matter, had stored away. Herbert, a photographer and graphic designer, and his wife Mercedes, an artist, had lived near East Hampton, where Pollock held court from 1945 until he died in a car crash in 1956. They had been close friends of his. Two years after Pollock’s death, in 1958, Herbert had wrapped the paintings in brown paper and placed labels on them stating that they were produced in the 1940s and were acquired by “gift + purchase.” He did not, however, state that they were Pollocks. Some were on boards and all were much smaller than Pol-

lock's usual huge canvases. In 1978 he put them in a storage locker in Wainscott, New York, near East Hampton. Herbert died in 1984 and Mercedes in 2001.

Alex Matter contacted the Manhattan art dealer Mark Borghi. Borghi had been the victim of fraud before, but sensed that in this case the Pollocks were genuine. Their provenance—Matter's father's direct connection with Pollock—seemed gold-plated. Nevertheless, he wanted a second opinion. In late summer 2004, he consulted Ellen Landau, a professor of art history at Case Western University in Cleveland, Ohio, who had written several authoritative books on Pollock. She dropped everything and flew straight to New York to view the cache. "I was completely blown away—the scholarly thrill of a lifetime," she says. The style, the boards, the initials "J" and "P"—"there are too many things about them that are pure Jackson." Her authentication seemed conclusive.

The trouble began when another Pollock expert, Eugene V. Thaw, a veteran art dealer, disagreed, arguing that Pollock did not use the sort of boards in the Matter cache and that it would have been out of character for him to borrow materials from Mercedes Matter when he worked in the Matters' New York studio. Besides, they just didn't look right. He proposed that they had been done by Mercedes and her art students in order to study Pollock's technique. Francis V. O'Connor, the guru of Pollock studies, whose book had inspired Taylor as a boy, agreed with Thaw. O'Connor and Thaw had coedited the Pollock catalogue raisonné, the list of all known Pollock works.

Back in 1985, Lee Krasner, Pollock's wife, had created the Pollock-Krasner Foundation to fund promising artists. In those days there were Pollocks popping up everywhere and, in 1990, the foundation established the Pollock-Krasner Authentication Board to sort the wheat from the chaff. However, after the supplemental volume to the Pollock catalogue raisonné was completed in 1996, the foundation decided to disband the authentication committee. They had just successfully defended two lawsuits from owners who charged "restraint of trade" when their canvases were not authenticated,

claiming that nonauthentication adversely affected their value. Besides, they were fed up with the huge numbers of fake Pollocks, as well as with the people who bought them and then reapplied for authentication. The committee had investigated over seven hundred paintings and were exhausted.

Landau, Thaw, and O'Connor had been members of the authentication committee and had worked together in harmony. Now the situation changed dramatically. In light of the number of works in the Matter cache and the money involved—if authenticated, each painting would be worth upwards of a million dollars—Ronald Spencer, an attorney for the foundation, announced that the foundation would “rethink its involvement in authorship questions.” The problem was that the authentication board could not be reconvened because the members were at odds over the authentication issue at hand, which by now had gone public.

Sparks flew. Thaw said that Landau should have included him from the start and that if she had done so the whole dispute would have been avoided. “If Ellen Landau’s opinion prevails,” Thaw told the *New York Times*, “people will happily buy [the paintings] and they’ll go into museums and books, but not the ones that I have anything to do with.”

Landau replied that she had not been paid for her advice, though she would receive a fee for organizing a show to celebrate the fiftieth anniversary of Pollock’s death, which would feature the Matter paintings. She declined to reveal how much the fee would be. In a slap at Thaw and O'Connor, she insisted that scholarship and objectivity were her only goals. “Unlike the authors of the Pollock catalogue raisonné,” who bought and sold Pollocks, she said, “I am an art historian with an impeccable reputation, not an art dealer.”

Aware of Taylor’s fractal analysis of Pollock’s work, O'Connor urged the Pollock-Krasner Foundation to contact him discreetly and ask him to assess the cache. Taylor agreed and in June 2005 received scans of six paintings selected by O'Connor. Three had appeared on Alex Matter’s website and so were widely known, while the others were representative of the style in the entire cache. The

Pollock-Krasner Foundation, Taylor recalled, “made me sign a confidentiality agreement that I would not disclose the findings.” In fact, he concluded that the works did not exhibit the fractal structure typical of known Pollock works, thus casting serious doubt on their authenticity. Anticipating accusations of bribery, he was adamant that the foundation had paid only his research expenses.

The foundation called a meeting at their offices in New York, and Taylor met his intellectual hero, Francis O’Connor. All the participants acknowledged “the unprecedented nature of the meeting [in which] for the first time computers were playing a significant role in determining the fate of artworks.” All agreed that every clue as to authenticity had to be followed up. The foundation even hired detectives to check the history behind the discovery and whether it squared with Pollock’s life.

Then, in November 2005, Mark Borghi, the Manhattan art dealer contacted by Alex Matter, approached Taylor. He also wanted him to do a fractal analysis. This put Taylor in a bind. He couldn’t tell Borghi that he had already done one or what his results had been. In fact, by commissioning him to do another, Borghi’s request bypassed the confidentiality agreement Taylor had signed. Although the foundation agreed that he could do another analysis, Taylor felt it was unfair and requested them to release his original findings.

While the foundation ruminated and continued work on a comprehensive report, rumors surfaced that Ellen Landau’s team had new evidence of the cache’s veracity—specifically, a photograph of Pollock standing in front of one of the paintings that Taylor had said did not display a fractal signature. If so, it would prove that the painting was genuine. “Thus the PKF [Pollock-Krasner Foundation] decided it was ‘put up or shut up time,’” says Taylor, “and so announced my findings” to the *New York Times*, which published them on February 9, 2006.

Landau learned of Taylor’s results when she was interviewed by the reporter Randy Kennedy, who was writing the story. Livid, Landau criticized the foundation for not revealing them to her or to Alex Matter. “Secrecy,” she said, “impeded scholarly debate and

consensus.” She added that fractal analysis was a “very new and contested field in art authentication.” Yet just three months earlier, Landau had been happy for Borghi to request Taylor to do just such a fractal analysis, which suggested that she was unhappy with the results rather than unsure of the method. She stated that a more exhaustive investigation would appear in “a full-scale catalogue as soon as it [was] completed.”

Francis O’Connor commented that Taylor’s results had “reinforced his initial doubts after examining the paintings.” The tide was beginning to turn, although the foundation still said it was awaiting further research and the moment when all the experts reached a consensus.

There were criticisms of Taylor’s work. One Pollock scholar claimed that Taylor’s analysis was inconclusive since he had examined only six paintings. Taylor agreed. “But this was not an ideal world. The story was unfolding in the international press at a rapid speed. I was asked to analyze six paintings in three weeks. My team had to work around the clock (literally).” Reputations were at stake—Taylor’s and, even more, Landau’s. But when Taylor phoned the foundation, a lawyer there broke the news that some of the cache had already been sold to a New York art dealer and “you’ve just lost them \$40 million.” The foundation warned Taylor to expect an all-out assault.

The only expert that Landau and her group could come up with was a physics graduate student from her own university. In an interview with the *New York Times*, the student, Katherine Jones-Smith, stated categorically that Pollock’s paintings were not fractal. Taylor recalls at this point picking up the phone in his office to hear Mandelbrot’s voice. “Oh my God. What have I done wrong?” was his first thought. In fact, Mandelbrot had called to offer his support. He was delighted to find another case in which “mathematics had an incredible link with physicality.”

Jones-Smith, along with a senior colleague, Harsh Mathur, published their evidence in the journal *Nature* on November 30, 2006. Landau was triumphant. “I am pleased they have successfully

refuted Richard Taylor's thesis. . . . Irrespective of whatever determination is ultimately made on the authenticity of the recently found Matter paintings, fractal analysis should not be considered a foolproof technique for authenticating works by Pollock. The fact that Taylor has refused to fully share his testing criteria casts further doubt on the credibility of his claims."

In fact, Taylor had published his response alongside the article by Jones-Smith and Mathur. Jones-Smith and Mathur claimed that Taylor had not used a small enough mesh to prove conclusively that he was dealing with fractals. Not so, he replied. He had employed the guidelines used by all fractal researchers to examine physical systems—which, unlike mathematical curves, are not fractal "all the way down"—and had worked according to the concept of limited-range fractals, that is, of a system displaying fractal patterns statistically, like a tree. If Jones-Smith and Mathur's demands were met, he added, half the published papers on fractals would have to be dismissed.

Jones-Smith and Mathur offered a childlike doodle of stars and claimed that it showed the same fractal patterns that Taylor had found in Pollock paintings. But Taylor's analysis of similar star patterns found them to be, in fact, not fractal. As another fractal expert, Lazaros Gallos, put it, "What [Jones-Smith and Mathur] have done is a simple trick. This is bad science about fractals." In addition, Taylor says, his fractal analysis was purpose-built specifically for Pollock paintings, not star patterns. "This is like taking an analysis of elephant ears and applying it mindlessly to a giraffe!"

So why was Jones-Smith and Mathur's simple-minded analysis published in the first place? Referees had recommended against publication, says Taylor, but "*Nature* liked controversy." As the physicist Wolfgang Pauli would have said of their work, "Why, that's not even wrong."

An exhibition was being planned for the fiftieth anniversary of Pollock's death in his hometown of East Hampton in 2006, to feature the Matter cache. Matter insisted that the paintings be displayed as Pollocks, which would thereby authenticate them. Aware

of the controversy, Ruth Appelhof, the director of Guild Hall, where the show was to be held, refused and the exhibition was canceled.

The air was thick with innuendos, promises of new evidence in support of the cache, and rumors of lawsuits. All this came to light in a series of emails published in the *Cleveland Plain Dealer*. The emails were between Landau, Borghi, Albert Albano, the director of the Intermuseum Conservation Association in Cleveland and a former conservator at the Museum of Modern Art, Robin Zucker, Matter's publicist, and James Martin, a forensic scientist, and had been sent between November 2005 and January 2007. Steven Litt, the paper's art critic, had been following the Matter story closely. To begin with, he had intended to write about the controversy from the viewpoint of Ellen Landau, who, being a professor at Case Western University, was a local hero. Litt had no reason to doubt her assessment, given her high position in the art world. But then Thaw's opposition surfaced, followed by O'Connor's, and he "began aggressively pursuing the story."

In November 2005, not long after declaring the Pollocks genuine and unbeknownst to the foundation or to Taylor, Landau had asked Albano to recommend an expert to cross-check a pigment analysis of three of the paintings which was already under way at the Harvard University Art Museums, for no charge. Albano recommended James Martin, founder of Orion Analytical in Williamstown, Massachusetts. Orion's website states: "Orion uses microscopy, spectroscopy, and scientific imaging to investigate the structure and chemical composition of materials found in more than 4000 years of cultural property, forensic evidence, and manufactured goods—from ancient Egyptian artifacts to printed circuit boards. We consult on materials at issue in authenticity studies and insurance claims, and serve as consulting or testifying expert in civil and criminal proceedings." Mark Borghi, the gallery owner, hired Martin in December 2005, unaware of Taylor's results. Martin got down to work. After a month, 350 extensive tests revealed that twenty-three of the purported Pollocks contained pigments and resins not available in Pollock's lifetime. Furthermore, in

some of the paintings Pollock's initials, "JP," appeared on top of the modern pigments.

Matter admitted that the paintings had been in poor condition and that in 2003 and 2004 he had had them heavily restored, rather than having them documented immediately by an art museum or materials analyst. It was a decision he now regretted. But the restoration merely complicated Martin's analysis. He was able to use sophisticated state-of-the-art microscopy to search beneath the surface to the original pigments.

Albano tried to think of ways that Pollock could have come to use such materials. One of his suggestions concerned some words Herbert Matter had written on the brown paper wrapping: "Robi paints." Robi was the nickname of Robert Rebetez, a Basel art store owner and Herbert Matter's brother-in-law. There were a lot of chemical firms in Basel, so perhaps he had stocked unusual pigments, not yet patented, that Pollock might have used. In February 2006, Albano reported his thoughts to Landau with the comment, "Hang in there. No one's dead yet!" Landau took them on board, continuing to give high-profile interviews, insisting unequivocally that she was convinced "these are Pollocks." But a month later Albano gave up his hypothesis. He was now convinced that attribution could not be maintained.

At the time, Landau was planning another exhibition of the Matter cache at the McMullen Museum of Art at Boston College, to open in September 2007. In an email dated September 5, 2006, the gallery owner Borghi informed Albano that "Jamie's [James Martin's] research [was] going to lead to the fact that the works were produced after Pollock's death." Borghi recommended canceling the exhibition as "a strategy for a graceful exit by Ellen [Landau]." Robin Zucker, the publicist working for Matter on the planned exhibition at the McMullen Museum, disagreed. In an email to Landau, he claimed new evidence had come to light that contradicted Martin's early findings.

Landau was delighted. She told Zucker to ignore her statements about giving up. "Despite the paint analysis," she wrote to Zucker, there was a great deal of "documentary and circumstantial evi-

dence” that linked “these paintings to Pollock’s relationship with the Matters.”

In reply, Zucker emailed that Alex Matter was “troubled by both Martin’s initial findings and Taylor’s subsequent fractal support.” This was not a problem, however, because he had “learned that fractal analysis is invalid, and that Martin’s report still leaves questions.” In fact, of course, Taylor had already dealt with the fractal criticism and Martin’s results were not “initial” but completed. As circumstantial evidence for the cache’s veracity, Matter pointed to the “personal and artistic integrity of his parents,” meaning they would not have attempted fraud.

Jeremy Epstein, the lawyer whom Matter had hired after the cancellation of the 2006 show in East Hampton, had also claimed that fractal analysis was “dubious and unproven as a way to analyze paintings,” and added that soon-to-be-released “circumstantial evidence” was strongly on the side of Landau and her backers.

In October 2006, Martin presented his report and all the supporting data to Borghi and Landau but remained silent about what he had found, fearing a lawsuit by Matter. Epstein denied threatening Martin. But in an interview in February 2007, Matter mentioned that the possibility of a lawsuit was “very negotiable.” He told the *Cleveland Plain Dealer* that he would release Martin’s report when the exhibition at the McMullen Museum of Art opened, because it was as yet unfinished, though he left unanswered the question of why it was as yet unfinished.

As for the bombshells that were supposed to vindicate Landau and her team, neither the photograph of Pollock standing next to one of Matter’s cache nor the “circumstantial evidence” mentioned by Zucker and Epstein ever materialized. In January 2007, the team at Harvard came to the same conclusion as Martin had—that the pigments were modern.

Landau soldiered on and assembled a show with the title “Pollock Matters” at the McMullen Museum of Art to run from September 1, 2007, through December 9, 2007. Landau’s new strategy was to focus on the relationship between Pollock and Herbert Matter rather

than on the newly discovered works. The disputed paintings were exhibited separately without attribution and the publicity blurb made no mention of any controversy. The catalogue mentioned the Harvard University analysis, but only in passing. In reply to the Harvard team, Landau claimed that more extensive investigation might be able to prove that Pollock could have used materials not yet patented or commercially available. She alluded to “still other avenues of exploration,” referring to the “Robi paints” that Pollock may have obtained from Robert Rebetez. In fact, the Harvard team had learned from one of Robi’s daughters that “neither she nor her sister recalled paints being sent to relatives in the U.S. and their father’s store stocked only standard brands of artist’s paints.” In any case, Landau stated, the science of dating pigments “is not as hard and fast as is often assumed.” Eyeballing or “cold canvassing” sufficed for her.

Landau also mentioned a fingerprint found on a paint can in Pollock’s studio which matched one on a painting in the Matter cache. This had been mentioned in an article by Paul Biro, a forensic art expert who examines paintings for the artist’s fingerprints. He had suggested that this could be evidence for the authenticity of the Matter cache.

Martin did not contribute to the catalogue even though he had been invited by the McMullen to do so and had done the most extensive analysis, and despite the fact that a press release by the McMullen’s director, Nancy Netzer, stated that the exhibition would make available all known evidence regarding the attribution of the Matter cache. In an email to the *Cleveland Plain Dealer*, Netzer explained that Martin needed permission from Borghi and Matter to publish his results, as it was they who had hired him to do the analysis. But along with their permission came a heavy-handed agreement, as Martin’s attorney, Stanley Parese, explained to the paper. The agreement drawn up by Epstein, Matter’s lawyer, prohibited Martin from speaking about his findings before or after the publication of the catalogue. According to Martin’s original contract he was free to go public with his analysis, but he did not do so for fear of a law-

suit. What Epstein proposed would have relegated Martin's work to obscurity.

Parese continued, "As a scientist and a scholar, Martin was not willing to have the owners of the paintings [including the New York art dealer who had recently purchased several of them] dictate the terms under which he would participate in a scholarly publication." One of Martin's collaborators on the authentication work told the *Cleveland Plain Dealer* that he was appalled that the McMullen would stand by and permit a scientist to be silenced. Richard Newman, head of scientific research at the Museum of Fine Arts, Boston, and one of the contributors to the catalogue, refused to be silenced and in his article mentioned Martin's work "which has not been published," citing Martin's report filed at Orion which scholars could consult and study. He did not, however, mention Martin's conclusion.

Landau mentioned Richard Taylor's fractal analysis and then dismissed it, saying it had been shown by Jones-Smith to be "demonstrably flawed." There was no mention of Taylor's rebuttal.

At this point, Jones-Smith and Mathur teamed up with Jones-Smith's PhD supervisor, the astrophysicist Lawrence Krauss, to produce what they claimed to be a more precise critique of Taylor's fractal analysis. In the October 2007 issue, *Scientific American* triumphantly announced their results, which was strange as their paper had merely been submitted for publication to the prestigious physics journal *Physical Review Letters* and not yet refereed. Despite this, they had gone ahead and released their results to *Scientific American*. This time, instead of dealing with star pattern doodles, they analyzed three authenticated Pollocks and claimed to find no evidence of fractal patterns, contradicting Taylor's hypothesis that fractal patterns were Pollock's signature.

Hany Farid, a computer scientist at Dartmouth College who had been following the controversy, told *Scientific American* there were flaws in their results. "I think they took a fairly simplistic way of separating those colors," he said, which skewed their results away from the verification of fractal patterns in the Pollocks they analyzed.

Taylor explains that their color separation technique, separating out Pollock's layers of poured paint, was simply too primitive to detect fractals, while his own was highly sophisticated and complex, far exceeding the techniques that the Case Western scientists had at their disposal. In the end, their detailed article was rejected by *Physical Review Letters*. Both the author of the *Scientific American* article and the magazine itself were "rightly embarrassed," Taylor recalls.

The article in *Scientific American* includes an image of a drip painting with a fractal signature that was not Pollock's. This suggested, wrote the author, that fractal patterns are "no reliable way to distinguish a Pollock." In fact, Taylor had always insisted that fractal analysis had to be supplemented with other analyses, such as of paint pigments and style, to identify Pollock's hand. In the end, the concluding factor had to be that the picture looked like a Pollock.

The situation had reached flash point. On September 28, 2007, a symposium was convened to decide the fate of the Matter cache. Sponsored by the International Foundation for Art Research, whose brief was to look into issues of attribution and authenticity of works of art, it was held at the National Academy of Design in New York. The symposium's title was simply, "Are They Pollocks?" The subtitle is significant—"What Science Tells Us About the Matter Paintings"—because in the end it was science that decided the issue.

Francis O'Connor recalls, "The entire art world was present at the meeting. I have never before or since seen such a gathering of everybody who matters." Three major players were absent: Matter, Richard Taylor, who was in New Zealand, and Landau, who "graciously declined" the invitation. The three speakers were Pepe Karmel, chair of the art history department at New York University and a co-curator of the 1998 Pollock retrospective at the Museum of Modern Art, Richard Newman, head of scientific research at the Museum of Fine Arts, Boston, and James Martin of Orion, who had carried out the pigment analysis.

Karmel gave an in-depth formal analysis, comparing the Pollock cache with authenticated Pollocks in terms of style and paint

application. He concluded that the works were probably experimental paintings by Herbert or Mercedes Matter done in the style of Pollock, as many artists were doing in the 1950s. This showed how great Pollock's influence had been and how it had pointed to new possibilities. "These pictures are not a new bunch of Pollocks," he concluded.

Newman's stance differed from the position he had taken in his article for the catalogue for the McMullen Museum exhibition. He emphasized the presence in the Matter cache of paint pigments that were not available during Pollock's lifetime and reminded his listeners that even the appearance of material available to Pollock on paintings in the Matter cache "does not mean that Pollock created the painting." Connoisseurship—the application of aesthetic principles and the expert eye—was also needed.

Martin, no longer relegated to a footnote, gave a virtuoso performance, stating firmly that several of the pigments on the painting had not been produced until 1977, that the boards were manufactured in the 1970s, and that the initials "JP" appear on top of paint that was definitely not available to Pollock. Martin concluded that these findings, in conjunction with the statements of the other two speakers, "are patently *inconsistent* with the claimed attributes of the Matter Paintings as objects that were created by 1949 or, indeed, as objects that were created prior to Jackson Pollock's death in 1956."

Martin had also had the fingerprints on some of the paintings investigated by two qualified law enforcement fingerprint examiners, who concluded that there was insufficient detail for an identification. He had even contacted officials at the federal, state, and local level and found no known samples of Pollock's fingerprints. It seems that Pollock had never been fingerprinted. Martin concluded that perhaps the fingerprints on the paintings were Pollock's, or perhaps they belonged to others in his studio, such as Krasner or Herbert Matter.

For Karmel it was pigment analysis that had decided the issue, not fractals, which he dismissed as a "red herring." (In this he mis-

understood fractals, defining a fractal pattern as possessing self-similarity at any magnification, all the way down. But this refers only to mathematical patterns, not patterns in nature such as trees, craggy mountain ranges, and Pollock's paintings.) What if the pigment analyses had turned out to be inconclusive? Surely in that case fractals would have been given added weight by art historians. They weren't such a red herring after all. Taylor continues to be called upon for his advice on Pollocks and reports that his "fractal analysis technique has a 100% record."

O'Connor tells me that he "can still see the expression on the face of the dealer who was revealed to be their owner, surrounded by lawyer types, fuming as he left. There never was any litigation, the evidence was overwhelming." The dealer had bought the paintings from the Mark Borghi Gallery.

Epstein, Matter's lawyer, insisted on having the final word. In an interview in the *East Hampton Star*, he questioned Martin's professional reputation, claiming that Martin had not completed his research, had destroyed data, and demanded extra payment for redoing work he had destroyed. Martin's response was that Epstein's comments were "patently wrong," but that he welcomed scholarly debate. He continued, "given the statements attributed to Mr. Epstein, it is no mystery why very few experts are willing to speak publicly on matters related to authenticity of fine art and other cultural property."

It was Epstein's remarks that prompted Albano of the Intermuseum Conservation Association in Cleveland to release the whole sequence of emails to the *Cleveland Plain Dealer*. "My concern is that the credibility of a highly regarded and intelligent colleague is being impugned," he wrote. He went on to assert that Martin's results were "irrefutable," had been corroborated by other laboratories, and had to be taken with the "utmost seriousness." The *Cleveland Plain Dealer* reported a survey of pigment scientists and paint industry executives all stating that the possibility that Pollock could have used the materials in the paintings "ranges from unlikely to virtually impossible." Litt concluded that the emails Albano passed

to him “underscore the central importance of scientific evidence” in rendering it “extremely improbable” that the Matter cache were Pollocks.

In 2010, Ellen Landau removed the paragraph claiming she had authenticated the Matter cache from her biography on the Case Western University website.

Some mysteries remain. If Herbert Matter wrapped the paintings up in 1958, how can it be that some of the paint was not produced until 1977, as Martin said? Why did Herbert Matter place the cache in a storage locker in 1978, twenty years after he had wrapped them up in brown paper? 1978 was the year that the Pollock catalogue raisonné appeared, edited by Francis O’Connor and Eugene Thaw. Why didn’t Herbert Matter contact the editors so that they could add the paintings to the catalogue, instead of putting them into storage? Did someone open the locker before 2002 and tamper with the contents, and if so, who? Who put the initials “JP” on the paintings? And were they done by Mercedes Matter and her students in the style of Pollock, which remains the most likely explanation?

The Matter paintings are currently in limbo, whereabouts unknown.

Obviously Pollock didn’t discover fractals. Rather, he created patterns that he instinctively found to be beautiful, and Taylor later established that this was for the very reason that they were fractals. Fractals are all around us and the eye is an excellent detector, all the more so in that our daily movements frequently involve analyzing patterns. As Taylor has noted, this was behind O’Connor’s uncanny intuition as to what was a real Pollock. In this way fractal analysis goes way beyond matters of authentication and is far from being merely a red herring.

In the backyard of Pollock’s house in East Hampton there are trees with branches sprouting more branches, like a river dividing into rivulets. Perhaps Pollock stared at them, wondering whether

they contained a deeper structure, which would come to be called self-similarity. Pollock attempted to represent these deeper structures in the most aesthetic way possible by unknowingly adjusting the fractal dimension (it is around 1.3) and cropping his painting by removing outer regions where fractal quality deteriorated.

The Matter matter was a monumental clash between art, science, and the art world. It was precipitated when the eyeball judgment of one eminent art historian was called into question by connoisseurs whose own eyeball judgment differed. Two of the “legs” of artistic assessment were at odds: art history and connoisseurship; art historians with their focus on provenance couldn’t tell a fake Pollock from a real one. The third leg, science, entered in the form of pigment analysis and, for the first time, fractal analysis. In the end pigment analysis decided the issue, but fractal analysis played its part in “identifying the artist’s ‘hand’ rather than simply the materials they used,” as Taylor put it. It also emphasizes the inherent distrust of the art world for scientific methods that might undermine the monopoly of connoisseurs and art historians.

An important spin-off, one that goes far beyond the authentication of Pollocks, is the realization that, as Richard Taylor puts it so well, the study of fractals and even science itself could perhaps “throw a narrow beam of light into those dim corners of the mind where great paintings exert their power.”