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# *Remaking the X-Ray as an Instrument of Authentication*

Authentication in Art Congress 2014
The Hague, 7-9 May 2014[1]

Thanks very much Martin, and thanks to Milko and our organizers and hosts today.

With its capacity to plumb the depths of a painting and, like a geologist's stratigraphic section, to reveal information about the painting's inner material condition and history, the X-ray is a valuable tool of connoisseurship emblematic of the additional dimensions that the application of technology can contribute to conservation, authentication and attribution.

Like the many other tools and approaches detailed on the posters outside and that we'll hear about over the coming two days, the X-ray is often cast in opposition to aesthetic judgment and to the connoisseur. Science to art.

The X-ray and its cousins have alternately been described as reductive intruders to a practice that demands exquisite sensitivity to holistic effects or, on the other hand, as enlightened antidotes to the fuzzy thinking of traditional connoisseurship. At best, discussions of technical approaches to the study of paintings cast science and art as strange bedfellows, as in a quotation from a curator describing a technical approach to Renoir:

> It's so weird. You think you know an artist, and then science tells something different about him.[2]

We are familiar with this story from contemporary controversies, of course, but it was all the more true during the early 20th century: a period during which discipline builders were drawing and questioning the boundaries of art connoisseurship, art history, and even the sciences themselves (*Slide 1*).

These fields – art connoisseurship, art history, and the sciences – had radically different training regimes and made competing claims to expertise in aesthetic and technical approaches alike. Both were also vulnerable to accusations of inconsistency in their

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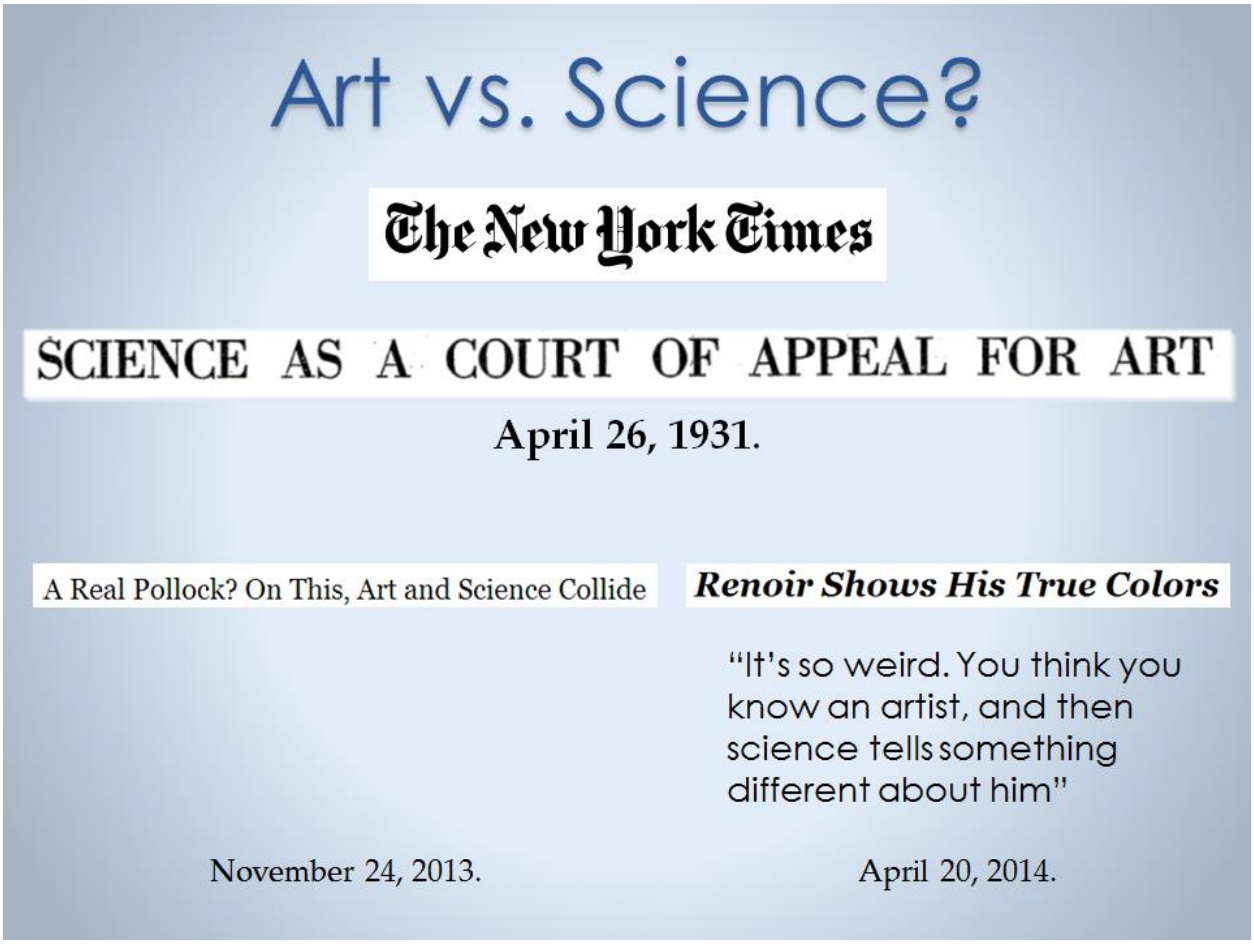
[1] This is an edited transcript of a talk delivered on 7 May 2014 at the Authentication in Art Congress. Thanks to Milko den Leeuw and Oliver Spapens for organizing this Congress and arranging for papers presented there to be made available.
[2] Kenneth Chang, "Renoir Shows His True Colors," *The New York Times*, April 20, 2014, http://www.nytimes.com/2014/04/22/science/renoir-shows-his-true-colors.html.

judgments by opportunistic critics or skeptical outsiders, like Judge Black, as we just heard from John.




**Slide 1**

Viewed in this way, the current state of affairs in our field is perhaps unsurprising. Of course we're in a reprehensible state. The conflict between art and science in a field like authentication is radically overdetermined by the great divergences in approaches taken by specialists in different disciplines. But even as the X-ray played a role in a conflict between art and science, it did, in fact, become an accepted tool for the study of paintings.

This is the puzzle that I'm going to address today. I'm not going to focus on explaining why disputes have occasionally flared up over the use of the X-ray, but rather on trying to understand how in the world anyone came to agree upon a role for the X-ray in the art world, and then in art connoisseurship, in the first place. In doing so for this quite emblematic tool of technical art criticism, I hope to present an approach that might help us understand why other technical approaches have or have not managed to spread, and also to shed further light on some of the challenges of standardization in this area.

Now, this is a problem that historians of science and technology have studied as well. It turns out that, just as you can't pick up an X-ray from a physicist's lab, drop it into a museum, and put it to work unproblematically, so too, it takes a lot of work to translate a scientific instrument from one scientific setting into another discipline of the sciences.

An example of this is the use of spectroscopic techniques in chemical analysis. We heard a wonderful description of Morelli's contempt for the absurdity of "chemical analysis that is done by eye alone."[3] In fact, for many chemists in the early 20th century that's just what spectroscopic techniques were. Spectroscopy took them away from their beakers and their reactions and gave them a sheet of paper printed out by a machine to analyze: a very alien sort of experience to them.

Now, there are a couple ways in which historians of science and technology have dealt with this process of the transplantation of instruments. **First,** on the level of the artifact, historians of technology Bernward Joerges and Terry Shinn have described how a local technical practice becomes a scientific instrument used across different fields as a process of *disembedding* and *re-embedding*.[4]

Both disembedding and re-embedding involve specific skills. Disembedding is the process of taking a local technical practice, a single lab setup, and making it into a generic instrument. This is the kind of expertise that's developed by instrument manufacturers. The work of re-embedding involves the set of practices necessary to refashion such a generic instrument to fit a new context, the assumptions and the experience of new users. We will mostly be discussing the latter practice today.

**Second,** on the level of people, historian of science Carsten Reinhardt has focused on the role of the people he calls "method makers."[5] Method makes are mediators with one foot in two different scientific cultures. They come up with ways of making an instrument drawn from one field legible and trustworthy in a field whose practitioners have a very different kind of training, rely on different standards of evidence, different modes of interpretation and different laboratory routines (*Slide 2*).

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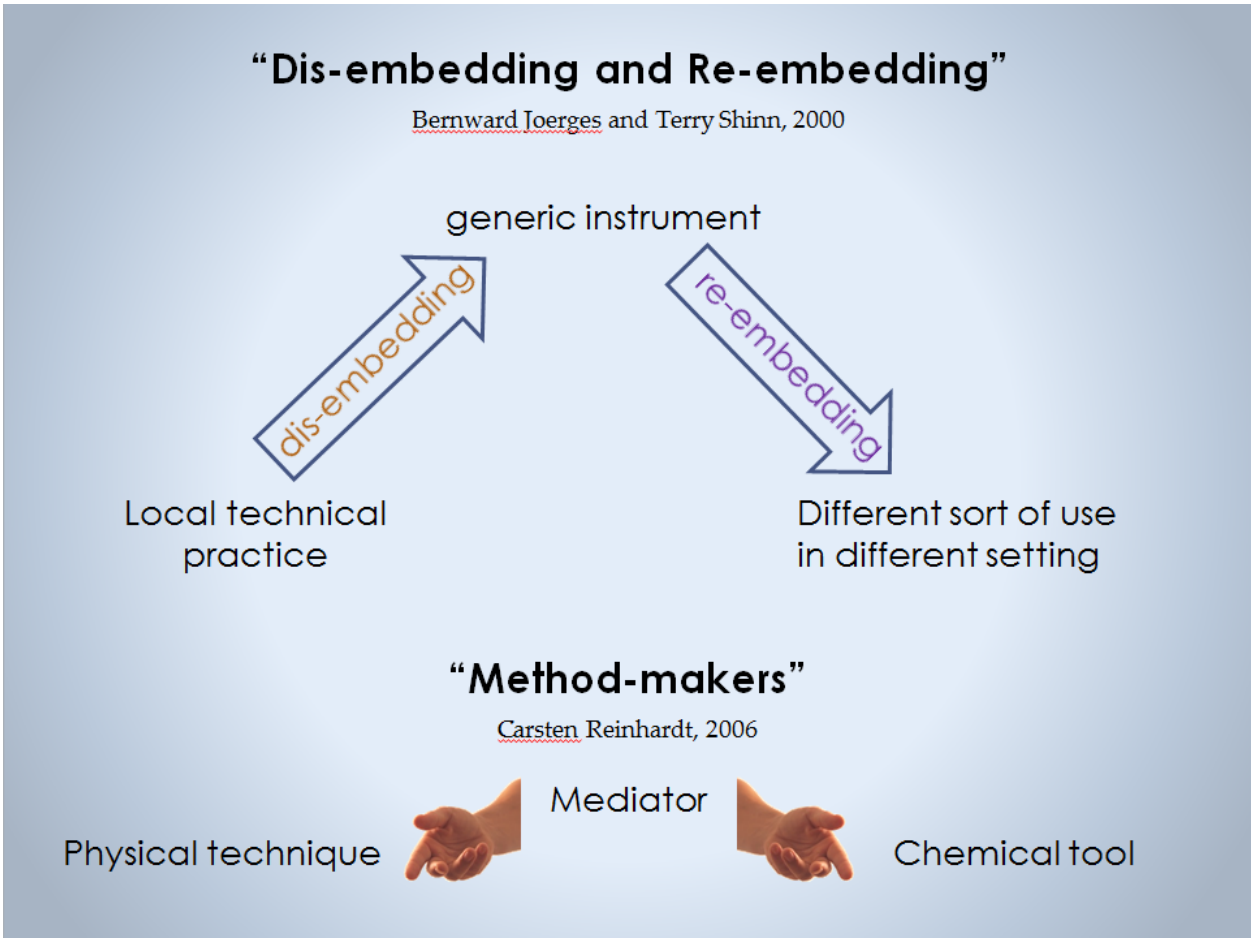
[3] Dietrich Seybold, "A More of Certainty. Giovanni Morelli (1816–1891) or The Quest for Scientific Connoisseurship," Authentication in Art Congress 2014, http://www.authenticationinart.org/congress-2014/congress-papers.

[4] Bernward Joerges and Terry Shinn, "A Fresh Look at Instrumentation: An Introduction," in *Instrumentation Between Science, State and Industry,* ed. Joerges and Shinn (Boston: Kluwer, 2001), 10–11; Joerges and Shinn, "Research-Technology in Historical Perspective: An Attempt at Reconstruction," in *Instrumentation Between Science, State and Industry*, 245–247.

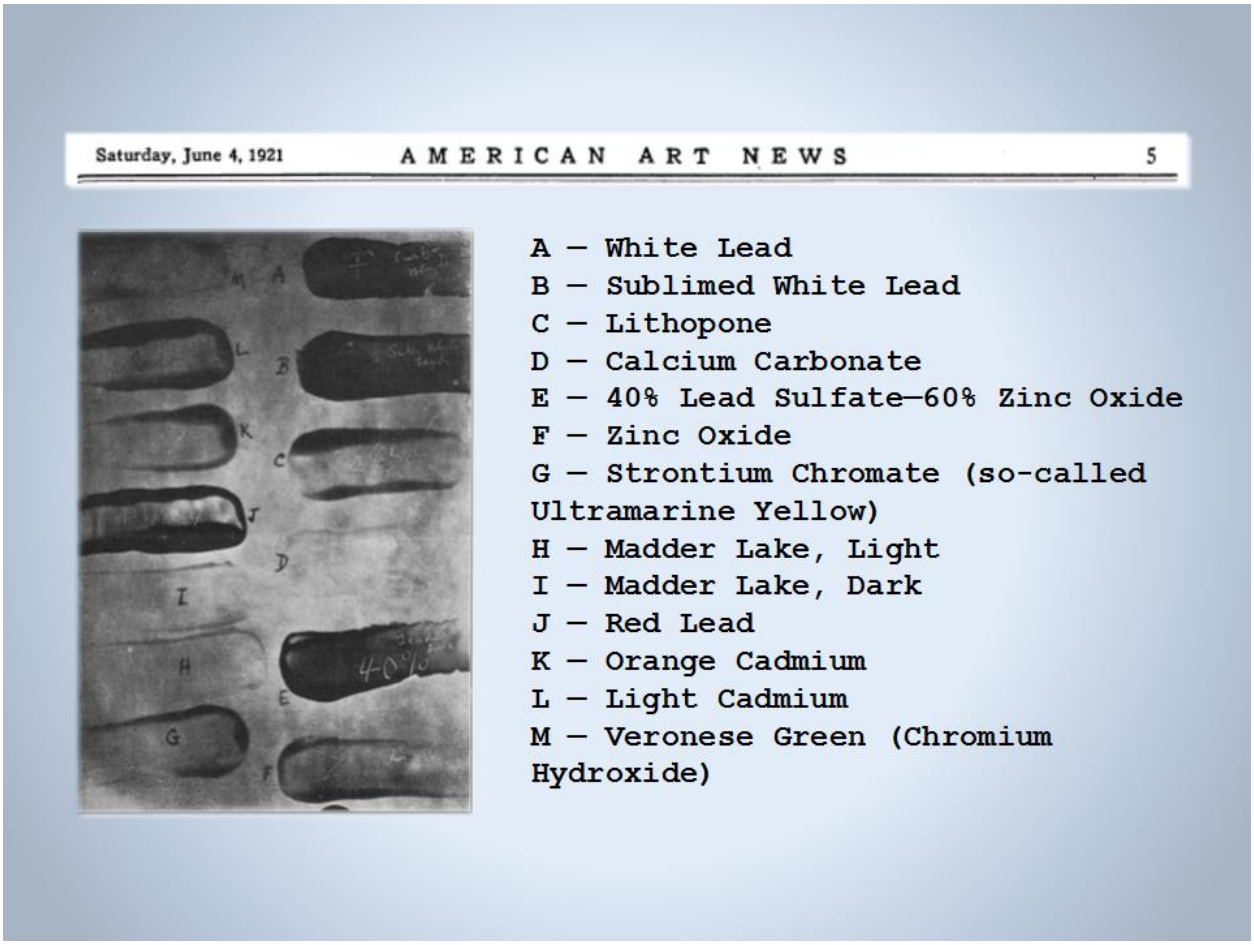
[5] Carsten Reinhardt, *Shifting and Rearranging: Physical Methods and the Transformation of Modern Chemistry* (Sagamore Beach, MA: Science History Publications, 2006).




**Slide 2**

I'll be discussing a couple of such method makers in the field of technical art criticism shortly. But first, a quick primer on how X-rays worked.

X-rays were discovered by German physicist Wilhelm Roentgen in 1895, and within a year they were used on paintings. The way that this worked was that an X-ray machine would be set up, a painting would be put in front of it and then film placed behind the painting. The source emitted X-rays, and the backing and pigments of the painting would absorb a portion of the radiation in proportion to their density and the weight of the elements that made them up. So the lead in lead white pigment would absorb a lot of the radiation, whereas organic pigments made up of lighter elements like carbon and oxygen would absorb very little of it (*Slide 3*).




**Slide 3**

Then, the remainder of the X-rays that penetrated the painting would expose the film. So what you got was an image of the shadow cast by the painting: hence the term "shadowgraphs" for these images. These shadowgraphs could reveal the condition of the painting. They could reveal information about underpainting and revisions carried out by the artist or restorer. They could even provide information about brushstrokes that might be obscured from the naked eye or the photomicrograph by varnish, restoration, or the artist's own revisions.

So an X-ray is three things. It's an **instrument**, the machine you set up to expose the painting. It's a kind of **evidence**, the film that the X-ray produces. And it is a **method**, a practice involving the selection of certain paintings and the exclusion of others for study using the X-ray, and involving certain specific goals.

In all three of these senses, the X-ray is open to be modified, to be changed, to be remade: the instrument itself, in its physical configuration, the evidence, in practices of interpretation and the kinds of arguments that can and cannot be made from an X-ray film,

and the method and goals that those who were carrying out this X-ray procedure are attempting to achieve.

Now, if you wanted to study X-rays of paintings you had to have access to an X-ray machine. For this reason, much of the work on the X-ray of paintings through the early 1920s was carried out by physicists and medical radiologists. There were a few important exceptions, including Munich researcher Walter Gräff and later Marten de Wild here in The Hague.

But more typical was the author of this article, a clubbable paint chemist and entrepreneur in 20th century New York named Maximilian Toch.[6] Venturing into art authentication using the X-ray and chemical techniques during the 1920s, Toch caught much media attention with sensational claims about the reattribution of paintings then attributed to Rembrandt, claims that were utterly dismissed by many connoisseurs. Wilhelm Valentiner, whom we heard about a little bit earlier, dismissed Toch's judgement; an editorializing newspaper reporter called it "a chemist's notion of how a painter works."[7] So, again, the hard boundary between art and science.

Two men who succeeded in bridging this boundary, in making the X-ray into an instrument of authentication, were Edward Waldo Forbes and Alan Burroughs. These two were different than people like Toch. They were connoisseurs who took up the X-ray, not scientists who decided to take up the study of paintings.

Forbes was the second director of Harvard's Fogg Museum and founder of its department of technical studies. He was a Boston Brahmin – the Waldo in his name was taken from the name of his great uncle Ralph Waldo Emerson, and the Forbes is that of current American Secretary of State John Forbes Kerry. So he was a man from a good family.

Forbes studied art and the humanities at Harvard, and then, around the turn of the 20th century, he travelled through Italy collecting paintings. In doing so, he grew particularly interested in problems of restoration, and became increasingly involved in the art world at Harvard and in Boston. He was appointed director of the Fogg is 1909 and immediately set to work cultivating technical and historically sensitive approaches to conservation at the museum.

Alan Burroughs was the son of Bryson Burroughs, curator of paintings at the Metropolitan Museum of Art in New York. In the early 1920s, Alan Burroughs was an assistant curator at the Minneapolis Art Institute. There, in 1923, he was tasked with X-raying a mummy case to determine its contents. The case did indeed contain a mummy, and this generated much public excitement. The experience taught Burroughs firsthand how rhetorically powerful a tool the X-ray was, how much it excited the public imagination.

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[6] Augustin Cerveaux and Evan Hepler-Smith, "Quest for Permanence," *Chemical Heritage* 31, no. 1 (2013): 20–26.

[7] "Enthusiastic Expertism," *Baltimore Sun*, March 24, 1931, 10

But he also took note of something that the newspaper stories overlooked: the trace of painted decoration on the mummy case that appeared on the X-ray film. Burroughs wanted to study this further, and in looking for sponsors for this sort of research, he got in touch with Forbes. Forbes brought Burroughs to the Fogg for a trial period over the summer of 1925, and with some prodding by Burroughs over the following two years, Burroughs managed to secure a permanent position at the Fogg Museum.

Burroughs was also the husband of the painter Molly Luce, who painted this portrait of her husband-to-be engaged in his early X-ray studies just before they were married. If you want to learn more about Burroughs, Forbes and conservation at the Fogg Museum, I highly recommend Francesca Bewer's wonderful book *A Laboratory for Art*.[8]

Teaming up with a physics grad student that summer in 1925, Burroughs begin to explore how the X-ray could become a useful tool for criticism. First, Forbes made Burroughs carry out some trials to verify the physicists' assurances that the X-ray would not harm the paintings, because this was a period in which the potential threat of the X-ray to human health was first becoming widely known.[9] After these trials, Forbes signed off on the X-ray of real paintings, and Burroughs began to make his way through a small collection of the Fogg's paintings and those of a few other private collectors.

In June, he hit the jackpot. X-rays of one painting, previously tentatively attributed to the late-16th and early-17th century Dutch painter Frans Pourbus the Younger, revealed a face that confirmed this attribution, hidden behind overpainting. This was a sensational find, Burroughs argued.

Soon thereafter, he made another discovery. He identified a supposed 14th-century Italian painting of a crucifixion as a forgery. This was based on the X-ray's revelation of wormholes in the panel completely filled with ground. Burroughs reasoned that a true 14th-century master wouldn't have executed his painting on a panel that was already full of wormholes, and that a forger must therefore have taken an old panel and skillfully overpainted the scene on it. (Ironically, one of the reasons that, as John mentioned, the jury in the Hahn-Duveen trial discredited Burroughs' evidence was that he misidentified the backing of the La Belle in the Louvre. So he was not assiduously aware of backing in all of his work.)

Burroughs and Forbes took the overpainted Pourbus and the telltale worm holes of the forged crucifixion as canonical examples, demonstrating that, as Burroughs wrote in September, 1925, "the X-ray has developed into a valuable addition to the expert's equipment for judging the antiquity or genuineness of paintings more than a hundred years

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[8] Francesca G. Bewer, *A Laboratory for Art: Harvard's Fogg Museum and the Emergence of Conservation in America, 1900-1950* (New Haven: Yale University Press, 2010).
[9] Matthew Lavine, *The First Atomic Age: Scientists, Radiations, and the American Public, 1895-1945* (New York, NY: Palgrave Macmillan, 2013).

old, or for estimating in some cases the evidence of authorship on more tangible grounds than style and feeling."[10]

This sounds very much like a celebration of science in opposition to previous practices of connoisseurship. But behind the surface of these demonstrations was a method that remained uncertain.

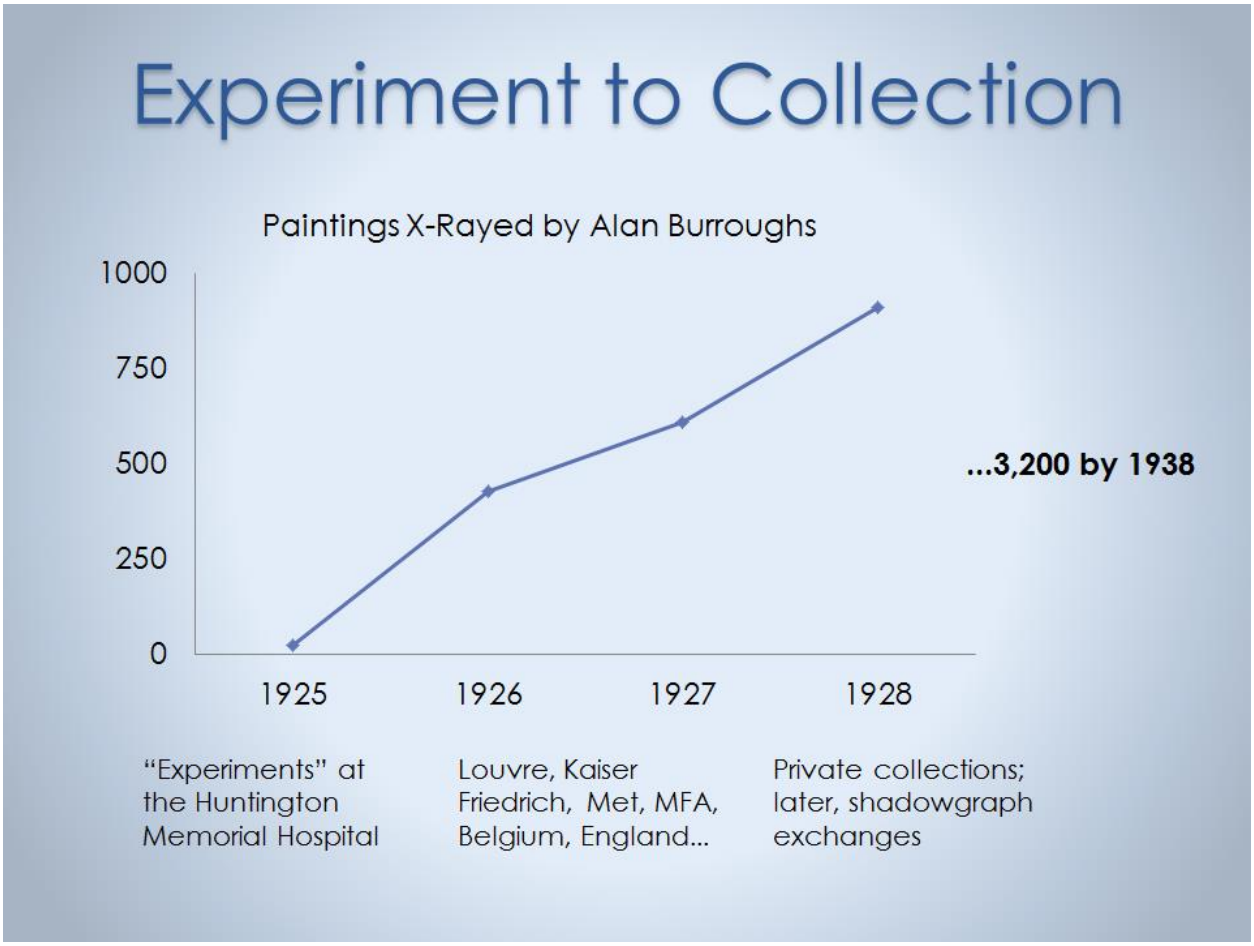
The paintings on which Burroughs staked the claim for his method hadn't been selected at random. In fact, the owner of the Pourbus had known beforehand that the face of the painting was a 19th century addition. Further, the crucifixion scene had been knowingly purchased by the Metropolitan Museum of Art as a demonstration piece for the detection of forgeries. So Burroughs had managed to uncover repainting in a work already known to have been repainted and to find evidence of forgery in a painting already known to be fake.

This didn't negate the value of Burroughs' findings, but it did expose a major challenge. How would he and Forbes get access to paintings that weren't already acknowledged to be in some way inauthentic? Even with Burroughs' father's intercession, the Met would not allow Forbes and Burroughs to X-ray any paintings other than this one demonstration piece. Further, even if the owners of paintings would allow them to be X-rayed, there remained the matter of how to carry out these X-rays. Over that first summer, Burroughs had done his work in the X-ray room of a Boston hospital late at night – not a method suitable to being applied more widely.

So the instrument, the evidence, and the method of the X-ray all had to be reshaped.

This is a graph of the number of paintings that Burroughs X-rayed (*Slide 4*). It looks like a steady increase from the mid-1920s to the late '30s. But the most telling part is the big jump from 1925, during which Burroughs X-rayed only 24 paintings in his initial sample, to the collection of hundreds of X-ray films over the following years.

[10] Alan Burroughs, "Application of the X-Ray to Connoisseurship: Report of X-Ray Experiments on Pictures, Conducted at the Fogg Museum of Art," typescript, 13 Sept 1925, Harvard Art Museums Archives, Papers of Edward Waldo Forbes (HC 2), Box 107, Folder 2324, 2.




**Slide 4**

Burroughs framed his initial 1925 project, the collection of these initial 24 images, as *experimentation*. His purpose was to assemble an experimental collection, a collection that he could use to derive interesting facts about the X-ray process through experiment. He repeated this word, "experiment," over and over in describing what he was up to.[11]

The following summer, Forbes gave the young man a very different sort of task. Forbes had painstakingly arranged for Burroughs to visit several museums in Europe, principally the Louvre and the Kaiser-Friedrich-Museum (now the Bode Museum), to X-ray paintings whose attributions were unquestioned.

On this trip and subsequent ones, Burroughs' aim was to assemble a file of X-rays to service as a reference collection. He wasn't experimenting any more, but rather collecting and documenting. This transformed the role of the X-ray from critique and experiment to canonization. It's not that Burroughs stopped doing authentication entirely. He still examined paintings, looking for overpainting or forgeries, and media attention continued

[11] See. e.g., the subtitle of his report; Burroughs, "Application of the X-Ray to Connoisseurship: Report of X-Ray Experiments on Pictures, Conducted at the Fogg Museum of Art."

to focus on this use of the X-ray. But from 1926 on, he and Burroughs framed this work as a sideline, presenting the real business of the X-ray as the documentation of good and genuine paintings.

With this latter goal in mind, private collectors submitted more and more paintings to Burroughs, so that their works could be added to this key reference collection of X-rays. By the late 1930s Burroughs could write that "The Fogg Museum is acknowledged to have the most extensive library of X ray shadowgraphs of paintings in the world, and the proper maintenance of this position remains our present problem."[12] Within the art community, they recast the primary use of the tool as documentation, which augmented the painting's status rather than calling it into question.

In order for Burroughs to gather all of these X-rays in trips across Europe and the US, he needed an instrument that was smaller than a hospital room. For his initial work in Europe, Burroughs purchased a mobile X-ray unit designed for dentists. The machine made his collecting trip possible, but it was not optimal for his purposes. It emitted X-rays of slightly too high an energy to be ideal for use on paintings, and Burroughs had all sorts of misadventures with extension cords and voltage conversions. At one point he had to saw a toaster in half and plug the power source into the toaster to get the correct voltage. You can imagine the curator watching a broken toaster sparking on the floor of his museum, wondering what on earth this guy was doing.

However, as Burroughs travelled to different museums, some of these museums were also beginning to establish their own technical studies laboratories. Officials at these museums investigated the use of X-rays themselves, and, crucially, made agreements to exchange X-rays with the Fogg Museum. In this way, investing in an X-ray machine would yield increasing returns: not only would you get X-rays of your own paintings, but you could also trade copies of these films for copies of the X-rays that Burroughs and others were carrying out.

As the use of X-rays in museums spread, instrument manufacturers began to take notice. By 1930, X-ray makers were staffing boots at the international meetings of museum professionals. Soon thereafter, Burroughs was designing his own machines, corresponding with the manufacturer to configure these machines specifically for his purposes, based on his years of experience X-raying paintings. For example, Burroughs designed his machine to swivel ninety degrees, so that it could be used to X-ray paintings that a curator would not

[12] Memorandum, n.n. [Burroughs], n.d. [late 1930s], Harvard Art Museums, Straus Center for Conservation (hereafter "Straus"), Box "Burroughs – Clippings & Varia," Folder "Campbell X-ray Corp (equipment)."

allow to be removed from the wall and placed on sawhorses, the usual procedure for X-raying a painting.[13]

Finally, Burroughs and Forbes reshaped the nature of the evidence provided by the X-ray. In 1925 – this all comes from Burroughs' initial summary report of his first summer's work on the X-ray of paintings – in 1925, Burroughs had emphasized the *difference* between the sort of evidence that connoisseurs typically drew upon and the sort of evidence that X-ray films promised to yield.

Once again citing the Pourbus and the crucifixion forgery, Burroughs expressed hope that the X-ray could take the question of repainting and forgery "out of the class of personal opinion and [put] it into the class of scientific demonstration." Moreover, this "demonstration" would generate facts that could be proven, facts accessible to a "jury of layman" who could judge their validity.[14] You can see the influence of the Duveen-Hahn trial and other high-profile trials regarding artwork.

A decade and a half later, Burroughs was describing the X-ray in very different terms. In the 1938 book *Art Criticism from a Laboratory*, Burroughs wrote about a technical studies course that he taught: "Students came to the course for a pseudo-scientific solution of problems which have baffled expert critics. They found instead a new approach to artists' points of view," in which they had been trained in their other courses.[15]

"As we all know but often forget," Burroughs wrote,

> critical truths are mainly derived through the emotional sensitiveness which develops from intimacy with works of art. By enabling the critic to become more intimate with the insides of pictures, the first thoughts of artist and any struggles inherent in the artistic process, the X-rays may guide the critic to new critical truths.[16]

Note that Burroughs writes of "critical truths," not *facts*, "derived through emotional sensitiveness" and "intimacy," not *proven*, by "the critic," not *the layman*. And, again, note that this is really about developing an instrumental aid for the criticism and appreciation of artwork, not a forensic tool for authentication. The latter remained an application of the X-ray, but it was an application that, after his first year or two of work with the X-ray, Burroughs sidelined whenever possible. He wanted to make the X-ray primarily a means of deepening the critic's relationship with paintings and only secondarily a tool for criticizing paintings or calling their authenticity or attribution into question (*Slide 5*).

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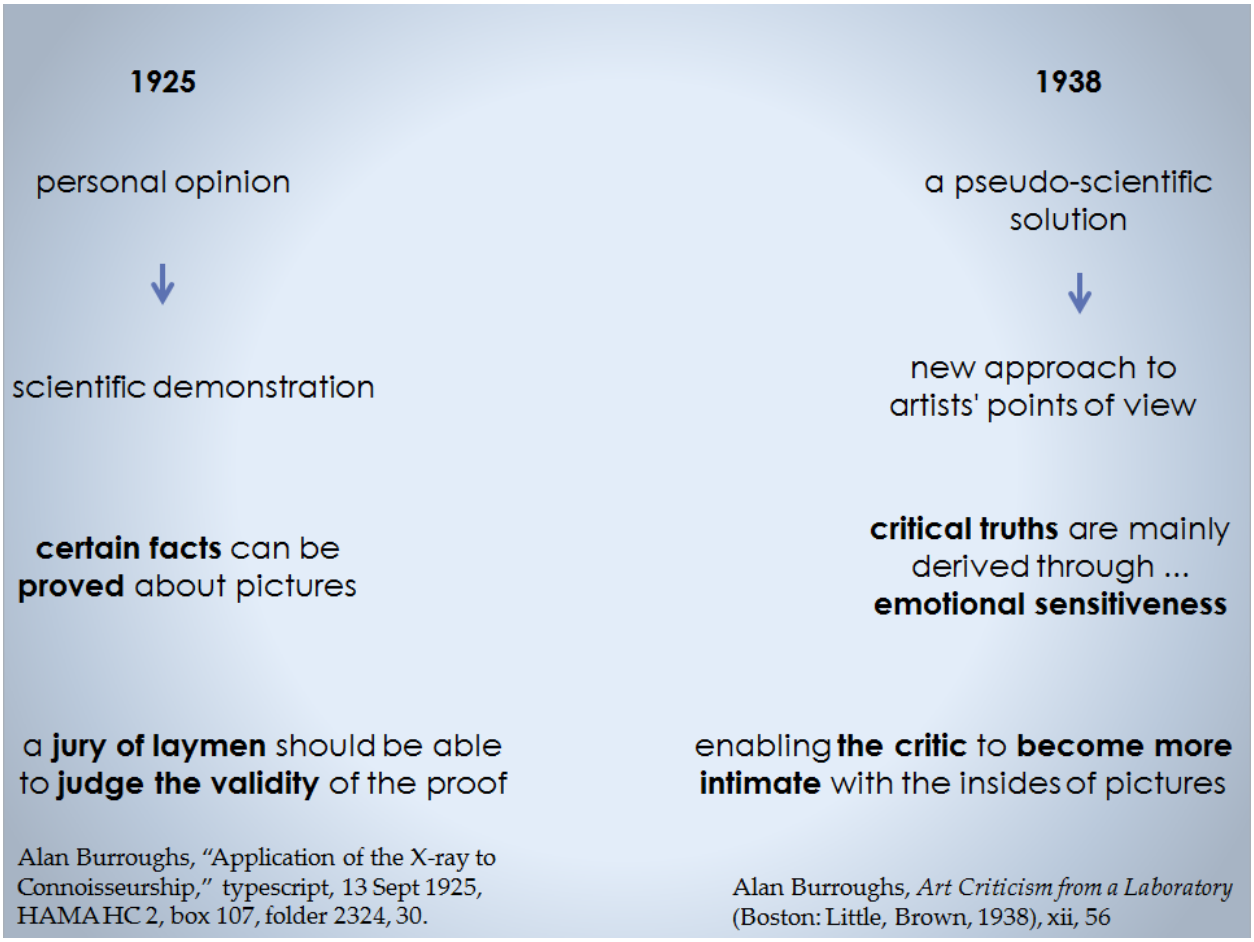
[13] Alan Burroughs to Fred R. Campbell, Campbell X-Ray Corporation, 27 Apr 1936, Straus, Box "Burroughs – Clippings & Varia," Folder "Campbell X-ray Corp (equipment)."
[14] Burroughs, "Application of the X-Ray to Connoisseurship," 30.
[15] Alan Burroughs, *Art Criticism from a Laboratory*, lst ed. (Boston: Little, Brown, 1938), xii.
[16] Ibid., 56.




**Slide 5**

I'm reminded of the quotation with which our host opened today's session. *Although we knew that it was the original*, he said about that BMW, *we have the authentication done anyway*. This is akin to what Burroughs and Forbes tried to do with the X-ray: make it into a tool that owners of paintings unquestionably known to be originals would want to use to deepen their appreciation and understanding of their artworks. It was as this sort of tool that Burroughs and Forbes envisioned that the X-ray could make it into the practice of art criticism; once established in this manner, it could also serve as a tool of authentication.

Given the usual antagonistic framing of the relationship between art and science, we would imagine that the X-ray could have found use in authentication and attribution only through the triumph of scientists over art experts, or perhaps through an agreement to parcel out the study of art into objective parts that were the business of the technicians and subjective parts that remained the domain of the connoisseurs. But, as we've seen, Forbes' and Burroughs' successful introduction of the X-ray into broad use in museums worked differently.

Their goal was not experiment and testing, but rather collecting and documentation.

They reconfigured the X-ray to move on from repurposed medical equipment to custom built units and eventually off-the-shelf instruments, designed specifically for use in museums, from their size and positioning to the specific wavelengths of X-rays that they produced.

Finally, they made the interpretation of X-rays into a tool for extending critical judgement into the depths of the object, and for extending the compressed temporal dimension of the painting into a kind of set of slices through the artist's work of developing the painting – slices that could be analyzed and yield insight into the artist's process. And they contrasted this with what they said the X-ray was *not*: a "pseudo-scientific" tool to generate judgements on its own.

Burroughs wrote, "The X-ray does not determine the artist, but by means of the X-ray you do the determining."[17] "You," in this case, was not the layman but the trained connoisseur. So *you* will have much more informed ideas about the significance of this story for current practice than I will. But I want to submit just one idea, in conclusion.

As we think about the relationship between art and science today – in such technologies as digital image processing and pattern recognition, in addition to the many spectroscopic techniques detailed quite nicely on the posters outside – as these techniques enrich our criticism, it's useful to remember that technical approaches to connoisseurship, such as the X-ray, not only *can* be subject to the critical participation of professionals trained in the humanities, but in some cases perhaps *can only* become broadly accepted techniques in this way.

So it's not a matter of selecting or rejecting black-boxed tools built by technical experts, but rather of certain method-makers, with one foot in the world of technical studies and the other foot in the world of criticism and art history, engaging with the flexibility of these tools and reshaping them, in order to re-embed them in the culture of connoisseurship of paintings, in accordance with its traditions and its current needs. Thank you.

*May 7, 2014*
*Transcript edited July 12, 2015*

[17] Alan Burroughs, "Lecture to Museum Course," 5 Dec 1935, Straus, Box "A. Burroughs – Articles, Lectures, Reports, Exhibitions," Folder "Lectures by Alan Burroughs."