Technology Transition Workshop| *Sarah West*

Conventional Approaches to Fingerprint Comparison

Headline – Cops Use Greasy Fingerprints to Nab Hungry Burglar

"*Assistant Commonwealth's Attorney Bethany Harrison said Lynchburg* **police matched prints on an orange juice bottle left at the scene** *of a breaking and entering to 33-year-old Bernard Wood.*"

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LYNCHBURG, Va. Friday, November 14, 2008 FOX NEWS

Headline – Suspects in Brutal Rape of Mother and Son Head to Trial

"Authorities say DNA evidence found on condoms inside the apartment and **fingerprints identified the defendants as the culprits***."*

Headline – Prosecutor: Ohio Teen Fatally Shot Twin Brother

*"The trial of a man accused of fatally shooting his identical twin brother began Tuesday with **prosecutors revealing new fingerprints linking the man to the killing** while the defendant's lawyer insisted another man had masterminded the attack."*

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Headline – Officers Trap Train Robber Using Fingerprints

"PC Bellinger added: "The fact that the victim retained the evidence, despite what had just happened, was crucial since Freeman **Roach's fingerprints on the items enabled us to place him at the crime scene***."*

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Kent News February 19, 2010

Headline – Expert Warns Fingerprinting System is 'Riddled With Flaws'

*"A leading US forensic expert has called for a radical review of fingerprint testing to determine the **extent of flawed identification**."*

"I would strongly recommend a review of all fingerprint identifications outside the confines of the agency first effecting the identification."

– James Starrs, professor of law and forensic sciences at George Washington University

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2004 SMG Sunday Newspapers Ltd.

Study of Faulty Fingerprints Debunks Forensic Science 'Zero Error' Claim

"*Now, UC Irvine criminologist Simon Cole has shown that not only do errors occur, but* **as many as a thousand incorrect fingerprint "matches"** *could be made each year in the U.S.*"

Science Daily (Sep. 13, 2005)

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The Achilles' Heel of Fingerprints

*"Our current approach to fingerprint evidence, in which experts claim 100 percent confidence in any match, is **dangerously flawed and risks causing miscarriages of justice."***

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National Academy of Sciences Report

"Strengthening Forensic Science in the United States:
A Path Forward"

"Strengthening Forensic Science in the United States: A Path Forward" Committee on Identifying the Needs of the Forensic Sciences Community; Committee on Applied and Theoretical Statistics, National Research Council ISBN: 0-309-13131-6 February 2009

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National Academy of Sciences Report
"Strengthening Forensic Science in the United States: A Path Forward"

*"Thus, not all fingerprint evidence is equally good, because the **true value of the evidence is determined by the quality of the latent fingerprint image**."*

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National Academy of Sciences Report

"Strengthening Forensic Science in the United States: A Path Forward"

*"With the exception of nuclear DNA analysis, however, no forensic method has been **rigorously** shown to have the capacity to **consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source**."*

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Do these and other challenges have any substance?

Criteria

- **Let's consider the following:**
  - **Scientific validity**
  - **Sufficiency**
  - **Consistency**
  - **Transparency**
  - **Reproducibility**
  - **Training**

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Criteria

- **Scientific validity**

  – **What is the scientific basis for fingerprint individualisation?**

- **Sufficiency**

  – **What constitutes a "usable" latent print?**

- **Consistency**

  – **How do we ensure that each examiner achieves the same result?**

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Criteria

- **Transparency**
  - **How do we explain how those results are achieved?**

- **Reproducibility**
  - **How can we ensure that the same result is achieved for the same comparison?**

- **Training**
  - **How do we train examiners to competence?**

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Error Rate

How often do we expect the process to produce an incorrect / inaccurate answer?

Is This a Fair Set of Criteria?

- **Legal: judges, juries, lawyers, investigators**
    - **Robust information to understand our process**
- **Scientific: forensic scientists**
    - **Set of tests**

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GTKPR

- **G**eneral acceptance

- **T**ested

- **K**nown standard

- **P**eer reviewed / publication

- **R**ate of error (known or potential)

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*G*TKPR

- **General acceptance**
  - **What is meant by the scientific community?**
    - **Legal and scientific**
      - **More encompassing than just the fingerprint community?**

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GTKPR

- **Tested**

- **Peer reviewed**
  - **Scientific validity, reproducibility, sufficiency**

Daubert Tests

- **In fact Daubert can help clarify what we mean by scientific validity**

  *"To the contrary, under the Rules, the trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but **reliable**."*

  *"In a case involving scientific evidence, evidentiary **reliability** will be based upon scientific validity."*

  *"The inquiry is a flexible one, and its **focus must be solely on principles and methodology, not on the conclusions that they generate**."*

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DAUBERT v. MERRELL DOW PHARMACEUTICALS, INC., 509 U.S. 579 (1993)

What Constitutes Reliability?

- **Scientific validity**
- **Consistency**
- **Reproducibility**

Our **process** *needs to be reliable —*
It is not all about the "expert"

National Academy of Sciences Report

*"The simple reality is that the **interpretation** of forensic evidence is not always based on **scientific studies to determine its validity**."*

*"In terms of scientific basis, the analytically based disciplines generally hold a notable edge over disciplines based on **expert** interpretation."*

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*GT**K**PR*

- **Known standard**
  - **By definition, standards introduce consistency**
  - **Using known standards brings training into consideration**

*GTKP**R***

- **R**ate of error
  - **While significant, this will not be directly addressed**

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Where Are We?

- **We have suggested a number of criteria by which to consider our process of fingerprint comparison**

- **All are logical and relevant**

- **We can reference some to legal commentary**

- **We can reference others to scientific reports, such as NAS**

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How Current Approaches Measure Up

- **Scientific validity**

- **Sufficiency**

- **Consistency**

- **Transparency**

- **Reproducibility**

- **Training**

Non-Numerical Approach

- ## We have a non-numerical method in the USA
  - ### For completeness, we'll consider the numerical approach too
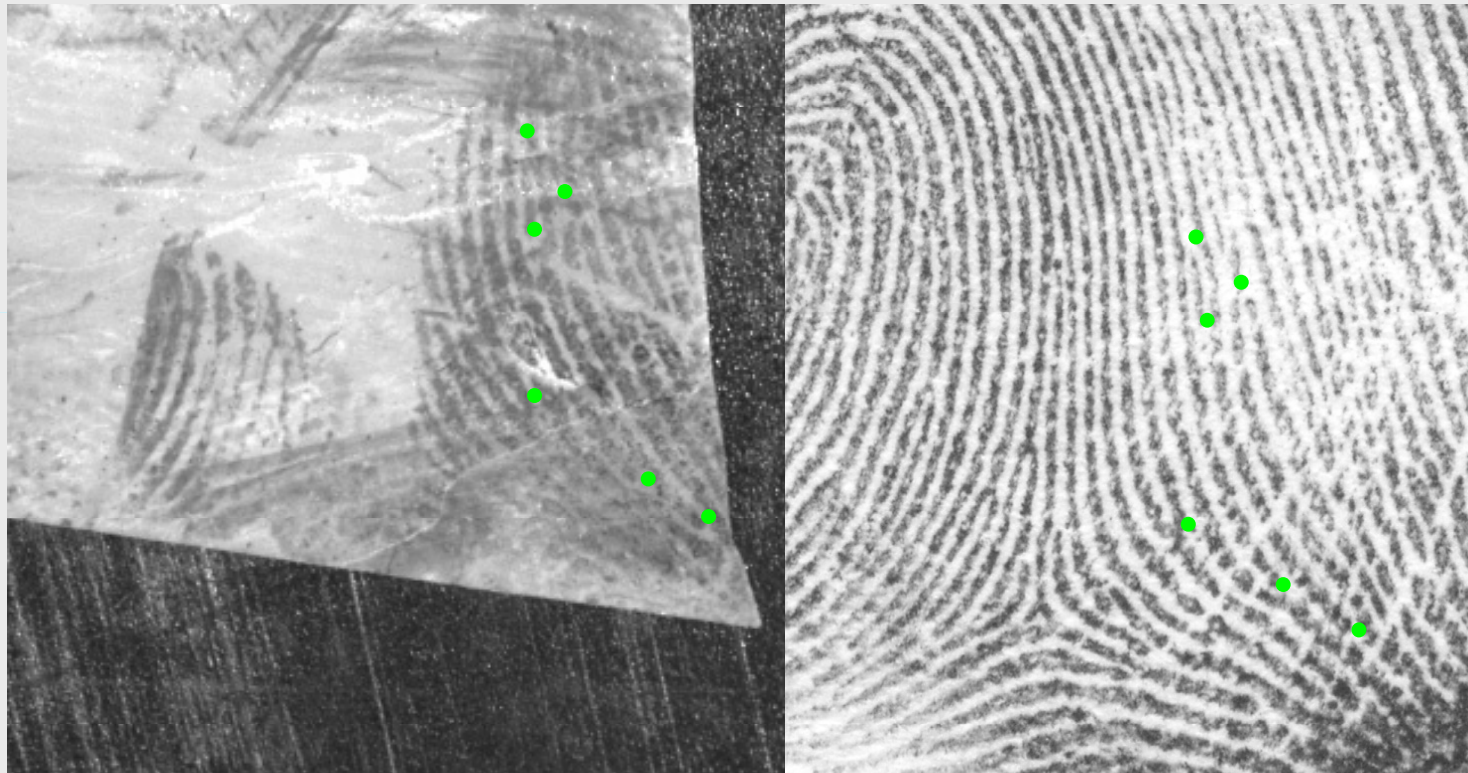
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Terms and Definitions

- **Minutiae: ridge endings and bifurcations only**
  - **Not dots**
- **Features: the totality of anatomical features**
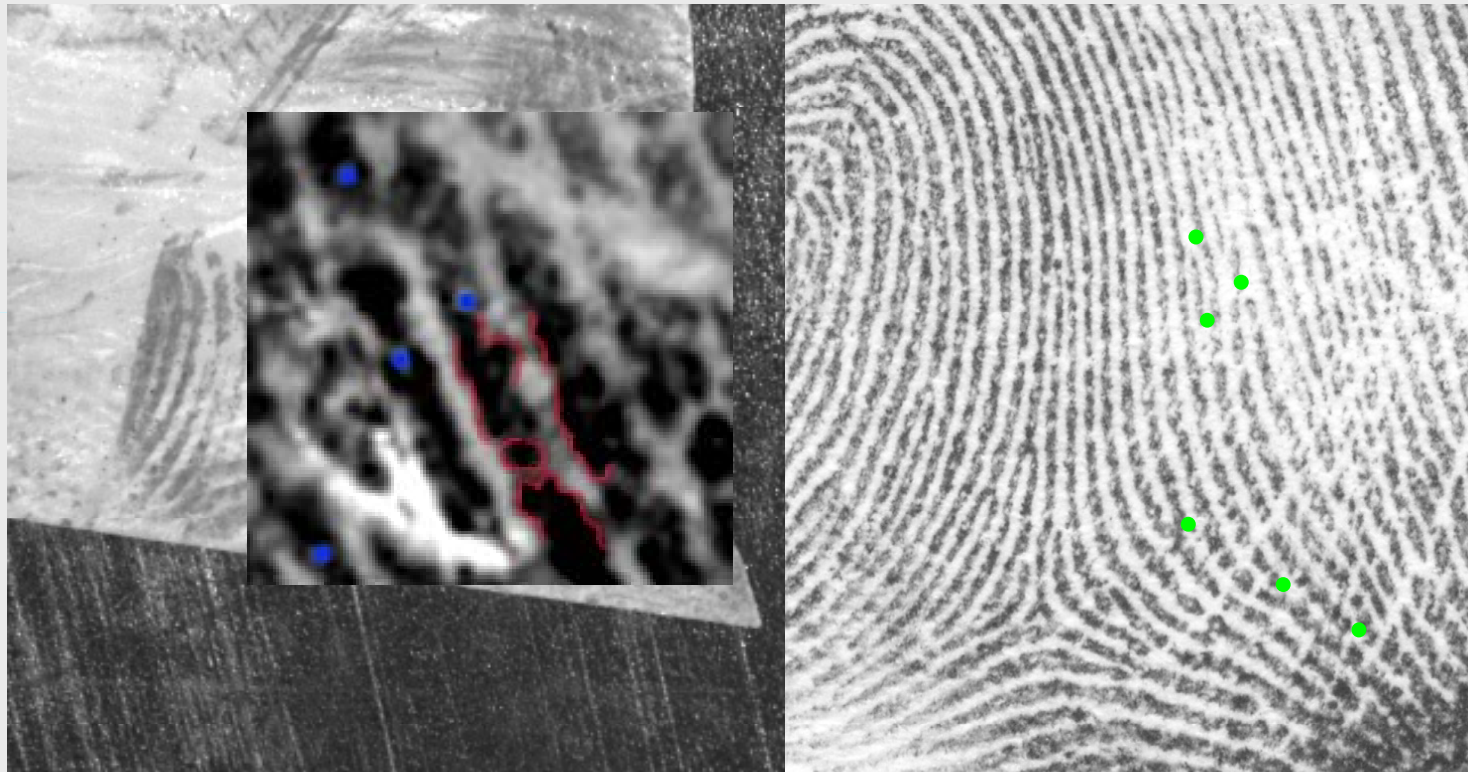
Non-Numerical Approach

- **No set threshold of features required**

- **ACE-V method**

    1. **Analysis**

    2. **Comparison**

    3. **Evaluation**

    4. **Verification**

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Non-Numerical Approach

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Non-Numerical Approach

Non-Numerical Approach

- **How does this approach work?**
    - **Personal thresholds?**
    - **Institutional thresholds?**
        - **Norming**
    - **"Black Box"**

Non-Numerical Approach

- **Some aspects are not clear**

  - **Are all features of equal evidential weight?**

  - **If not, how do we apportion the weight?**

  - **Do we fully understand the reproducibility of all features?**

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Non-Numerical Approach

- **How does the non-numerical approach measure up against our criteria?**

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Comparison Criteria and the Non-Numerical Approach

- **Scientific validity**
  - **Early pioneers?**
  - **Biological "uniqueness"?**
  - **Empirical evidence?**
  - **Probabilistic studies?**

- **Does this fully support an ability to conclusively match a latent print to a known where there are few features, distortion, etc.?**

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Comparison Criteria and the Non-Numerical Approach

- **Sufficiency**
  - **Doesn't offer any definition**

- **Consistency**
  - **What part of ACE-V ensures the same result?**

- **Transparency**
  - **We explain the A, the C and the V**
  - **The "E" in ACE-V explains how the examiner arrives at her/his evaluation**

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Comparison Criteria and the Non-Numerical Approach

- **Reproducibility**
  - **What part of ACE-V makes it reproducible?**

- **Training**
  - **How do you train someone?**

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ACE-V

- **What NAS had to say about ACE-V:**

  "ACE-V provides a broadly stated framework for conducting friction ridge analyses. However, this framework is not specific enough to qualify as a validated method for this type of analysis."

- **ACE-V is an excellent description of how to carry out a fingerprint comparison**
 - **In fact any comparison…**

Strengthening Forensic Science in the United States: A Path Forward" **Committee on Identifying the Needs of the Forensic Sciences Community; Committee on Applied and Theoretical Statistics, National Research Council ISBN: 0-309-13131-6 February 2009, page 142**

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Numerical Standards

- **Define a strict threshold of features**

  - **Match or exceed and it is an "individualization"**

- **Can be referenced to early pioneers**

- **Also often using ACE-V**

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Numerical Standards

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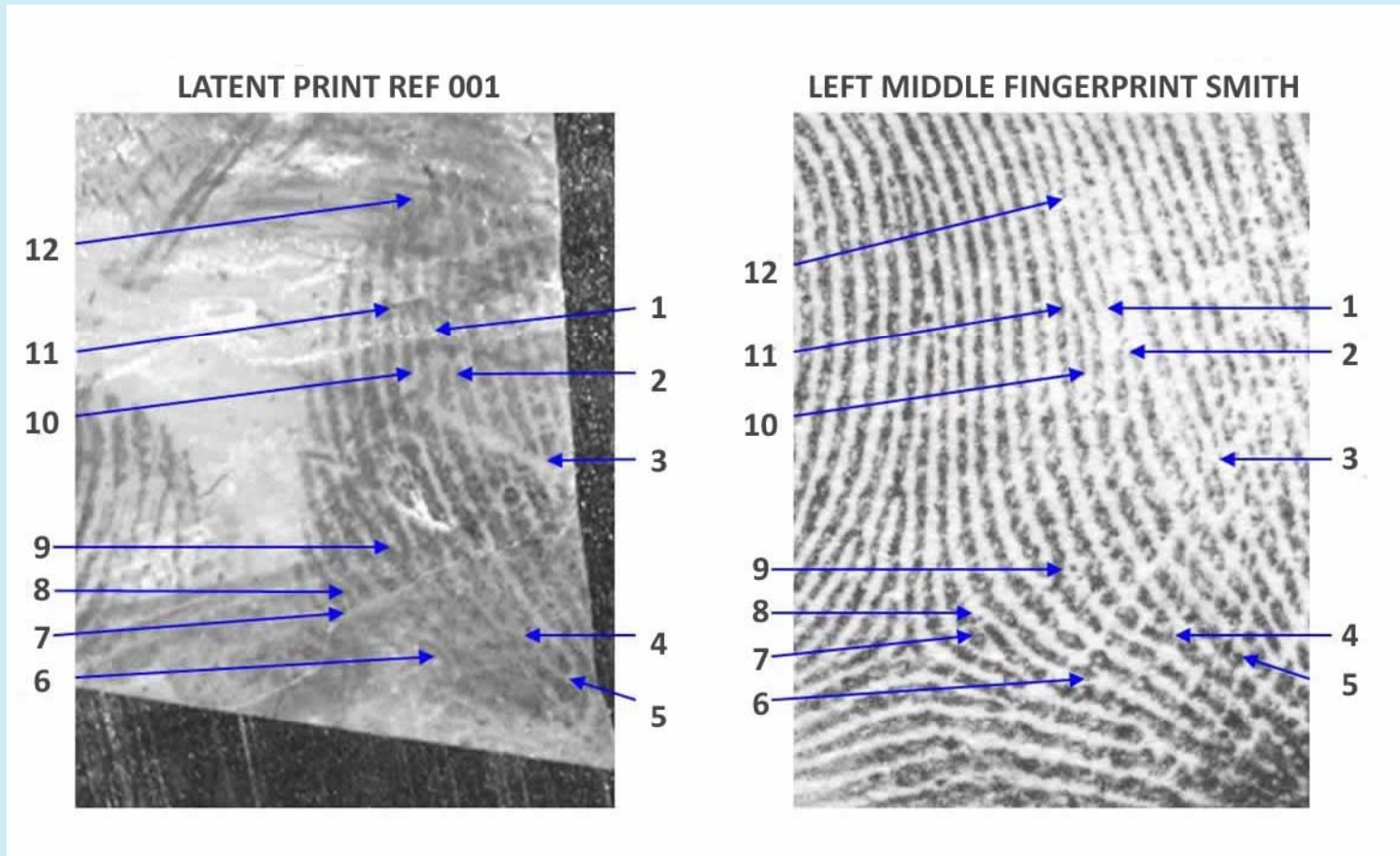
Numerical Standards

- **Are thresholds valid?**
- **Ne'urim Symposium and IAI Standardisation Committees**
  - **No scientific basis**
- **Persuasive**
  - **"An illusion of certainty"**

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Numerical Standards

- **Let's see how this approach measures up…**

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Comparison Criteria and the Numerical Standard Approach

- **Scientific validity**
  - **How is the threshold derived?**
  - **Is there a simple threshold?**
- **Sufficiency**
  - **Allows a definition, but is it sound?**
- **Consistency**
  - **IF all examiners apply consistent definitions**
- **Transparency**
  - **Provides an "illusion of certainty"**

Comparison Criteria and the Numerical Standard Approach

- **Reproducibility**
  - **As with consistency, if definitions are applied**

- **Training**
  - **Yes, but is it sound?**

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Comparison Criteria and the Numerical Standard Approach

- **Interestingly, some numerical systems allow the threshold to be modified**

- **Also, some numericists insist that they do approach examinations holistically — using all features**

- **The non-numeric / numeric distinction may not be so well defined**

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Is There a Way to Improve Our Process?

- **One way is to consider introducing probability concepts**

  - **Already used in other areas of forensic science**

  - **In fact, latent print comparison can already be considered to be probabilistic**

- **Perhaps we can research and develop "tools" to help us**

Summary

- **Our current approaches do not fully address the criteria we have set**

- **But neither do they invalidate the process completely**

  - **We all know that fingerprints, in general, provide robust intelligence / evidence**

Summary

- **Probability and the associated tools are, of course, unlikely to address all the challenges, but they can bring some significant benefits**

- **In this workshop, using a first generation tool developed by the FSS, we are going to explore how probability and the associated tools can be used to highlight the benefits**

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Questions?

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Note: All images are courtesy of Paul Chamberlain.