Committee on Identifying the Needs of the Forensic Sciences Community

Fingerprints

by Ed German
Certified Latent Print Examiner (IAI)
Fellow of The Fingerprint Society (UK)
Chief Warrant Officer Five (Retired), US Army

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This presentation is personal opinion and does not purport to represent the position or opinion of any entity of the US Government, or any organization with which the presenter was or is affiliated.
Latent Print Examination

1 - What is the scientific basis that informs the interpretation of the evidence?

2 - Overview of the fingerprint identification techniques …What is the state of the art?

3 - Where is research conducted?

4 - Where is it published?

5 - What are the major problems in the scientific foundation, methods, and practice?

6 - What research questions do you think need to be answered?
Fingerprints

1 - What is the scientific basis that informs the interpretation of the evidence?
Fingerprints

1 - What is the scientific basis that informs the interpretation of the evidence?

Permanence and Individuality

Reliability of fingerprint examination is supported by the theories of biological uniqueness and permanence, probability modeling, and empirical data gained through over one hundred years of operational experience.

The comparison and individualization of two areas of friction ridge impressions are based on the examination of infinite combinations of ridge structure, individual ridge appearance, minutiae, spatial relationships, pores, and other details.
There can be no doubt as to the advantage of having, besides their photographs, a nature-copy of the forever-unchangeable finger-furrows of important criminals.

Fingerprint Research published by Dr. Henry Faulds, *Nature*, Oct 1880
ヘンリー・フォールズ住居の跡

ここは明治初頭にあった築地居留地の18号地で
英国人医師ヘンリー・フォールズ（1848～1930）が明治7年
（1874）から明19年（1886）に至る滞日中に居住した所である。

フォールズはスコットランド一ノ長老教会の宣教師として来日し
キリスト教布教のたたかい、築地本院を問って診療に従事し
また日本人の育児はかたがつ育人の保育教育にも尽力した。

彼はわが国で行なわれていた指印の習慣に興味をもったため主
要な考古学的発掘された土器に印象されていた古代人の指紋を見つけこれに
ヒントを得てここに初めて科学的な指紋の研究を行なった。

明治13年（1880）10月英国の雑誌「ネーチャ」に日本から投稿した彼の
論文は科学的指紋学に関する世界最初の論文といわれその中で早くも
犯行者の個別識別の方法を発表しまた指紋の遺伝に関係にも言及している。

明治44年（1911）4月1日わが国の警察においてはじめて指紋法が採用
されてから満50年の今日とここから先の地に記念碑を建立し、その
伸長をたたえるものである。
DR. HENRY FAULDS
PIONEER IN FINGERPRINT IDENTIFICATION
LIVED HERE
FROM 1874 TO 1886
Francis Galton  March 1902, aged 80 years

Right Hand

rt. Thumb rt. fore rt. middle rt. ring rt. little

Left Hand

left little left ring left middle left fore left thumb
Figure 1

Growth of the hand progresses from paddlelike form (A 19.5 X), continues as the fingers separate (B 17.3 X), the volar pads become prominent (C 7.7 X) and achieves infantlike appearance (D 4.2 X). [Cummins, 1929].
High pad → Whorl

Intermediate pad (steep radial side) → Loop (ulnar)

Low pad → Arch
Fingerprints are formed during the third to fourth month of fetal development and, except for scars caused by permanent damage to the dermis or diseases such as leprosy, do not change throughout life.
Permanence References (SWGFAST Sourcebook)

• Maceo, A. The Basis for the Uniqueness and Persistence of Scars in the Friction Ridge Skin. Fingerprint Whorld 2005, 31 (121), 147-161.
• Misumi, Y.; Akiyoshi, T. Scanning Electron Microscopic Structure of the Finger Print as Related to the Dermal Surface. The Anatomical Record 1984, 208 (1), 49-55.
Permanence References (Continued - SWGFAST Sourcebook)

Individuality References (SWGFAST Sourcebook)

- Babler, W. J. Marquette University, Milwaukee, WI. Personal communication, 1999.
**Individually References (Continued - SWGFAST Sourcebook)**

- Cummins, H.; Midlo, C. Finger Prints, Palms and Soles: An Introduction to Dermatoglyphics; Dover: New York, 1943.
Individuality References (Continued - SWGFAST Sourcebook)

Individuality References (Continued - SWGFAST Sourcebook)


• Loesch, D. Quantitative Dermatoglyphics: Classification, Genetics, and Pathology; Oxford University Press: New York, 1983.


Individually References (Continued - SWGFAST Sourcebook)

• Schaumann, B. Medical Applications of Dermatoglyphics. Progress in Dermatoglyphic Research 1982, 84, 33-34.
• Siervogel, R. M.; Roche, A.; Roche, E. Developmental Fields for Dermatoglyphic Traits as Revealed by Multivariate Analysis. Human Biology 1978, 50 (4), 541-556.
Fingerprints

2 - Overview of the fingerprint identification techniques ... What is the state of the art?
Fingerprints

2 - Overview of the fingerprint identification techniques

What is the state of the art?

• Latent Print detection / visualization and recording is very mature.
• Able to individualize small impressions.
• AFIS is mature for multiple finger comparisons.
• AFIS is advancing for partial finger and palm print comparisons …requires tremendous human expert resources.
Fingerprints

Alarm Clock from IED and close-up of fingerprint developed on inside of clock face cover.
Latent Fingerprint Adjacent to Questioned Signature

challenge...my number one SNCO ACAF, AFSOC, and 18th Wing
up Three Induction Ceremony CO of the Quarter for Jul-Sep 97
my first choice to get answers...promote to chief how!

Jun 98

Baker
NONCONCUR

now!
Jun 98

...
Suspect’s Fingerprint Card
Right Ring Fingerprint
Latent and Record Comparison
Quality and Quantity
Quality and Quantity

LESS AREA – MORE NOISE
Quality and Quantity

LESS AREA – MORE NOISE
Quality and Quantity

LESS AREA – MORE NOISE
Quality and Quantity

LESS AREA – MORE NOISE
Quality and Quantity

LESS AREA – MORE NOISE
Quality and Quantity

LESS AREA – MORE NOISE

5 Enhanced
Quality and Quantity

LESS AREA – MORE NOISE
Quality and Quantity

LESS AREA – MORE NOISE

7
# Match Results for Latent 98-1-1557-8

## Ten-Print Results

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Control ID</th>
<th>Match Score</th>
<th>Class Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>t569, 98-1557</td>
<td>Right Middle</td>
<td>1164825</td>
<td>569</td>
</tr>
<tr>
<td>t554, 98-1739</td>
<td>Right Index</td>
<td>85104</td>
<td>554</td>
</tr>
<tr>
<td>t576, 98-0643</td>
<td>Right Thumb</td>
<td>79717</td>
<td>576</td>
</tr>
<tr>
<td>t880, DB</td>
<td>Left Thumb</td>
<td>69849</td>
<td>880</td>
</tr>
<tr>
<td>t243, 98-1040</td>
<td>Right Middle</td>
<td>67790</td>
<td>243</td>
</tr>
<tr>
<td>t243, 98-1040</td>
<td>Right Little</td>
<td>67120</td>
<td>444</td>
</tr>
<tr>
<td>t243, 98-1040</td>
<td>Right Little</td>
<td>60973</td>
<td>517</td>
</tr>
<tr>
<td>t653, 98-1892</td>
<td>Right Thumb</td>
<td>58086</td>
<td>491</td>
</tr>
<tr>
<td>t653, 98-1892</td>
<td>Right Middle</td>
<td>57890</td>
<td>488</td>
</tr>
<tr>
<td>t653, 98-1892</td>
<td>Right Little</td>
<td>52680</td>
<td>653</td>
</tr>
</tbody>
</table>
**Level 1** Information - Pattern or general ridge flow as represented in the skeleton at right.

**Level 2** Information - Galton Points such as ridge endings, bifurcations and dots as represented in the skeleton at right.

**Latent Print Examiners do NOT base friction ridge identifications on just Level 1 and 2 information.**

**Level 3** Information - Ridge path, shape, pores and other information upon which Latent Print Examiners base friction ridge identifications, as represented in the image at right.
Fingerprints

3 - Where is research conducted?

• Forensic Laboratories (US and Foreign)
• University Laboratories (Texas Tech, WVU, more…)
• National Laboratories (ORNL, LNLL, PNNL, etc.)
• Private Industry (AFIS Manufacturers)
• Other…
Fingerprints

4 - Where is research published?
Fingerprints
Fingerprints

• International Association for Identification
  – Established in 1915;
  – Has over 5,000 Parent Body members;
  – Over 50 National, State and Regional Divisions of the IAI publish various Journals or Newsletters;
  – Over 1,000 members attend the Annual Educational Conference;
  – AAFS splintered from IAI in 1948;

• The Fingerprint Society
  – Established in 1974;
  – Members in over 30 countries;

• Other organizations native to individual researchers…
Fingerprints

1933-2006 Electronic Archive of IAI Publications
(Primarily Fingerprint Oriented)

25,264 indexed pages
PDF Archive on 3 CDs
(instantly searchable)
Fingerprints

5 - What are the major problems in the scientific foundation, methods, and practice?
Permanence and Individuality

Based on Embryology, Anatomy, Genetics, friction ridge studies AND forensic science observations from analysis and comparison of billions of friction ridge impressions worldwide during the past 100+ years.

Evidence Foundation

Training - competency, under qualified instructors
Experience - years full-time
Ability - confirmed by initial competency testing and annual proficiency testing

Practitioner

Training

Experience

Ability

Society’s Safety Net is the Scientific Process

Evidence Foundation

Evidence - custody chain, markings
Friction Ridge Quality
Friction Ridge Quantity

Friction Ridge Quality

Insufficient Quantity/Quality - Examiners with similar training, experience and ability should come to the same conclusion about impressions with the same quality (clarity) and quantity of Level 1, 2 and 3 friction ridge features.

Comparative Evaluation

Analysis - of Level 1, 2 and 3 ridge features before comparison

Analysis

Verification

Identification Confirmation - separate decision by a second examiner

Comparative - Evaluation

Quantity - Examiners with similar training, experience and ability should come to the same conclusion about impressions with the same quality (clarity) and quantity of Level 1, 2 and 3 friction ridge features.

Methodology

Quantity/Quality - Examiners with similar training, experience and ability should come to the same conclusion about impressions with the same quality (clarity) and quantity of Level 1, 2 and 3 friction ridge features.

Society's Safety Net is the Scientific Process
Fingerprints

5 - What are the major problems in the scientific foundation, methods, and practice?

A. Absence of mandatory national expert certification with annual proficiency testing.
B. Absence of standardized national training to competency program for fingerprint experts.
C. Absence of sufficient fingerprint expert training facilities and programs (shortage of experts …many crimes not processed).
D. Absence of sufficient funds for needed research.
Fingerprints

6 - What research questions do you think need to be answered?

A. Absence of comprehensive statistical modeling using all friction ridge detail present (to support latent print individualization and accurate qualified conclusions).

B. AFIS technology immature for single and partial finger comparisons (often low resolution and never uses all detail). Lights-out IDs for most latent prints would dramatically increase crime solving.
Questions?

Ed German, CLPE, FFS
PO Box 1600
Newington VA  22122-1600

Email ed@onin.com
www.onin.com/ed
• BACKUP SLIDES AFTER HERE
Specimen Received from Iraq
Enhanced Close-up of Print
Latent Print Image with Minutiae
Latent Print Minutiae Only
Sample AFIS Candidate List
Elimination or Identification?
Elimination or Identification?
Elimination or Identification?
Elimination or Identification?
Elimination or Identification?
Elimination or Identification?
Elimination or Identification?
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Elimination or Identification?
Level 1 Friction Ridge Detail
...discernible at 150 ppi & 500 ppi

150 ppi  500 ppi
Level 2 Friction Ridge Detail
...bad at 150 ppi, discernible at 500 ppi

150 ppi

500 ppi
Level 1 and 2 Friction Ridge Detail
... discernible at 500 ppi and 1200 ppi
Level 3 Friction Ridge Detail
... poor resolution at 500 ppi

1200 ppi  500 ppi
Level 3 Friction Ridge Detail

... 1200 ppi superior to 500 ppi

1200 ppi

500 ppi
Level 3 Friction Ridge Detail
... 2400 ppi superior to 1200 ppi

2400 ppi

1200 ppi
Two Prints from the Same Person?

Latent Print on electrical cord from robbery

Suspect's Inked Print (from police records)
Two Prints from the Same Person?
Attempting to merge typical fingerprint biometric systems with typical forensic operations causes square peg to round hole problems…

Cooperation is more important than ever.
Legacy Data
Speaker’s Employment History

Over 35 years experience in fingerprint work.

- Local police - 3 years in Tennessee and North Carolina as Police Officer, Crime Scene Technician and Latent Print Examiner;
- State Police - 3 years as Forensic Scientist, supervised state-wide fingerprint program when Illinois became first ASCLD/LAB accredited crime lab in America;
Speaker’s Employment History (Cont.)

• Private industry - Two years with laser company in Silicon Valley, conducted laser evidence detection training in over 30 federal, state and local labs throughout America;

• US Federal Agencies - 27 years
  – Served in overseas US Government forensic laboratories 7 years (Asia and Europe);
  – Retired as number-two ranking Army CID Special Agent worldwide in 2005;
  – Currently GS-15 US Government employee;
Speaker’s Testimony and Certifications

Expert testimony over 100 times in US and overseas including 16 American states and one US territory;
Testified in first Daubert fingerprint hearing (1999);
Certified as Latent Print Examiner by International Association for Identification (IAI) since 1978;
Speaker’s Professional Memberships

Member of IAI since 1977; member of IAI Latent Print Certification Board 1983-88; Chair of IAI Fingerprint Committee 1998-99; Chair of IAI AFIS Committee 2000-2002 (current member);

Fellow of The Fingerprint Society since 1979;

Founder of Nihon Kanshiki Gakkai (Japan Identification Society) 1989;

Member SWGFAST since 1996; Chair of SWGFAST Quality Assurance Committee 1996-98; Chair of Friction Ridge Automation Committee 1998-99 and 2004-05;

Member or Midwestern Association of Forensic Scientists 1982-1992; Latent Print Section Coordinator of MAFS 1983-85;
Speaker’s Research

Participated in original research:

• Cyanoacrylate (superglue) fuming - 1979-81;
• Laser enhancement of fingerprints - 1980-83;
• Computer image enhancement of fingerprints – 1982-87;
• Reflected (Shortwave) UV Imaging Systems for fingerprints – 1986-89;
Speaker’s Publications

• Technical articles published in Journal of Forensic Identification; Identification News; Fingerprint Whorld; FBI Crime Laboratory Digest; US Government Fingerprint Symposium Proceedings; US Army Crime Laboratory Newsletters;

• Contributed content to two forensic text books;

• Authored fingerprint chapter for McGraw Hill Encyclopedia of Science and Technology;

• Since 1994, have maintained the largest and most popular Internet reference source for fingerprint information - Google “fingerprints” to reach www.onin.com