The Fingerprint Science and Ridgeology

(The following paper was presented at the August 6, 1994 SCAFO meeting)

By KURT E. KUHN
Identification Supervisor
Beverly Hills Police Department

The information contained in this paper is a review of an in-depth research project published and presented by Sgt. David R. Ashbaugh of the Forensic Identification Support Section of the Royal Canadian Mounted Police; "RIDGEOLOGY - Modern Evaluative Friction Ridge Identification". As a result of his research, the RCMP has incorporated the use of "Ridgeology" into their forensic examination of friction ridge structure. Additional research and application here in the United States has recently resulted in the identification of a latent print which contained three (3) "Galton Details" by the Federal Bureau of Identification.

The science of fingerprint identification has been undergoing dramatic changes over the past two decades. First came the introduction of the new latent fingerprint processing techniques. These new processing techniques were soon followed by the advent of the Automated Fingerprint Identification Systems. Now, latent print examiners are being introduced to additional available identification methodologies.

Ridgeology is a method of evaluating all friction ridge structure. It is based upon scientific principles and procedures that have been established and verified through years of research. The term Ridgeology refers to a forensic identification science that is associated with any and all ridge detail on the volar areas (bottoms of the hands and the feet) and not just formations that appear in these areas.

Ridgeology incorporates the use of a number of physical sciences as well as the identification sciences of edgescopy and poroscopy as it addresses the whole ridge detail spectrum. Ridgeology attempts to explain how and why friction ridge structure differs from individual to individual rather than depending upon the explanation of the basic laws of chance.

Ashbaugh interprets the examination of friction ridge structure in three levels. The first level is that of an evaluation of the pattern or ridge configuration present. The next level consists of an examination of the shape and location of the various minutiae and other accidental characteristics such as scars or areas of disassociated ridges. The final level utilizes both edgescopy and poroscopy
in an evaluation of the shape and location of each ridge unit both as an individual unit and as a whole.

Edgeoscopy was first presented in 1962 by Salili Chatterjee of India. Chatterjee envisioned an identification process where characteristics along the ridge edge would be compared and evaluated for comparison purposes. These characteristics are the result of the alignment and shape of the individual ridge units as well as the pores close to the edge of the ridge. However, these shapes are only of use when the friction ridges are clearly reproduced in both the latent and the exemplar prints.

Poroscopy was established by Dr. Edmond Locard of Lyons, France in 1912. Locard was of the opinion that friction ridges could be identified by comparing pores. Locard suggested that identification could be based upon the size, shape, relative position and the frequency of the pores. His opinion was that the agreement of 20 to 40 pores was sufficient for a positive identification.

Historically, the pore structure present in most crime scene prints and inked prints is not sufficient for comparison and evaluation. However, with the introduction of the new latent print technology, the comparison of relative pore locations is feasible. It is also sad to note that, with the development of Live Scan and Electronic Fingerprint Imaging, this new technology may be removed from the forensic identification discipline just as it was being introduced.

A significant part of Ridgeology is understanding the "Science of Fingerprint Identification." What makes fingerprint identification a "science"? In most early academic training in the forensic fingerprint discipline, we were taught that dactyloscopy was defined as the "science of fingerprints." As I began to research this presentation, I discovered that the term dactyloscopy was not necessarily correct. The word dactyl is derived from the Greek word daktylos meaning finger. Dactyloscopy, as defined by Webster, is the classification of fingerprints. However during my review and discussion with colleagues, I came across another definition that appears more appropriate. Dactylography, as defined by Webster, is the "scientific" study of fingerprints as a means of identification.

Fingerprint examiners may not always realize it but they complete each of the steps that are followed in a routine scientific procedure. Each examiner initially conducts an "ANALYSIS", then a "COMPARISON", followed by an "EVALUATION" and finally a "VERIFICATION". These scientific aspects can easily be related to fingerprint identification.

* ANALYSIS
The unknown area of friction ridge structure (latent impression) must be examined. The specific area of the finger, palm or sole of the foot suspected of making the impression is determined. The clarity of the impression and the variety of details present are established.

* COMPARISON
The friction ridge structure (latent impression) is then compared to the exemplar(s).

* EVALUATION
Similarities or dissimilarities present in the ridge structure will each have specific value toward establishing the individuality of the area of friction ridge structure. It is either an identification, not an identification or the ridge structure is no value for identification purposes.

* VERIFICATION
The opinion of the forensic identification examiner must be verified by another qualified examiner.

Fingerprint Identification is based upon the applications and interpretations of several natural sciences.

* Anatomy
The study of the development of the volar pads and the subsequent development of actual friction ridge structure.

* Genetics
The study of the similarity observed in the fingerprint pattern types and actual friction ridge structure.

* Chemistry
The use of the various new chemical procedures that have been developed.

* Neurology
The mind takes that fingerprint image seen by the eyes and transforms it into electrical impulses that are then interpreted by the brain.

* Mathematics
The use of statistical information.
Everyone in this forensic discipline is aware of the principles of fingerprint identification, as we are routinely describing them to the juries during our testimony.

**Uniqueness and Permanence**

Based on the previous information, Fingerprint Identification can be defined as a "an applied science that is objective in nature with a subjective opinion being rendered as a conclusion." Some additional clarification from Webster may be necessary to fully understand this definition. "Objective" is defined as "without bias or prejudice." "Subjective" is defined as "personal." To simplify the wording, Fingerprint Identification is an applied science that is without bias or prejudice with a personal opinion being rendered as a conclusion.

It also appears as though some of our academic training in the history of fingerprint identification has been lacking. Most everyone involved in the discipline recognizes the names Marcello Malphigi, Sir Francis Galton, Sir Edward Henry, Henry Faulds and Johannes Purkinje. But there are several other researchers who have made significant input into our field.

In 1904, Miss Inez Whipple, a Zoology professor at Smith College in Massachusetts, published a research paper entitled "The Ventral Surface of the Mammalian Chiridium". This paper addressed the evolution of friction skin. It should be also noted that several other similar research projects were conducted prior to the start of this century. (Galton 1892, Kollman 1883, Klaatsch 1888, Reh 1894, Blaschko 1884, Hepburn 1895 and Wilder 1897). Whipple's paper was considered a landmark in the field of friction ridge identification and genetics.

In 1929, Harold Cummins, an Anatomy professor at Tulane University School of Medicine in Louisiana, published a paper entitled "The Topographic History of the Volar Pads in the Human Embryo". Cummins’ paper describes the development of the volar pads at approximately the sixth week and development of friction ridge structure at about the 13th week.

In 1952, Alfred Hale, also from Tulane University, published a thesis entitled "Morphogenesis of the Volar Skin in the Human Fetus". Hale's paper described the development of the friction ridges. His research also indicated the formation of these ridges at approximately the 12th or 13th week. He also established the role of pore structure and the development of the secondary layer of ridges. It was his theory that friction ridge volar patterns are subject to both genetic and physical factors.

In 1976, Michio Okajima, a professor from Japan, published a paper entitled "Dermal and Epidermal Structure of the Volar Skin". His research established the double rows of dermal papillae present under the surface of friction ridges. The primary importance of his research was that incipient ridges are, in fact, permanent friction ridge structure.

In a recent high profile murder trial in the Los Angeles area, questions were asked regarding the research that had been conducted regarding the individuality of friction ridge structure. Those examiners testifying in the case were able to identify several of the above individuals, thus defusing a possible challenge to the training and knowledge of the examiners involved.

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*We are what we repeatedly do. Excellence, then, is not an act, but a habit.*

--- Aristotle
Age Determination - Case Report

(The following article was originally published in the April 1994 issue of Fingerprint World, the publication of the Fingerprint Society. Thank you Dennis Uyeda/CAL-DOJ for this contribution.)

by Sgt. DEAN GREENLEES
South Australian Fingerprint Bureau, Adelaide

On Saturday 29th of August, 1992, one of our Crime Scene Examiners attended the scene of a breaking at a home unit in the Adelaide suburb of Woodville. An examination was made at three possible points of entry, with the development of two full hand prints on the outside glass surface of an aluminium(sic) sliding window. These impressions were photographed at the scene by the Crime Scene technician.

The negatives of these impressions were packaged and submitted to the Fingerprint Bureau, where they were subjected to a search on the Automated Fingerprint Identification System. As a result of the search, the impressions were positively identified as belonging to a Police Officer. The necessary paper work was prepared and despatched (sic) to the appropriate authority for investigation.

During the following investigation, the officer concerned stated he had never been to the premises leaving him a suspect for the unit break and larceny. Sometime over the next couple of days, the officer stated that he recalled attending at the unit some two years ago, in response to a call. The elderly owner had inadvertently locked himself out of the premises. The officer stated that he had pushed against all the windows of the unit in an attempt to gain entry for the owner. This response required further investigation from the Departments' Internal Investigation Branch. The owner of the unit, who was then residing at a Nursing Home, was contacted and stated that he had never cleaned the windows.

On Monday 28th of September, 1992, three members of the South Australian Fingerprint Bureau attended the unit. A request had been made to attempt to age the fingerprint impressions left on the glass. An examination of the impressions, which still had not ben cleaned since the breaking, was conducted and observations were also made of the position of the window in relation to the outside elements. The impressions that had been developed were as the photographs had depicted. Good quality for powder development, showing no signs of fragmentation of ridge detail, indicating little or no breakdown of the matter deposited on the pane of glass upon contact with the fingers.

The position, under an open ended car-port, was exposed to all the weather elements including hot northerly winds, except for rain or moisture from dew. Where the glass had not been powdered, it showed signs of a dirty film over the outside surface, consistent with it not being cleaned for some time.

All observations made at the scene, led to the belief that the fingerprints were unlikely to have been left there for an extended period of time.
although it was impossible to know whether the original deposit on the window was purely perspiration or contaminated with other oils making the breakdown process longer.

Photographs of the developed impressions were also shown to a scientist from the South Australian Forensic Science Centre, who has had considerable research experience in latent fingerprints. He came to the same conclusions as the fingerprint experts, that it was unlikely the deposit was two years old as there was no signs of breakdown or fragmentation of the ridges.

Whilst further investigations were being carried out by Internal Investigation, the pane of glass was removed from the window by fingerprint experts and taken to the Bureau for further examination. The entire pane of glass was dusted with powder and a number of other fingerprint impressions were located. Internal Investigations advised that they had ascertained from records that the officer did attend the unit in August, 1990, to assist the owner in gaining entry. The records showed that the officer was accompanied at the time by a cadet, who when questioned could remember the incident and stated that he also tried all the windows in an attempt to gain entry.

With this information all the fingerprint impressions now developed on the pane of glass were examined, with more impressions of the officer concerned being identified, and, to our surprise, fingerprint impressions on the pane of glass were also identified as the cadet (sic). These fingerprints showed the same quality and powder adherence as those developed at the scene.

Both the officer and the cadet have not worked together since that event, drawing the conclusion that the impressions were deposited on the window in August, 1990. There they remained, undisturbed and undetected for a period of two years (through two summers with temperatures of 40° C and two winters with temperatures dropping to 1° C or 2° C; high humidity and low humidity) retaining sufficient moisture and form to be developed in August, 1992, without any tell tale signs of their age.

The question of 'age determination' in latent prints is one that will be talked about for many years and I agree with the concluding statement in Charles Midkiff's article, that speculation of the time a latent print was placed is fraught with danger.

I have included a few photographs showing the quality of the fingerprint impressions developed and the number located on the window.

(Operator -- Unfortunately, the photographs in the original article would not reproduce satisfactorily in this reprint. In the original article they illustrated that the prints were extremely clear and distinct.

I haven't located the "Charles Midkiff's" article to review for possible reprinting, but my search led me to another fine article from the Fingerprint Society "Latent Fingerprints - One Year Later", another testimony of the dangers of speculation, and it is reprinted on the next page of this issue of THE PRINT. Enjoy and be warned of the dangers in the speculation of when a print was placed.)
Latent Fingerprints - One Year Later

(This article appeared in the October 1986 issue of Fingerprint World)

by WENDELL W. CLEMENTS
Los Angeles Police Department

"Are you able to determine the age of a latent print?" is a question commonly asked of everyone who has given expert testimony in a court of law. It can only be answered in the negative, unless there is an eye-witness who observed the defendant handle the object or area were the prints were discovered. There may be other circumstances that provide us with information to make an educated guess as to the age of latent prints, but that would be the exception and not the rule.

The age of latent prints, fingers and palms, can have a strong impact on the outcome of a case, convincing a jury that physical evidence, latent prints, may be the deciding factor in the defendant's guilt. The issue has been a thorn in the side of prosecutors who have little else to offer as evidence.

An incident that occurred in Los Angeles will offer no comfort to the prosecutor concerned with the age of latent prints identified to a defendant.

In August, 1983, a Los Angeles Police Department latent print investigator responded to the scene of a church burglary. He developed two latent fingerprints from the point of entry that were eventually identified as the suspect's left middle and ring fingers.

Sound familiar?

The suspect was not apprehended, prosecuted and convicted. Why? He hadn't committed the crime!

The church burglarized in September, 1984, was the same church burglarized in August, 193, and the person identified to the latent fingerprints from the second burglary was in prison for the first burglary at the time of the second crime. Interesting, isn't it?

As you may have guessed, the answer to the riddle is that the second latent print investigator, in 1984, developed and lifted the very same latent fingerprints developed and lifted by the first latent print investigator a year earlier. Placed over each other, lift on lift, the latent fingerprints fit like a glove, matching position-wise and in every detail. The only difference is that the ridge structure in the second lift is weaker, though clearly identifiable.

It isn't unusual to develop and lift the same latent prints more than once. Glass and smooth, painted metal surfaces lend themselves to the possibility. In this case, the latent fingerprints were developed with magna powder on an interior wood door frame, and the time element is very significant in that more than 12 months elapsed between the first and second latent print investigations.

The question is not only how long latent prints will remain on an object before development, but how long they remain after development and lifting, as in this case, and retain clarity of detail.

Also of interest is another question: If the person convicted of the first burglary had not been in prison at the time of the second burglary, would he not have been charged with the second crime?

It can be argued, and correctly so, that this situation has absolutely no bearing on the validity of latent print science, as there is no doubt as to the identification of the latent prints.

We have the responsibility of testifying to our findings and conclusions, based on knowledge and experience acquired over a period of time. If we are to remain objective, allowing others to decide issues of guilt or innocence, we are charged with presenting scientific evidence in an honest and impartial manner.

It is not for us to be concerned with the legal or moral questions of each case in which we are involved. Whatever the outcome, we have done our duty.

(Editor -- Years ago I reviewed a case where the suspect was accused of two burglaries several months apart. Both burglary allegations were based principally on latent print identifications. The suspect admitted the first and adamantly denied the second. A review of the latents from both scenes revealed them as first and second lifts, three months apart. The same expert had conducted both investigations. During the second investigation, he recalled the first time he was there and examined the surface for evidence from the prior printing, no indication or evidence of the prior dusting and lifting of prints remained. The victim also concurred and indicated he had washed the window by spraying it with a water hose after the initial investigation. Besides the obvious caution this case provides, it is also significant as the second lifts were of a better quality in appearance -- even three months after deposition.)
Dear Lieutenant Blake:

I have your letter of March 4, 1958, to Special Agent G.J. Engert, concerning points of identity in latent fingerprints.

Under the prevailing rules of evidence in the United States, the courts do not have the discretionary power to determine how many points of identity are necessary for an identification. The FBI is not in possession of nor does it know of any court decision requiring twelve points or any specific number of points of identity.

Under the rules of evidence, fingerprint testimony is expert testimony and as such is opinion evidence. Therefore, anyone who qualifies in court as an expert may testify as to his opinion regarding a comparison of two prints regardless of the number of points.

FBI experts have testified in court to as few as seven points, and many times, in both Federal and state courts, to less than twelve points.

It is known that some departments, and even the FBI at one time, have a standard that the fingerprint expert must find at least twelve points before being permitted to testify, merely as a precaution, feeling that if the expert can find twelve points he will not be mistaken as to the identification.

The FBI discontinued the policy of requiring twelve points a number of years ago because experience, acquired through many years of handling millions of fingerprints, has shown that positive identifications can be made on less than twelve points. Each case is decided individually. Weight is given not only as to the number of points, but also as to their clarity, type, and relation to each other.

I hope that you will find the above information is of assistance to you.

Sincerely yours,

John Edgar Hoover
Director
Photographic Corner

(By George Reis)

One of our crime scene investigators photographed injuries to an 18 month old boy. He used an ABFO scale and color chart in several of the photographs. Twenty-four hours later another photographer (a person contracted by the county, who testified for the prosecution in this case) also took photographs of the child.

During the cross examination of this photographer, questions were raised regarding the accuracy of the color in the photographs. This became an issue particularly because there were reflections on some of the color charts, causing them to appear lighter in the print.

I then testified to attempt to clarify why there was a discrepancy. I stressed in my testimony two specific issues regarding the use of the scale/color bar.

The first issue was regarding why we include a scale/color bar in some of our photographs. The important point here is that it is used as a reference and an aim point. But, it is not intended to be exactly reproduced in the prints. Because of reflections, shadows, textures, distance from the light source, the recording nature of the film, etc., the color bar cannot be reproduced exactly. But, it can, and should, be used as a reference. That is, just as the scale is a reference to size (even if it is not reproduced 1:1), the color bar is a reference to the color in the print.

The second point was similar to what we have in fingerprints, that there can be no unexplainable differences in brightness and color to claim that the print is an accurate representation of the scene or object. That is, any differences between the brightness or color of the color bar, and that of the print must be explainable as a reflection, shadow, film characteristic, etc. I believe that these two points, made in our original testimony, can help save confusion when defense attorneys try to question the accuracy of our photographs.

The PRINT will publish material relating to the science of friction skin identification, crime scene investigation, photography or related material contributing to the promotion of our association's purposes. It will also serve as minutes for the association's meetings. To this end, the editor requests any person with original material or previously published material of interest to submit it for publication consideration. The editor would also appreciate any helpful criticism, which could benefit the publication and/or organization.

Editor -- Alan McRoberts
Los Angeles County Sheriff's Dept.
2020 West Beverly Blvd.
Los Angeles, CA 90057-2404
Work (213) 974-4605
FAX (213) 413-4283

(Editor -- Thanks again George and we look forward to the next submission)
Did you ever wonder what your forensic talents are worth to the agency you are employed by? The below fee schedule is one set by the Alameda County board of supervisors for the sheriff's department to offset operating costs. Present budget constraints require more agencies to consider similar action.

Fraternally,

Bill Corson

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<th>Most Common Forensic Analysis</th>
<th>Estimated Hours</th>
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<td>2. Fingerprint -- Latent Examination/Comparisons</td>
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<td>11. Impression Examination -- Footwear, Tires</td>
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(Editor -- Thanks Bill for your continued support in providing various items of interest)

In Memory of

John Joseph "Jack" Fives
S.C.A.F.O. Member -- Since 1990

Born March 19, 1926 Died July 12, 1994
Los Angeles County Sheriff’s Department Volunteer
Letter from the President

Welcome back after a brief break in July from our monthly meetings! I would like to thank everyone who attended the Knott's Berry Farm meeting. In addition, a sincere thanks goes to Kurt Kuhn for a good introduction to our seminar topic on Ridgeology. With the Annual Seminar just around the corner, our planning committee is working very hard to make it enjoyable and successful. Jim Lawson requests that you inform him of your choice of dinner, either fish or prime rib, when making your reservation. Please get your seminar and hotel reservations in as soon as possible, since space is very limited.

Our Association was saddened when we received the news that Jack Fives had passed-away on July 12. Jack was a member since 1990 and worked with the Santa Clarita Valley Sheriff’s Station as a volunteer performing latent print analysis. Jack was unconditionally generous with his time and talent, and was always interested in what was best for the Sheriff’s Department and the community he served. Jack will surely be missed and fondly remembered by SCAFO.

I would like to introduce our newest member, Teresa Hendrick, L.A.S.D., who was sworn-in at our August meeting. Please offer a warm welcome to her.

Our upcoming seminar promises to be an educational and enlightening experience for those who attend. I hope to see all of you at the 4th Annual Training Seminar at The Greens Executive Conference Center on September 10!

Warm regards,

Clark Fogg

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August Meeting Minutes

<table>
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<th>Date:</th>
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<td>Clark Fogg Beverly Hills Police Dept.</td>
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Net Gain $62.19
Attendance Drawing $30.00

The meeting was called to order at 2020 hours by President Clark Fogg. Flag salute was led by Past President Dell Freeman. Past Presidents in attendance were: Dell Freeman (1973), Lynette Atwood (1983), and Tim Golt (1992).

Program:
The Fingerprint "Science" and Ridgeology
Kurt E. Kuhn
Beverly Hills Police Department

Old Business:
Swear in of new members
Teresa Hendrick -- L.A.S.D.
by Past President Lynette Atwood

Second Reading: (motion to accept)
Wally Briefs -- Sunnyvale Police Dept.
Motion by Lou Herbert
2nd by Lynette Atwood

New Business:
First Reading:
David Van Nybuis -- San Diego Sheriff's Dept.
recommended by Lisa DiMeo -- San Diego Sheriff's

Announcements:
80th Annual I.A.I. Training Seminar will be held in Costa Mesa in July 1995, plan now to attend.

Attendance Drawing:
Won by Maggie Black -- Orange Co. Sheriff's Dept.

The meeting was adjourned at 2130 hours.
Employment Opportunities

Forensic Print Specialist
City of Los Angeles
Obtains latent prints at crime scenes; fingerprints dead bodies and severed fingers for fingerprint identification; uses various chemicals to process latent prints, including laser application; compares single, partial, and distorted finger and palm latent prints with exemplar prints; takes plaster cast impressions; and appears in court as an expert witness.

Requires two years of full-time paid experience in a latent fingerprint unit of a law enforcement agency in developing and comparing latent finger and palm prints and giving expert testimony in a court of law; or four years of full-time paid experience as a fingerprint classifier with a law enforcement agency. Filing may close without prior notice.

Salary: $3,064 to $3,807 monthly
Submit official City application and supplemental form at:
Personnel Department
700 East Temple Street, Room 100
Los Angeles, California 90012
Call (213) 847-9240 for application
An AA/EEO Employer

Forensic Identification Specialist II
The Los Angeles County Sheriff's Department is currently accepting applications for qualified Latent Print Examiners.
Salary: $3607 - $4476 monthly
Contact: Wayne Plumtree/Supervising Criminalist
Los Angeles County Sheriff's Dept.
Identification Section
2020 West Beverly Blvd.
Los Angeles, CA 90057-2404
(213) 974-4605

"Every man owes a part of his time and money to the business or industry in which he is engaged. No man has a moral right to withhold his support from an organization that is striving to improve conditions within his sphere."
- President Theodore Roosevelt - 1908

For subscription or membership information contact:
S.C.A.F.O. Bill Leo Secretary-Treasurer
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4th Annual S.C.A.F.O. Training Seminar
September 10, 1994
Limited Registration (75)
Pre-Registration Necessary

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7 Points of Identity in Latent Prints

8 Photographic Corner

10 President's Letter
August Meeting Minutes

Upcoming Events/Schools/Seminars --

Sept 10, 1994
4th Annual S.C.A.F.O. Training Seminar
Escondido, CA
Wolford Award Nominations Due

October 1, 1994
S.C.A.F.O. Meeting
Host: Diana Castro -- Los Angeles P.D.
Nominations for S.C.A.F.O. Board of Directors

October 15, 1994
C.S.D.I.A.I.
San Simeon, CA

October 19 - 22, 1994
Personal Identification Course
Pasadena, CA
C.A.C. & Forensic Science Society

November 5, 1994
S.C.A.F.O. Meeting
Debbie Coats -- Pasadena P.D.
(Elections)

December 3, 1994
S.C.A.F.O. Meeting
Doug Duckson -- Torrance P.D.

July 1995
I.A.I. 80th Annual Training Seminar
Costa Mesa, CA

Southern California Association of Fingerprint Officers
An Association for Scientific Investigation and Identification Since 1937