IN THE CIRCUIT COURT OF THE THIRTHEETH JUDICIAL CIRCUIT
LASALLE COUNTY, ILLINOIS

PEOPLE OF THE STATE OF ILLINOIS,	)	
	)	
Respondent,	)	
	)	
vs.	)	**No. 60-CF-753**
	)	
	)	
CHESTER WEGER,	)	
	)	
Petitioner.	)	

AFFIDAVIT OF CHRISTOPHER PALENIK, PHD

Now comes your affiant, Christopher Palenik, PhD, and under oath hereby states as follows:

1. I am of legal majority and can truthfully and competently testify to the matters contained herein based upon my personal knowledge and to a reasonable degree of scientific certainty. The factual statements herein are true and correct to the best of my knowledge, information, and belief.

A. Qualifications – Background – Dr. Palenik

2. I have been involved with forensic trace evidence for as long as I can remember. I started working on forensic research, publishing my first article on forensic hair analysis when I was twelve, presenting research on forensic paint analysis at a scientific meeting when I was fourteen, and cutting cross sections of the thousands of fiber samples in our fiber reference collection, including several DuPont Orlon samples (a fiber directly relevant to this case) over my high school summers. My experience broadened when I conducted a year-long mentorship

at the Internal Revenue Service Forensic Laboratory on the subject of ink chemistry and started to directly observe the handling of evidence and casework. I then carried out an internship at the Bundeskriminalamt, the national German police service's forensic laboratory, where I conducted work on forensic paint analysis. Following my Ph.D., which was conducted on the neutronics of a naturally occurring nuclear reactor, I conducted a postdoctoral fellowship at the FBI research laboratory in Quantico, VA.

3. Since 2005, I have been practicing as a forensic microscopist at Microtrace, where I have conducted casework on a wide range of materials that include, among others, hair, fibers, soil, polymers, ink, paint, tape, and glass. I have conducted federally funded forensic research as a principal investigator and have published results in peer reviewed journals. I have been invited to speak around the world, including talks at INTERPOL in Lyon, France; and I have served on appointed positions including the National Institute of Justice Sponsored OSAC, responsible for writing and approving United States Forensic Science Standards.

B. Qualifications – Case Specific Qualifications – Dr. Palenik

4. I have analyzed evidence, submitted on behalf of both the prosecution and defense, that is both recent and quite old (going back as far as the 1960's), which was in a variety of conditions: sealed and unsealed, mold damaged, waterlogged, largely consumed, and lacking proper identifiers. I have discussed and advised clients for both prosecution and defense teams on the potential probative value of such evidence. In many of these instances, we have had the opportunity to conduct analyses on such evidence. A full copy of my CV is attached hereto as Appendix A.

5. I have published on microscopical hair analysis and have worked on a variety of cases involving hair analysis. In addition, Microtrace staff have conducted hair comparisons in local, state, federal, military, and foreign cases. Microtrace staff have taught courses and presented around the world on forensic hair microscopy. Microtrace staff members have recently

authored book chapters and peer reviewed publications on microscopical hair analysis, forensic fiber analysis, and the microscopical analysis of trace evidence. Microtrace scientists have been and are currently members of various committees (e.g., OSAC, SWGs, and ASTM) that are responsible for drafting, editing, and voting on standards for the forensic analysis of hair.

6. I been conducting experimental casework, analysis, and research on the study of inks and documents for several decades. This has included research at the Internal Revenue Service forensic laboratory, internal research on document and ink analysis at Microtrace, and the analysis of ink and documents in matters of criminal forensic and civil litigation. I have conducted research on paper, ink, and the components of ink. I was invited to present a talk at INTERPOL in Lyon, France on the subject of counterfeiting analysis. I am presently an affiliate to the OSAC questioned document section.

C. Qualifications – Microtrace

7. Microtrace was founded in 1992 by Skip Palenik. Microtrace now consists of a 10,000 square foot laboratory built for the purpose of identifying, comparing, and determining the sources of small, unknown particles, residues, and liquids. Microtrace's staff has roughly 200 years of collective experience in this niche area of microanalysis and identification.

8. Our clients in criminal investigations represent both the prosecution and defense. These include federal and state laboratories, prosecutors, defense attorneys, and innocence projects. We also work with clients in civil and patent litigation. Working with clients from both sides of the courtroom has helped us to establish a reputation for providing discrete, unbiased, and scientifically supported results.

9. In addition to forensic work, we provide our services to a wide range of businesses including the pharmaceutical, food and manufacturing industries, which gives us perspective into the history of materials and the development of some of the newest materials.

10. As microscopists we have repeatedly demonstrated our capability of locating, detecting, and identifying clues that other laboratories have missed or that exceed the capability of traditional forensic laboratories. In the Green River Murders (the largest serial murder case in U.S. history), we located and analyzed microscopic paint particles found on the victims' clothing that were one to two orders of magnitude smaller than the evidence the state's crime laboratories located. The microscopic polymer particles isolated, analyzed, and sourced were instrumental in obtaining the confession of Gary Ridgway to the murders of 48 women.

11. Notable forensic cases in which we have provided assistance include: the Green River murders, the JonBenét Ramsey Case, the assassination of Dr. Martin Luther King Jr., the Atlanta child murders, the "Ivan the Terrible" case , the "Kiki" Camarena kidnap and murder, the murder of Danielle Van Dam , the Unabomber case, the Swiss Air crash, the Narita Airport bombing, the Air India bombing, the Hillside Strangler, the Freeway Strangler, the Oklahoma City bombing, the disappearance of Helen Brach , the murder of Jeanine Harms, the disappearance of Timothy Pitzen, and the murder of Teresa Halbach (Making a Murderer).

12. Our laboratory has a wealth of experience in the identification and comparison of a wide range of trace evidence materials that include, but are not limited to: hair, fibers, paint, tape, unknown materials, gunshot residue, fire debris, glass, soil, wood, drugs, body fluids, food, lubricants, metal, cremains, dust, documents, ink, polymers, and building materials, to name a few.

D. Qualifications – Quality Control, Registrations and Licenses

13. Microtrace is accredited to ISO 17025, the same accreditation held by forensic laboratories around the world, including the FBI, DEA and ATF.

14. Microtrace holds an ATF Manufacturer's license and is registered with the State of Illinois to store and analyze explosives.

15. Microtrace holds a DEA license and can accept and store all scheduled drugs.

E. Goals of this Analysis

16. In this matter, Hale & Monico have asked Microtrace to pursue the following goals through the analysis of existing evidence:

    a. Hair Screening. Microscopically screen various hair evidence to locate candidate hairs for DNA analysis. More specifically, Microtrace would non-destructively examine hair evidence from various items of clothing to identify candidate hair that is microscopically different from that of the victims. This is a common step in the DNA analysis process.

    b. Trace Evidence. Determine if evidence of a murder weapon exists among the trace evidence collected from the scene. More specifically, select evidence would be microscopically examined for trace materials potentially related to the murder weapon(s). The evidence requested below would be screened for materials including, but not limited to, metal and wood. This debris would be microscopically analyzed to identify the material and its properties and to identify or place constraints on potential sources of the debris. The clothing of the victims would also be examined for evidence of urination or defecation. The approaches, techniques and extent of data available for interpretation were not available at the time the original analyses were conducted.

    c. Document Examination. A typed version of the Chester Weger statement with apparent original signatures was observed by Attorney Hale on 9 March 2023. Based on an review of photographs provided to me, some potential irregularities were observed within and among the Weger signatures. For instance, Figure 1 of Appendix B shows a Chester Weger signature in which the "Chester" and "Weger" appear to be written with two distinctly different thicknesses of ink stroke and two different colored inks. In Figure 2 of Appendix B, "Chester W" appears to be written in one ink and "eger" appears to be written in a second ink. Finally, in Figure 3 of Appendix B, the entire

signature appears to be written with a single ink. I am requesting the opportunity to conduct a non-destructive inspection of this document, and in particular, the signatures, to scientifically explore these apparent anomalies at our laboratory.

17. Here we are asking to review a significant amount of physical evidence. During the original investigation, leads and analyses appear to have been largely pursued in a piecemeal fashion. The major reason for requesting this larger set of evidence at one time is to permit the evidence to be looked at in totality (or as close to totality as is possible in 2023 given the current catalog of evidence). There is literature demonstrating that a broader view of the evidence can lead to probative avenues not visible from a piecemeal analysis of individual items (e.g., Ristenbatt et al., 2021, a copy of which is provided in Appendix B). Here, a screening of the broad range of trace evidence that was collected and preserved has the potential to reveal significant probative evidence not recognized in the original analysis. This potential is based upon modern approaches to trace evidence analysis that were not available in the 1960's including (a) modern analyses that draw from a wide range of new scientific approaches and instruments and (b) more developed and advanced avenues of interpretation-based stemming from more advanced knowledge of materials. The suite of evidence requested here will permit a variety of different questions to be pursued at a higher level than the original work and at a higher level than had been previously possible (see the section "Analytical Approach – Trace Evidence").

F. Case Relevance – Hair Screening

18. The screening of hair evidence by microscopy prior to DNA analysis is a routine step in the forensic analysis of hair evidence. This non-destructive, pre-DNA analysis stage is intended to select candidate hairs for DNA analysis (nuclear or mitochondrial).

19. There are two positive outcomes to the microscopical screening process:

    a. One reason non-destructive hair screening by microscopy is utilized in casework is to prioritize or reduce the number of hair samples submitted for destructive DNA analysis. A microscopical screening serves to reduce the number of hairs submitted for

consumptive (or partially consumptive) DNA analysis by selecting those with microscopical characteristics that are consistent or inconsistent (depending on the question) with known hair samples. In this case, questioned hairs would be microscopically screened through comparison to standards of the victims' hair to select hairs that do not share microscopical characteristics with the victims' hair.

b. A microscopical screening also serves to document and memorialize features of hair evidence prior to destructive DNA analysis. This information would be forever lost if not previously examined and documented.

20. Microtrace is regularly hired by both prosecution and defense teams as well as DNA laboratories to conduct microscopical screenings of hair evidence for these purposes.

G. Case Relevance – Trace Evidence

21. Since the original work on the starved rock murder case was done in the 1960's, there have been major technological advances at every level of the trace evidence analysis process, including sampling and sample preparation, analysis, and interpretation. The requested analyses would utilize these advances in an attempt to develop new, probative information in this case.

22. In addition, a complete set of trace evidence reports generated in this case does not exist. As a result, we do not have a full record of the analyses that were conducted or the conclusions that were reached. These analyses would lead to a more complete understanding of the trace evidence and provide for the exploration and potential development of new, probative information in this case.

23. The Microtrace laboratory is as well equipped, and in many areas better equipped, than other trace evidence laboratories in the United States. Microtrace is also active in the forensic community in the areas of research, teaching, publications, and presentations. Microtrace is also hired by companies that manufacture a wide variety of materials, many of which eventually become trace

evidence. For these reasons, Microtrace has developed an international reputation for providing trace evidence results that serve and advance the criminal justice system.

24. Microtrace is routinely hired to constrain and identify the sources of trace materials, including fibers, wood, metal, and bodily fluids by defense and prosecution teams as well as clients at major food and pharmaceutical companies.

25. Microtrace has been involved in numerous cases where evidence has been submitted without specific target items. In other cases, Microtrace has identified new categories of probative microscopic particles of evidence that were not anticipated or expected. For example, Microtrace analyzed clothing in a serial rape case in which the suspect was not in any of the DNA databases. In this case, we identified various particles within the dust received from clothing left at the scene of two separate attacks as being consistent with someone involved with commercial dry wall installation. Following a media release, the police stopped a dry wall installer who confessed to the rapes. This illustrates the potential probative value of a thoughtful microscopical examination, and how such particles of interest would have been missed in a typical trace evidence investigation focused only on the comparison of typical materials such as fiber and hair.

26. This combination of laboratory and instrumental capabilities coupled with theoretical and technical expertise has put Microtrace in the position to find new, probative evidence in numerous cases that had been previously examined by other forensic laboratories. A recent NBC news article on the Green River Murder investigation documents "How a crime lab missed evidence that could have stopped the Green River Killer" that was later found by Microtrace. A PDF of this article is attached as Appendix C. This represents one of many examples where Microtrace has provided information previously missed. In another case, a suspected make-up stain had been almost entirely consumed by another laboratory in a non-probative analysis. From a nearly invisible, trace amount of remaining residue, Microtrace staff found and later testified to the presence of a suite of particles that were consistent with makeup. These represent two of the numerous cases in which

Microtrace has provided probative information after evidence had been initially analyzed by one or more laboratories.

H. Case Relevance – Document Examination

27. The Chester Weger Statement (Ex 76) was, to our knowledge, never examined by any forensic analysis. This document, which recently came to light, played a critical role in the conviction of Mr. Weger. We are requesting the opportunity to conduct an entirely non-destructive analysis of this document to look for inconsistencies and alterations, the potential significance of which can only be speculated on after the document is examined. Microtrace has studied, presented on, and conducted casework on the forensic examination of inks and documents. Last summer, two interns at our laboratory conducted a summer research project that I directed dedicated entirely to the non-destructive study of early to mid-20th century inks.

I. Analytical Approach – General Sample Handling

28. The samples will be handled in the following manner:

    a. All samples requested below are to be submitted to Microtrace for analysis at Microtrace in Elgin, IL. Microtrace staff can pick up the evidence from the LaSalle County Court or it can be hand delivered or shipped to Microtrace.

    b. Each sample shall be maintained under chain of custody from receipt at Microtrace to its return.

    c. Each package containing samples shall be photo-documented upon receipt.

    d. Each evidence package shall be opened and individual exhibits shall be compared against the chain of custody.

    e. Each item of evidence shall be photo-documented in its as received condition.

f. Analyses of individual items shall be conducted per the "Analytical Approach – Hair" or "Analytical Approach - Trace Evidence" as detailed below.

g. Upon completion of analysis, each item shall be individually repackaged, sealed and initialed.

h. Samples shall be returned under chain of custody to a court specified location (e.g., the submitting agency or a DNA laboratory).

J. Analytical Approach – Hair

29. This is a non-destructive examination that is commonly applied in forensic cases that involve hair. In this case, the goal of the microscopical hair screening is to screen for hairs that are inconsistent with the victims' hair. It is anticipated that a set of these hairs would then be selected for further analysis by a DNA technique.

30. The hair samples requested generally fall into three categories: (a) loose hair, (b) hairs placed between two glass slides without a mounting medium, and (c) hairs on a prepared slide mounted in a permanent mounting medium.

31. Following documentation described above, the microscopical examination and comparison shall be conducted as follows:

a. Hairs shall be examined and compared by stereomicroscopy to evaluate applicable larger scale features. Features of interest shall be photo documented, as applicable.

b. Unmounted hairs shall be mounted in a temporary mounting medium (this medium evaporates and leaves the hairs in an unaltered state following examination). Permanently mounted hairs are already prepared and do not require further preparation.

c. The hairs shall be studied under a compound microscope and then compared under a comparison microscope, if necessary. Features of interest shall be photo documented, as applicable.

d. The comparison may consist of a comparison of known hairs to known hairs, known hairs to questioned hairs, and questioned hairs to questioned hairs. The purpose of these comparisons is to compare and group questioned hairs by their macroscopical and microscopical properties.

e. The result of this examination shall be a report detailing the findings with a summary of hairs classified into various groups. It is anticipated that this report will serve as a basis for a future DNA analysis request.

K. Analytical Approach – Trace Evidence

32. The trace evidence analysis would focus on the following categories:

a. Samples will be screened for particles of wood and metal. The wood and metal would be isolated and analyzed to identify or place constraints on their potential sources/origin.

b. Red fibers observed on/in numerous items of trace evidence will be characterized, compared to place constraints on their possible source/origin.

c. The clothing samples of the victims will be screened for residues, which would be tested for evidence of urination/defecation.

d. Other particles of interest. The evidence will be screened and examined for other particles of potential probative value. Such particles cannot be anticipated or predicted and can only be found by conducing a broad and thoughtful screening.

33. The trace evidence samples include: (a) clothing of the victims, (b) materials recovered from the scene, and (c) traces already isolated such as samples between two glass microscope slides.

34. Following the General Sample Handling described above, the microscopical examination and analysis would be conducted as follows:

    a. Trace evidence would be screened by stereomicroscopy to identify particles and materials of interest. Larger items of evidence may be vacuumed to recover and concentrate trace evidence onto a filter, which would then be examined by stereomicroscopy.

    b. Particles of interest would be photodocumented.

    c. Particles of interest would be isolated for further analysis using micromanipulation tools such as forceps or a tungsten needle.

    d. Isolated particles/materials would be subjected to a suite of analyses appropriate to the material (e.g., wood, metal, fibers). These analyses would focus on properties that would help to compare and/or identify or constrain their origin. These methods include microscopy, vibrational spectroscopy, and chemical and elemental analysis.

    e. Results supporting the findings of these analyses would be documented appropriately.

L. Analytical Approach – Document Examination

35. The document and writing on it would be non-destructively analyzed for inconsistencies and alterations.

36. Methods of analysis may include: stereomicroscopy, alternate light sources, electrostatic detection apparatus, micro-x-ray fluorescence spectroscopy and Raman microspectroscopy.

37. Results of these analyses would be appropriately documented.

M. Samples Requested – Hair

Note that the exhibit numbers listed were taken from the Microtrace catalog of evidence (17 August 2021). Appendix D shows each item of evidence. Note that some items consist of multiple pieces (e.g., clothing, debris mounted in glass, particles permanently mounted) that are labeled as X.1, X.2, etc (where X is the exhibit number).

38. The following known hair samples are requested:

a. France Murphy, Victim A (Ex 1)

b. Mildred Linquest, Victim B (Ex 2)

c. Lillian Oetting, Victim C (Ex 3)

d. Chester Weger (Ex 945, 946)

e. Nicolas Spiros (Ex G11)

f. George Spiros (Ex G12)

g. Spiros Dog, Part Chin Part Shepard (Ex G54, G55)

h. George Nemke (M3a)

39. The following questioned hair samples are requested:

a. Hair from hand/finger of Victim C (Ex 4)

b. Locks of hair from cave (Ex 7)

c. Hair from binoculars (Ex 8)

d. Hair from cave (Ex 9)

e. Miscellaneous debris from Victim C body (Ex 14)

f. Hair from Victim C gray coat (Ex 15)

g. Potential hair from Victim C stockings (Ex 16)

h. Hair from Victim C shoe (Ex 17)

i. Hair from Victim C right glove (Ex 18)

j. Hair and debris from jacket of Victim C (Ex 19)

k. Strap with apparent hair (Ex 20)

l. Strap with apparent hair (Ex 21)

m. Hair from binocular case (Ex 23)

n. Debris from Victim B gloves with potential hair (Ex 39)

o. Hair and string from cave (Ex 51)

p. Debris from Victim C coat with potential hair (Ex 114)

q. Debris from Victim C skirt with potential hair (Ex 115)

r. Debris from Victim C suit jacket with potential hair (Ex 116)

s. Debris from Victim C slip with potential hair (Ex 117)

t. Debris from torn white panties of Victim C with potential hair (Ex 119)

u. Debris from blouse of Victim C with potential hair (Ex 121)

v. Debris from left boot and shoe of Victim C to screen for hair (Ex 128)

w. Debris from left glove of Victim C to screen for hair (Ex 129)

x. Debris from right glove of Victim C with potential hair (Ex 130)

y. Debris from clothing of Victim C with potential hair (Ex 907)

z. Debris from panties of Victim B with potential hair (Ex 909)

aa. Debris from girdle of Victim B with potential hair (Ex 910)

bb. Debris from binocular strap, right half (Ex 912)

cc. Debris from skirt of Victim A with potential hair (Ex 913)

dd. Debris from skirt of Victim B with potential hair (Ex 914)

ee. Debris from right shoe of Victim B with potential hair (Ex 915)

ff. Debris from bra of Victim B with potential hair (Ex 916)

gg. Debris from jacket of Victim A with potential hair (Ex 917)

hh. Debris from right boot of Victim A with potential hair (Ex 918 and 919)

ii. Debris from jacket of Victim B with potential hair (Ex 920)

jj. Debris from binocular strap, left half (Ex 921)

kk. Debris from coat of Victim B with potential hair (Ex 922)

ll. Debris from slip of Victim A with potential hair (Ex 923)

mm. Debris from right glove of Victim A with potential hair (Ex 925)

nn. Debris from slip of Victim B with potential hair (Ex 926)

oo. Hair and fibers taken from log (Ex 964)

N. Samples Requested – Trace Evidence

40. The following additional samples as well as each of the samples listed in the hair screening section are requested for trace evidence analysis:

i. Wood from the body of Victim C (Ex 6)

ii. Red fibers collected from the scene (Ex 12)

iii. Left hand clove from Victim A (Ex 13)

iv. Possible skin from handkerchief of Victim C (Ex 14)

v. Mounted hair from camera case (Ex 22)

vi. Red fibers found on trail (Ex 36)

vii. Gray jacket of Victim C and slides with debris from jacket (Ex 114)

viii. White girdle of Victim C and slide with red debris from girdle (Ex 118)

ix. Green scarf of Victim C (Ex 122)

x. Brown stockings of Victim C (Ex 123)

xi. Brown stockings of Victim C (Ex 124)

xii. Brown oxfords belonging to Victim C and isolated debris (Ex 128)

xiii. Binocular strap and debris from strap, right half (Ex 912)

xiv. Binocular strap and debris from strap, left half (Ex 921)

xv. Test tubes (Ex 927)

xvi. Sand from the scene (Ex 938)

xvii. Hair and fiber from clothing of victim A (Ex 961)

xviii. Blanket Fibers, 1st Bed, Room 109 (Ex F15)

xix. Bed Spread, 2nd Bed, Room 109 (Ex F19)

xx. Blanket Fibers, 2nd Bed, Room 109 (Ex F20)

xxi. Blanket fibers, Room 110 (Ex H2)

xxii. Fibers 1950 Plymouth (Ex K7)

xxiii. Fibers from sweaters in Bailey's locker (Ex M1)

xxiv. Red fibers from Art Askew shirt (Ex O1)

xxv. Fibers from George Spiros jacket (Ex O2)

O. Samples Requested – Document Examination

41. Chester Weger Statement with original wet signatures and initials dated 2:02 am 17 November, 1960 (Ex 76)

P. List of Appendices

42. Appendix A. Curriculum Vitae of Dr. Christopher S. Palenik

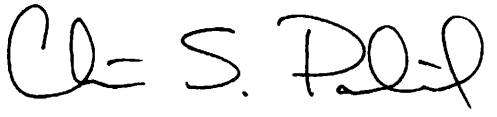
43. Appendix B. "Ristenbatt, R.R., Hietpas, J., De Forest, P.R., Margot, P.A. (2021) Traceology, criminalistics, and forensic science. Journal of Forensic Sciences. 28-32.

44. Appendix C. "How a crime lab missed evidence that could have stopped the Green River Killer" by Lewis Kamb, NBC News (https://www.nbcnews.com/news/us-news/gary-ridgway-green-river-serial-killer-washington-rcna67794?cid=sm_npd_nn_tw_ma)

45. Appendix D. Images of evidence requested for analysis at Microtrace.

FURTHER AFFIANT SAYETH NAUGHT

Under penalties as provided by law pursuant to Section 1-109 of the Illinois Code of Civil Procedure, the undersigned certifies that the statements set forth in this instrument are true and correct except as to matters therein stated to be on information and belief and as to such matters the undersigned certifies that he verily believes the same to be true.



Christopher Palenik, Ph.D.
Microtrace LLC

Curriculum Vitae

of

Christopher Samuel Palenik, Ph.D.

(cpalenik@microtrace.com)

Current as of 12/21/2022

Microtrace
790 Fletcher Drive
Suite 106
Elgin, IL 60123-4755

847.742.9909 (p)
847.742.2160 (f)

www.microtrace.com

Table of Contents

Educational History

2002-2004	University of Michigan, Department of Geological Sciences Ph.D. Geology Dissertation Chair: Prof. Rodney C. Ewing Dissertation Committee: Prof. Eric J. Essene, Prof. Ronald Fleming, Prof. Lumin Wang, Prof. Lynn Walter DOE-OCRWM fellowship recipient Horace H. Rackham 2004 Distinguished Dissertation Award
1999-2001	University of Michigan, Department of Geological Sciences M.S. Geology Prof. Rodney C. Ewing, Advisor
1995-1999	University of Chicago B.S. Chemistry, B.S. Geology
1992-1995	Illinois Mathematics and Science Academy, Aurora, IL
1991-1992	Saint Edward's Catholic Central High School, Elgin, IL

Employment

2005 - Present	Vice President and Senior Research Microscopist, Microtrace, a forensic laboratory specializing in small particle analysis using microchemistry and microscopy.
2004-2005	Federal Bureau of Investigation (ORISE sponsored) Post-Doctoral Fellow in the Counter Terrorism and Forensic Science Research Institute.
1999-2004	Graduate Student Research Assistant in the Electron Microbeam Analysis Laboratory, University of Michigan. Duties include training and assistance to university scientists in TEM, EMPA, XRD, and SEM/EDS.
1999-2000	Graduate Student Instructor for Determinative Methods (GS-455). Teaching responsibilities included XRD, SEM, Microprobe, Raman, FTIR.
1993-2004	Microscopist (consultant) at Microtrace, a forensic laboratory specializing in small particle analysis using microchemistry and microscopy.

Licenses and Registrations

- DEA Licensee to purchase, handle, analyze all scheduled controlled substances
- ATF Manufacturer's Explosive License
- Illinois Explosive License
- USDA soil permit
- Illinois Firearms Owners Identification Card (FOID)

Appointments and Committees

- Chemistry/Instrumental Analysis Scientific Area Committee's (SAC's) Materials (Trace) Subcommittee within the Organization of Scientific Area Committees (OSAC), appointed by Mark Stolorow of the National Institute of Standards (NIST)
    - 2021-present – Affiliate
    - 2014-2021 – Member (Charter)

- North Carolina Forensic Science Advisory Board Member, Charter Member, Appointed by the Attorney General of the State of North Carolina. Acting as an advisor to the NC State Crime Laboratory to strengthen the laboratory system. (2012-present)

- ASTM International, Subcommittees: E30 - Forensic Sciences, E30.01 – Criminalistics, E30.11 - Interdisciplinary Forensic Science Standards, Participating Member (2014-present)

- Scientific Working Group for the analysis of Geological Materials (SWGGEO), charter member (2012-2014).

- Independent Review Board for Lawrence Livermore National Laboratory "U and Pu Impurities" Project (2013)

- UNESCO International Union of Geological Sciences (IUGS) Initiative on Forensic Geology Geological (IoFG) Trace Evidence Advisor. (2011-present)

- FermiLab Community Advisory Board Member (2010)

- Board of Directors, RQA Food Forensics LLC (2008-2016)

- Alumni Board Member, University of Michigan Department of Geological Sciences (2005-2015)

Professional Affiliations

- International Association of Geoanalysts (2016-2017)

- American Society of Trace Evidence Examiners (ASTEE), Charter Member (2009-present)

- American Academy of Forensic Sciences, Fellow (2001-present)

- Midwestern Association of Forensic Scientists, Member (2007–present)

- Mineralogical Society of America (2000-present)

- Geological Society of America (2002-present)

- Sigma Xi – Scientific Research Society, Member (1998-2013)

- American Chemical Society (1998-present)
- State Microscopical Society of Illinois (1998-2000, 2007-2010)
- Materials Research Society (2002-2004)

Honors

- Editorial Board Member of the American Academy of Forensic Sciences, appointment to editorial board (2019)
- Certificate of Recognition by the Midwestern Association of Forensic Scientists for appointment to the Materials (Trace) OSAC Committee, Board of Directors (2015)
- Horace H. Rackham Distinguished Dissertation Award (Highest honor given to dissertations produced under the auspices of the University), University of Michigan (2004)
- John Dorr Graduate Academic Achievement Award – Department of Geological Sciences, University of Michigan (2004)
- Geological Society of America, Travel Grant, (2004)
- Graduate Fellowship Recipient, Department of Energy - Office of Civilian Radioactive Waste Management, (2002-2004)
- Best Paper Award, C.S. Palenik and R.C. Ewing, "Microanalysis of Radiation Damage Across a Zoned Zircon Crystal" - Materials Research Society National Meeting (2001)
- Geological Society of America Travel Grant (2004)
- Scott Turner Research Grant in the Earth Sciences (2001, 2002)
- Member, Rackham Graduate Student Forum (2002)
- Co-President, University of Michigan Geology Club (2000-2002)
- Dean's List, University of Chicago (1995-96, 1997-98, 1998-99)

Expert Testimony and Deposition

- Qualified as expert witness in State, Federal, and Military courts and the International Chamber of Commerce.
- List can be provided upon request.

Additional Training and Experience

- Explosive Residue Collection, Analysis, and Determinations, Taught by Raleigh W. Parrott II, Technical Leader - Explosives Chemistry, Explosives Training Program Manager, Explosives Unit, FBI Laboratory, half day

workshop (scheduled, September 2022).

- Hair Root Staining – What Can Hematoxylin Do for Your Laboratory? Taught by Evie Nguyen and Lindsey Admire, North Carolina Forensic Science Laboratory, webinar (2022)
- Raman Spectroscopy of Carbon materials, taught by Tim Smith and Jennifer Ferguson of Renishaw, webinar (2022)
- Examining Documents Requiring a Multi-Faceted Approach A Hands-on, taught by Todd Welch, D-ABFDE, MAFS 2021 Annual Meeting, (2021)
- State of Illinois Explosive License Training Course, taught by Nick Sterling, Illinois Department of Natural Resources, 1 day, Starved Rock State Park (2021)
- Orbitrap training, taught by Dr. Sean McCormick, Thermo, 3 days at Microtrace (2021)
- Orbitrap familiarization training, taught by James Brammeier, Thermo, 5 days at Microtrace (2021).
- DSC Advanced Applications Workshop, taught by Dr, Aniket, Applications Specialist, Perkin Elmer, 1 day workshop at Microtrace LLC (2019)
- Forensic drug analysis seminar, taught by Terry DalCason, Research Chemist, DEA, retired, 1 day seminar at Microtrace LLC (2019)
- Current topics in asbestos analysis seminar, taught by Dr. Eric J. Chatfield at Microtrace LLC, 1 day seminar (2019)
- Electron Backscatter Diffraction and Aztec HKL Training Course taught by Michael Hjelmstad, Oxford Instruments, 3 day workshop, Pleasanton, California (2019)
- Electron Backscatter Diffraction workshop taught by Richard McLaughlin, Oxford Instruments, 2 day workshop (2019)
- ICP-MS Workshop taught by Dr. Peter C. Weiss at the Forensic Science Institute of the Bundeskriminalmt, Wiesbaden, Germany (2018).
- DOJ Grants Financial Management Training. 8 credit hours. Certificate of Completion (2018).
- Fiber, Dye, and Paint Analysis: Approaches of the Netherlands Forensic Institute (NFI). Lectures and discussions by Jaap van der Weerd, reporting officer on fibre and paint investigations. Lecture and Discussions (2017).
- GSR Analysis and Interpretation. Lectures by Robert Berk, Illinois State Police Crime Laboratory, Retired. Lecture and discussions (2017).
- Advanced Trace Evidence Analysis in The Netherlands (MH17 crash investigation). Lecture and Discussions by Dr. Peter Zoon, Nederlands Forensisch Instituut, Divisie Chemische en Fysische Sporen, Microsporen & Materialen (2017).
- Fluorescence Microscopy. Lectures and Workshop taught by Dr. Steve Ruzin, Director, College of Natural Resources Biological Imaging Facility. 1.5 days of laboratory and lecture (2016).

- μ-XRF of glass: A practical explanation of ASTM E2926. Lectures by Troy Ernst, Michigan State Police Forensic Laboratory and Ted Manasian, Ohio Bureau of Criminal Investigation. Presented by NIJ / RTI (2016).
- Forensic Hair Analysis. Lecture by Dick Bisbing, retired from McCrone Associates and Michigan State Police. 3 days of laboratory and lecture (2015).
- Introduction to Basic Human Body Tissues. Taught by Dr. Lynne Herold, retired from the Los Angeles County Sheriff's Department Scientific Services Bureau. 2 day workshop (2015).
- Pistol Training. Taught by Jerry Kau, NRA-IPA-IA-ISV-IVA-Certified instructor (2015).
- Blood Spatter and trace Evidence in the Sam Shepard Case. Lecture and discussion presented by Bart Epstein (retired Assistant Director of from the Minnesota Bureau of Criminal Apprehension) (2014).
- Asbestos Analysis by TEM - Instruction in the Standard Methods for the Analysis of Asbestos. Taught by James R. Millette, Ph.D. and Steven P. Compton, Ph.D. of MVA Scientific Consultants, Duluth, GA. 3 day workshop (2014).
- Thermal Field Emission SEM Operations Training Course. Taught by Natasha Erdman, Ph.D. and Tony Laudate of JEOL at JEOL USA, Peabody, MA. 2 day workshop (2014).
- Forensic Applications of Infrared and Raman Spectroscopy. Taught by Ed Suzuki, Ph.D. of the Washington State Police Forensic Laboratory at Microtrace, Elgin, IL. 4 day workshop (2013).
- Post Mortem Root Banding Hair Workshop. Taught by Stephen Shaw, Sandy Koch, and Karen Korsberg Lowe of the Federal Bureau of Investigation and Amy Michaud (of the Bureau of Alcohol, Tobacco, Firearms, and Explosives) at the Smithsonian Institute. 1 day workshop (2013).
- Nanotechnologies in Textiles Workshop. Taught by Prof. Seshadri Ramkumar (of Technical Textiles in the Department of Environmental Toxicology, Texas Tech University). Webinar (2013).
- Automotive and Industrial Paint Workshop. Taught by Tim Moczulewski and Jon Granberg of PPG Industries at the Oak Creek, WI Coatings Plant in conjunction with the Midwestern Association of Forensic Scientists Annual Meeting. ½ day workshop (2012).
- The Analysis of Low Explosives. Taught by Edward C. Bender, ATF Laboratory, Retired. Held at Midwestern Association of Forensic Scientists Annual Meeting, Milwaukee, IL. 1 day workshop (2012).
- Optical Mineralogy. Taught by Prof. Mickey Gunter of the University of Idaho. 1.5 day workshop held at Microtrace LLC.
- ISO 17025 Without Tears. Taught by Terry Mills of ANSI-ASQ-FQS, Tampa, FL. Three day workshop (2012).
- Geology of Volcano National Park. Taught by Phillip Ong, M.S. at Volcano National Park, Big Island, HI. One day session (2012).
- Natural Fiber Identification. Taught by Skip Palenik at McCrone Research Institute. One day training session (2011).
- Animal Hair Identification. Taught by Bonnie Yates of the U.S. Fish and Wildlife National Forensic Lab at the National Institute of Justice Trace Evidence Symposium. One Day Workshop (2011).

- Quartz Grain Surface Textures. Taught by Prof. Peter Bull of Oxford University at Microtrace LLC. One Day Workshop (2011).
- Forensic Paint Examinations and Comparisons. Taught by Scott Ryland of the Florida Department of Law Enforcement (2010).
- An Introduction to Glass Science and Technology workshop. Taught by J. Terry Fisk of JTF Microscopy Services (formerly of the Corning Glassworks Research Lab, New York) (2010)
- Wood Identification workshop, taught by Dr. Regis Miller of the Center of Wood Anatomy Research, Forest Products Laboratory (2009)
- Microspectrophotometry User Course. Workshop taught by Dr. Jim Throne of CRAIC instruments at Microtrace (2009)
- Airborne Fungus Spores. Workshop taught by Dr. John Haines of the New York State Museum and Science Services, Albany, NY at McCrone Research Institute (2009)
- Energy Dispersive X-ray Spectroscopy- Thermo Noran System 6. Workshop taught by Dr. Dave West, ThermoFisher Scientific at Microtrace (2009)
- Private workshop on SERS sample preparation and analysis with Dr. Marco Leona of the New York Metropolitan Museum of Art (2008)
- Fluorescence Microscopy Workshop, taught by Dr. Steve Ruzin of the University of California at Berkeley at McCrone Research Institute (2008)
- Cement and Concrete Microscopy, taught by Don Campbell of the Campbell Petrographic Services, Inc. Dodgeville, Wisconsin (2007)
- Heavy Mineral Identification, taught by Maria Mange of the University of California at Davis (2007)
- Forensic Paint Examination, taught by Scott Ryland of the Florida Department of Law Enforcement, Lansing, MI (2007)
- Hardwood Identification workshop, taught by Dr. Regis Miller of the Center of Wood Anatomy Research, Forest Products Laboratory (2007)
- Advances and Changes in Forensic Paint Examination Workshop, taught by Scott Ryland of the Florida Department of Law Enforcement at California Associate of Criminalists Semi-annual workshop (2006)
- Forensic Soil Examination Workshop, taught by Dr. Ray Murray, Dr. Robert Graham, Marianne Stam, Dr. Lynne Macdonald, Dr. George Sensabaugh, Skip Palenik and Chris Palenik, at California Associate of Criminalists Semi-annual workshop.
- Paper Fiber Identification Workshop, taught by Dr. Walter Rantanen of the Integrated Paper Service (2006)
- Wood Identification Workshop, taught by Dr. Walter Rantanen of the Integrated Paper Services (2006)
- Softwood Identification workshop, taught by Dr. Regis Miller of the Center of Wood Anatomy Research, Forest Products Laboratory (2006)

- Orientation Imaging Microscopy and Phase Identification EBSD workshop, taught by David Dingley and Matthew Nowell, TSL/EDAX, Draper, Utah, (2005)
- Forensic Analysis of Paint, taught by Ed Suzuki, Ed Bartick, FBI Academy, Quantico, VA (2004)
- FTIR Spectroscopy, taught by Edward Bartick, John Reffner, Edward Suzuki, FBI Academy, Quantico, VA (2004)
- Cathodoluminescence Microscopy Workshop, taught by V. Barbin, M. Schvoerer, K. Ramseyer, Florence, Italy (2004)
- Spent Nuclear Fuel workshop, Chicago, IL (2004)
- Lock and Security workshop, Folger-Adams Security, Lemont, IL (2004)
- Metal Working instruction workshop, taught by Julian Broad, Shop Supervisor, University of Michigan (2004)
- Scientific Glassblowing workshop, taught by Harald Eberhart, Master Glassblower, Ann Arbor, MI (2003)
- Secondary ionization mass spectroscopy (SIMS) of uraninite, under Prof. M. Fayek, Oak Ridge National Laboratory, TN (2003)
- Spindle Stage Methods workshop, Instructors: Prof. D. Bloss, Prof. M. Gunter, Dr. S. Su, McCrone Research Institute, Chicago, IL (July, 2003)
- Actinide Chemistry workshop, Institute for Transuranic Elements, Karlsruhe, Germany (June 2003)
- Micro-Raman spectroscopy research on radiation damage in zircon, under Prof. L. Nasdala, Universität Mainz, Germany (March 2002)
- Micro-XRF experimentation, Advanced Photon Source, Argonne, IL (2002)
- Engineering Mineralogy of Ceramic Materials workshop, University of Siena, Italy (June 2001)
- Forensic Fiber Examination, Instructor: S. Palenik, Department of Public Safety, Austin, TX (June, 2000)
- Synthesis of Hf-borosilicate glasses, under Prof. L.L. Davis, Pacific Northwest National Laboratory, Hanford, WA (February, 2000)
- Design and development of the "Microtrace Forensic Fiber Reference Collection", with S. Palenik, Microtrace, Elgin, IL (1998-1999)
- Study of automobile paint finish systems, under Dr. W. Stoecklein, Forensic Science Institute of the Bundeskriminalamt, Wiesbaden, Germany (Summer 1998)
- Study of inclusions in the Allende meteorite, Prof. L. Grossman and Dr. S. Simon, Department of Geophysical Sciences, University of Chicago (1996-1998)
- Mentorship study of Gel-based inks, under L. Olson, National Forensic Laboratory, Internal Revenue Service (1994-1995).
- Infrared Spectroscopy Interpretation, Bowdoin College, Maine, (June, 1996)

- Microchemical Methods, Instructor: S. Palenik, McCrone Research Institute, Chicago, IL (1996)
- Scanning Electron Microscopy, Instructor: Stevens, McCrone Research Institute, Chicago, IL (1994)
- NMR Spectroscopy use and interpretation, IMSA, Aurora, IL (1993-1995)
- Polarized Light Microscopy, Instructor: J. Delly, McCrone Research Institute, Chicago, IL (1992)

Analytical Techniques

Include but are not limited to: Polarized light microscopy, thermal microscopy, scanning electron microscopy, electron microprobe, energy dispersive X-ray spectroscopy, high-resolution transmission electron microscopy, Raman microspectroscopy, infrared microspectroscopy, cathodoluminescence, UV/visible spectroscopy, scanning white light interferometry, UV/visible/near infrared microspectrophotometry, powder x-ray diffraction, micro-X-ray fluorescence, phase contrast microscopy, differential interference contrast microscopy, fluorescence microscopy, gas chromatography-mass spectrometry, ultra-high performance liquid chromatography, high resolution mass spectrometry, electron backscatter diffraction, differential scanning calorimetry, thin layer chromatography, electrostatic detection apparatus, ultra-high performance liquid chromatography with high resolution mass spectroscopy.

Research Grants

Applied Research in the Characterization, Identification, and Comparison of Pigmented Fiber Evidence (2022, National Institute of Justice, 15PNIJ-21-GG-04185-RESS) – Role: Principal Investigator

The development of objective approach to the characterization and interpretation of paint evidence by SEM/EDS (2017, National Institute of Justice, 2017-IJ-CX-0027) – Role: Principal Investigator

Nanotrace: Applications of subvisible to nanoscale particles in trace evidence (2015, National Institute of Justice, 2015-DN-BX-K0033) – Role: Principal Investigator

Advanced research in Microspectrophotometry of Fibers: Analysis and Interpretation (2012, National Institute of Justice, 2012-DN-BX-K040) – Role: Principal Investigator

Development of a Turnkey Analytical System for the Forensic Comparison and Identification of Fiber Dyes on Casework-sized Fibers (2012, National Institute of Justice, 2012-DN-BX-K42) – Role: Principal Investigator

Raman spectroscopy of automotive and architectural pigments: in situ identification and evidentiary Significance (2011, National Institute of Justice, 2011-DN-BX-K557) – Role: Principal Investigator

Fundamentals of Forensic Pigment Identification by Raman microspectroscopy: A practical identification guide and spectral library (2010, National Institute of Justice, 2010-DN-BX-K236) – Role: Principal Investigator

Graduate Committees

Samuel Yatzkan (2017) Detection and Persistence of Gunshot Residue (GSR) on Facial Features using SEM/EDX. Master of Science in Forensic and Investigative Science, West Virginia University. Additional committee members: Prof. Keith Morris (chair) and Prof. Susan Bell.

Barbara Fallon (2016) A Tale of two corchorus species: jute and its substitutes in commercial goods. Forensic Science – Master of Science, Michigan State University. Additional committee members: Prof. Ruth Smith (chair) and Prof. Jeremy Wilson.

Katelyn Hargrave (2013) A New Technique for the Identification of Dyes Extracted from Fibers. Master of Science in Forensic Science, University of Illinois at Chicago.

Publications and Teaching

Courses and Workshops Taught

Beyond Comparison: An introduction to trace evidence. (2021) Seminar lecture to the Winter 2021 semester "Forensic Science Seminar Series" hosted by Prof. David R. Fisher at the New Jersey Institute of Technology, 5 March 2021.

Development of an objective approach to the characterization and interpretation of paint evidence by SEM/EDS. (2019) Forensic Technology Center of Excellence Webinar Series - Emerging Research: Forensic Chemistry, 4 April 2019.

Applications of Raman Spectroscopy for Trace Evidence Examinations (2018) – workshop taught by Buzzini, P, Suzuki, E.M., Palenik, C.S., Bowen, A.M. at the American Academy of Forensic Sciences Annual Meeting, Seattle, WA.

Advanced Trace Evidence Analysis (2016). Topics included: dye and pigment identification, soil analysis, nanoparticle analysis – workshop taught by Palenik C. at the 8th Annual Asian Network of Forensic Sciences meeting, Bangkok, Thailand.

Petrographic identification of soil minerals (2015) - workshop taught by Palenik, S. and Palenik, C.S. at the National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.

Applications of Raman Spectroscopy for Trace Evidence Examinations (2014) – workshop taught by Buzzini, P, Suzuki, E.M., Palenik, C.S., Bowen, A.M. at the American Academy of Forensic Sciences Annual Meeting, Seattle, WA.

What did you just step in? (2012) – workshop taught with Mooney, K.E., Flohr, D.B., Bowen, A, Stoney, D, Bisbing, R., Hopen, T., Murray, R., Palenik, C.S., Palenik, S., Schneck, W.M., Stam, M. at the American Academy of Forensic Sciences Annual Meeting, Atlanta, GA.

Classification of Pigments by Raman Spectroscopy (2011) – workshop taught at the Midwestern Association of Forensic Sciences Ruby Jubilee Meeting, Lombard, IL.

Identification of Animal Hairs (2011) – workshop taught with Skip Palenik and Jason Beckert at the American Academy of Forensic Sciences Annual Meeting, Chicago, IL.

Advanced Hair and Fiber Microscopy – synthetic fiber section (2009) taught with Skip Palenik and Jason Beckert at McCrone Research Institute, Chicago, IL.

#Methods in Stereomicroscopy (2009) Customized Class. Rockville, MD.

#Forensic Pigment Analysis (2009) National Institute of Justice (NIJ) Trace Evidence Symposium, Clearwater Beach, FL.

Special topics in Forensic Science (2008) taught with Skip Palenik and Jason Beckert at McCrone Research Institute, Chicago, IL.

#Palenik, C.S (2005-2008) Trace evidence in forensic science. Seminar presented at Northwestern University Forensic Science Series, Chicago, IL (presented annually)

Introductory workshop to Forensic Microscopy (2007) taught with Skip Palenik at the Federal Bureau of Investigation (FBI) / National Institute of Justice (NIJ) Trace Evidence Symposium, Clearwater Beach, FL.

Book Chapters and Peer Reviewed Reports

Palenik, C.S. (2015) Forensic Microscopy in Forensic Chemistry (ed. Jay Seigl) American Academy of Forensic Sciences under Wiley Publications.

Palenik, C.S., Beckert, J.C., Palenik, S.J. (2015) Microspectrophotometry of Fibers: Advances in Analysis and Interpretation. Submitted in completion of NIJ grant 2012-DN-BX-K040, 421p.

Palenik, C.S., Palenik, S., Groves, E., Herb, J. (2013) Raman spectroscopy of automotive and architectural paints: in situ pigment identification and evidentiary significance. Submitted in completion of NIJ grant 2011-DN-BX-K557.

Palenik, C.S., Palenik, S., Herb, J., and Groves, E. (2011) Fundamentals of Forensic Pigment Identification by Raman Microspectroscopy: A practical identification guide and spectral library for forensic science laboratories. Submitted in completion of NIJ grant 2010-DN-BX-K236, 572p.

Palenik, C.S. and Buscaglia, J. (2007) Applications of cathodoluminescence in Forensic Science, in Forensic analysis on the Cutting Edge: new methods for trace evidence analysis, ed. R. Blackledge, Wiley.

Palenik, C.S. (2004) Isotopic and Neutronic Composition of the Okelobondo Natural Nuclear Reactor. Ph.D. Thesis, University of Michigan.

Palenik, S.J. and Palenik, C.S. (2004) Microscopy and microchemistry of physical evidence, in Forensic Science Handbook II, 2nd ed. Ed. R. Saferstien, Prentice Hall.

Journal Articles

Beckert, K. and Palenik, C.S. (2020) The Analysis of 3D Printer Dust for Forensic Applications DOI:10.1111/1556-4029.14486

White, K. and Palenik, C.S. (2020) Toner particles as forensic evidence: Microanalytical characterization of known toner and recognition of toner in environmental samples. 10.1111/1556-4029.14501

Palenik, C.S. (2019) The Role of Collections in Trace Evidence. The Microscope, 67(2).

Palenik, C.S., Groves, E., Insana, J., Palenik, S. (2019) Locating, Identifying and Comparing Sub Visible Paint Particles. Journal of Forensic Sciences. doi: 10.1111/1556-4029.14062.

Palenik, C.S., Brinsko-Beckert, K., Insana, J., and Palenik, S.J. (2018) Analytical and transfer characteristics of a fluorescent detection spray: Implications for subvisible and nanotrace particle transfers. Forensic Science International Volume 286, May 2018, 96-105.

Groves, E.G., Palenik, S.J., and Palenik, C.S. (2018) A Generalized Approach to Forensic Dye Identification: Acquisition and Development and Utility of Reference Libraries. Journal of the American Association of Analytical Chemists (JAOAC) 101(5) 1385-1396.

Groves, E.G., Palenik, S.J., and Palenik, C.S. (2018) Reproducibility of high-performance thin-layer chromatography (HPTLC) in textile dye analysis. Forensic Chemistry, 8, 104–110.

Groves, E.G., Palenik, S.J., and Palenik, C.S. (2016) A Survey of Extraction Solvents in the Forensic Analysis of Textile Dyes. Forensic Science International (268) 139-144.

Groves, E.G. and Palenik, C.S. (2016) Applications of Blue Light Curing Acrylic Resin to Forensic Sample Preparation and Microtomy. Journal of Forensic Science. March 2016, Vol. 61, No. 2 489-493.

Palenik, C.S. and Palenik, S. (2014) Seeing Color: Practical Methods in Pigment Microscopy. The Microscope, v62, 51-61.

Trejos, T., Koons, R., Becker, S., Berman, T., Buscaglia, J., Duecking, M., Eckert-Lumsdon, T., Ernst, T., Hanlon, C., Heydon, A., Mooney, K., Nelson, R., Olsson, K., Palenik, C., Pollock, E.C., Rudell, D., Ryland, S., Tarifa, T., Valadez, M., Weis, P., Almirall, J. (2013) Cross-validation and evaluation of the performance of methods for the elemental analysis of forensic glass by μ-XRF, ICP-MS, and LA-ICP-MS. Anal Bioanalytical Chemistry, 405: 5393-5409 (DOI 10.1007/s00216-013-6978-y).

Jantzi, S.C., Trejos, T., Zdanowicz, V. Dalpe, C., Palenik, C.S., Koons, R. Becker, S., Pollock, E.C., Hanlon, C., Almirall, J.R. (submitted) Inter-laboratory comparison of laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS), micro X-ray fluorescence (μXRF) and laser-induced breakdown spectroscopy (LIBS) methods for bulk soil analysis. Forensic Science International.

Palenik, C.S. and Diaczuk P. (2013) Plumbum microraptus: Microscopic indicators of a bullet hole in a synthetic fabric. The Microscope Journal and reprinted in the Journal of the American Society of Trace Evidence Examiners (Volume 4, Issue 2, August 2013).

Ernst, Troy, Berman, Ted, Buscaglia, JoAnn, Eckert-Lumsdon, Tiffany, Hanlon, Christopher, Olsson, E. Kristine, Palenik, Christopher, Ryland, Scott, Trejos, Tatiana, Valadez, Melissa, Almirall, Jose (submitted 2012) Chemistry Signal-to-noise ratios in forensic glass analysis by micro x-ray fluorescence spectrometry. X-ray Spectrometry. DOI 10.1002/xrs.2437

Trejos, T, Koons, R., Becker, S., Berman, T., Buscaglia, J., Dueckingc, M., Eckert-Lumsdon, T., Ernst, T. Hanlonh, C., Heydoni, A., Mooney, K., Nelson, R., Olssonk, K., Palenik, C., Pollock, E.C., Rudelli, D. Ryland, S., Tarifaa, A., Valadez, M., Weisc, P. Almirall, J. (2) Forensic analysis of glass by μ-XRF, SN-ICP-MS, LA-ICP-MS and LAICP-OES: Evaluation of the performance of different criteria fo comparing elemental composition. Journal of Analytical Atomic Spectrometry, 38, 1270-1282. DOI: 10.1039/c0xx00000x.

Trejos, T, Koons, R., Becker, S., Berman, T., Buscaglia, J., Dueckingc, M., Eckert-Lumsdon, T., Ernst, T. Hanlonh, C., Heydoni, A., Mooney, K., Nelson, R., Olssonk, K., Palenik, C., Pollock, E.C., Rudelli, D. Ryland, S., Tarifaa, A., Valadez, M., Weisc, P. Almirall, J. (accepted) Forensic analysis of glass by μ-XRF, ICP-MS, LA-ICP-MS and LA-ICP-OES - Part I: Method Standardization

Egan, J.M.; Mooney, K.; Palenik, C.S.; Mueller, K.T., and Golombeck, R. (2006) Synthessis, Isolation, and Characterization o f Chlorinated Products of Bleached 1-(methylamino)anthraquinone. Journal of Forensic Sciences.

Reich, M., Kesler, S.E., Utsunomiya, S., Palenik, C.S., Chryssoulis, S.L., and Ewing, R.C. (2005) Solubility of gold in arsenian pyrite. Geochimica et Cosmochimica Acta, 69, 2781-2796.

Palenik, C.S. and Palenik, S.J. (2004) Forensic Science and Academic Science, Comment on Forensic Science: Oxymoron? Science, 303, 1136.

Utsunomiya, S., Palenik, C.S., Valley, J.W., Cavosi, A.J., Wilde, S.A. and Ewing, R.C. (2004) Nanoscale behavior of Pb in an Archean zircon. Geochimica et Cosmochimica Acta, 68, 4679-4686.

Ewing, R.C., Palenik, C.S. and Konikow, L. (2004) Comment on: "Probabilistic Risk Analysis for a High-Level Radioactive Waste Repository" by B. L. Cohen in Risk Analysis, vol. 23, 909-915, Risk Analysis, in press.

Palenik, C.S., Utsunomiya, S., Reich, M., Kesler, S.E. and Ewing, R.C. (2004) Invisible Gold Revealed: Direct imaging of gold nanoparticles from a Carlin-type deposit. American Mineralogist, 89, 1359-1366.

Davis, L.L., Darab, J.G., Qian, M., Zhao, D., Palenik, C.S., Li, H., Strachan, D.M. and Li, L. (2003) Hafnium in peralkaline and peraluminous boro-aluminosilicate glass and glass sub-components: a solubility study. Journal of Non-Crystalline Solids, 328, 101-122.

Palenik, C.S., Nasdala, L. and Ewing, R.C. (2003) Radiation damage in a zircon. American Mineralogist, 88, 770-781.

Jensen, K.A., Palenik, C.S. and Ewing, R.C. (2002) U^{6+}-phases in the weathering zone of the Bangombe U-deposit: Observed and predicted mineralogy. Radiochimica Acta, 90, 1-9.

Palenik, C.S. (2000) The role of the forensic scientist in the new millennium. Academy News (American Academy of Forensic Sciences), 23-24.

Palenik, C.S. (1989) The microscopical differentiation of dog and cat hairs, The Microscope, 38(4), 415-421.

Conference Proceedings

Palenik, C.S., Jensen, K.A. and Ewing, R.C. (2004) The impact of uncertainties in geochemical modeling on performance assessments: Lessons from natural analogues. Materials Research Society Spring Meeting, San Francisco, CA.

Palenik, C.S. and Ewing, R.C. (2002) Microanalysis of radiation damage across a zoned zircon crystal. Proceedings of the Materials Research Society, 713, JJ8.8.1-JJ8.8.6.

Zhao, D., Davis, L.L., Li, L., Palenik, C.S., Wang, L.M, Strachan, D.M. and Ewing, R.C. (2000) Gadolinium and hafnium alumino-borosilicate glasses: Gd and Hf solubilities. Proceedings of the Materials Research Society, vol. 608, 683-689.

Other Publications

Palenik, C.S. (2020) Resolving the Source of Foreign Matter in Formulations. In Powder and Bulk Solids. Published online 26 June 2020 (https://www.powderbulksolids.com/screening-separation/resolving-source-foreign-matter-formulations). Print version in September 2020 issue.

Palenik, C. S.; Palenik, S.; Groves, E. (2019). Microscopy | Forensic Microscopy. In Worsfold, P., Poole, C., Townshend, A., Miró, M., (Eds.), Encyclopedia of Analytical Science, (3rd ed.). vol. 7, pp 57–64, Elsevier.

Palenik, C.S. and Jackson, G. (2016) Forensic Myths and Methods. The Analytical Scientist, March 2016 #38, 24-32.

Palenik, C.S., Palenik, S.J., and Groves, E.G. (2014) Forensic Microscopy, In: Reedijk, J. (Ed.) Elsevier Reference Module in Chemistry, Molecular Sciences and Chemical Engineering. Waltham, MA: Elsevier. 07-Aug-14 doi: 10.1016/B978-0-12-409547-2.11426-X.

Palenik, C. and Nytes, B. (2014) Mercury Wings, (ed.) Bethany Halford in Chemical and Engineering News, Newscripts. Volume 92 Issue 22, p40, June 2, 2014.

Palenik, C. (2013) Consumer Complaint Sample Analyses: Considerations for Outsourcing Sample Analysis, Submitted to Society of Consumer Affairs Professionals – Customer Relationship Management CRM Magazine. Summer 2013.

Palenik, C. (2011) A Better Fate For Mercury?, Letter to the Editor, Chemical and Engineering News, 18 April 2011, 89(16), p6.

Palenik, C. (2005) Big "I" in Owens. Letter to the Editor, New York Times, November 13.

Utsunomiya, S., Palenik, C.S., and Ewing, R.C. (2004) Nano- to Atomic Scale Imaging of Heavy Trace Metals Utilizing Advanced Microscopy Techniques in The Dekker Encyclopedia of Nanoscience and Nanotechnology. Marcel Dekker Pub., NY

Palenik, C.S. and Palenik, S.J. (2004) Forensic Microscopy, in Encyclopedia of Analytical Sciences, 2nd Ed., eds. Worsfold, P., Townshend, A and Poole, C. Elsevier, NY.

Palenik, C.S. and Palenik, S.J. (1999) Forensic Fiber Reference Collection Manual. Microtrace: Elgin, IL 46p.

Palenik, S.J. and Palenik, C.S. (1999) Forensic Fiber Identification Course Guide. Microtrace: Elgin, IL, 32p.

Abstracts and Talks

*Keynote or Plenary address; #Invited talk; ^Session chair, %Scheduled/Accepted

#Palenik, C.S. (2023) Advances in the Microscopical Analysis of Trace Evidence in Advancements in the Analysis of Forensic Trace Evidence at the 6th annual NIJ Forensic Science Symposium at PITTCON 2023, Philadelphia, PA.

#Palenik, C.S. (2022) Forensic Problem Solving through Microanalysis. Midwest Microscopy and Microanalysis Society (M^3S), Westmont, IL.

#Palenik, C.S. (2022) Microscopical analysis applied to the detection and sourcing of counterfeit products in the panel session "Challenges of Counterfeit Detection in Pharmaceutical Industry" at the Eastern Analytical Symposium, Princeton, NJ.

Beckert, K., Abraham, O., Groves, E., and Palenik, C.S. (2022) Examination of Pigmented Fibers for Trace Evidence Applications at the Eastern Analytical Symposium, Princeton, NJ.

Beckert, K., Abraham, O., Groves, E., and Palenik, C.S. (2022) Forensic Microscopy of Pigmented Fibers. Joint Midwestern Association of Forensic Scientists / ASTEE Meeting. Des Moines, IA.

Palenik, C.S. (2022) Image Only: Analysis when sampling is not possible. Inter/Micro 2022, Chicago, IL.

McConnell, J., Ottinger, S., Palenik, C.S., and Palenik, S. (2022) Classification and Identification of Historical Inks. Inter/Micro 2022, Chicago, IL.

Beckert, K., Abraham, O., Groves, E., and Palenik, C.S. (2022) Forensic Microscopy of Pigmented Fibers. Inter/Micro 2022, Chicago, IL.

Abraham O., Groves, E., Beckert, K., and Palenik, C.S. (2022) Beyond what the eye can see: application of long exposure fluorescence imaging to the characterization of pigmented fibers. Inter/Micro 2022, Chicago, IL.

Groves, E., Beckert, K., Abraham O., and Palenik, C.S. (2022) Microtomy of Pigmented Fibers – Making the Right Cut Inter/Micro 2022, Chicago, IL.

Brown, S, Messé, G., Notari, C., Garvin, H., Gogola, N., Maxwell, V., Reffner, J.A., De Forest, P.R., Palenik, C.S., Harrington, P., Huck-Jones, D., O'Donnell, B., Whitley, A., Kammrath, B.W. (2021) Soil Mineral Analysis by Particle Correlated Raman Spectroscopy (PCRS): Optimized Dispersion and Double-Pass Raman Analysis. Eastern Analytical Symposium.

Brown, S., Messe, G, Garvin, H, Gogola, N. Notari, C. Maxwell, V. Reffner, J.A., De Forest, P.R., Palenik, C.S., de B. Harrington, P., Huck-Jones, D., O'Donnell, B., Whitley, A., Kammrath, B.W. (2022) Mineral Analysis by Particle Correlated Raman Spectroscopy (PCRS): Optimized Dispersion and Double-Pass Raman Analysis, American Academy of Forensic Sciences 2022 Annual Meeting.

#Palenik, C.S. (2021) Reference Collections and their use in Forensic Fiber Analysis, presented at the virtual 2021 Online Trace Symposium on 29 July 2021.

Gogola, N., Garvin, H., Brown, S. Reffner, J.A., De Forest, P.R., Palenik, C.S., de B. Harrington, P., Huck-Jones, D. O'Donnell, B. Whitley, A. Kammrath, B.W. (2021) Soil Mineral Analysis by Particle Correlated Raman Spectroscopy (PCRS): Sample Preparation and Raman Analysis Optimization. 10th Annual Forensic Science Symposium hosted by the Global Forensic and Justice Center at FIU.

Gogola, N., Garvin, H., Brown, S. Reffner, J.A., De Forest, P.R., Palenik, C.S., de B. Harrington, P., Huck-Jones, D. O'Donnell, B. Whitley, A. Kammrath, B.W. (2021) The Effects of Sample Preparation Optimization on Soil Mineral Analysis by Particle-Correlated Raman Spectroscopy (PCRS) American Academy of Forensic Sciences 2021 National Meeting.

Garvin, H., Gogola, N. , Brown, S. Maxwell, V. Reffner, J.A., De Forest, P.R., Palenik, C.S., de B. Harrington, P., Huck-Jones, D., O'Donnell, B., Whitley, A., Kammrath, B.W., (2021) Soil Mineral Analysis by Particle Correlated Raman Spectroscopy (PCRS): Method Optimization. American Academy of Forensic Sciences 2021 National Meeting.

Kammrath, B.W., Garvin, H., Gogola, N., Brown, S., Reffner, J.A., De Forest, P.R., Palenik, C.S., Harrington, P., Huck-Jones, D., O'Donnell, B., Whitley, A. (2021) Soil Mineral Analysis by Morphologically-Directed Raman Spectroscopy: Method Optimization. Pittcon 2021.

#Palenik, C.S. (2020) Oblique Illuminations. Talk in the Ernst Abbe Award session honoring Brian J. Ford. Eastern Analytical Symposium.

#Palenik, C.S. (2020) Developments in the forensic analysis of automotive paints by SEM/EDS. Pittcon 2020, Chicago, IL.

Palenik, C.S., Groves, E, Michely, L., Lim, Y.C., and Palenik, S.J. (2020) A survey of elements detectable in automotive paint layers by SEM/EDS. American Academy of Forensic Sciences Annual Meeting, Anaheim, CA.

Lewis, A., Palenik, C.S., Palenik, S., Buzzini, P. (2020) Characterization of Nylanthrene Dyes in the Differentiation of Macroscopically Similar Black Fibers using Light Microscopy and Visible Microspectrophotometry. American Academy of Forensic Sciences Annual Meeting, Anaheim, CA.

#Palenik, C.S. (2019) Microanalysis in forensic paint investigations. Midwest Microscopy and Microanalysis Society (M^3S), Round Lake, IL.

Brinsko Beckert, K., Palenik, S., Palenik, C.S. (2018) Nanoparticles as Trace Evidence. Joint Meeting of the Southern Association of Forensic Scientists (SAFS) and the American Society of Trace Evidence Examiners in Ashville, NC.

#Palenik, C.S. (2018) Advanced topics in forensic microscopy. Talk given at the Bundeskriminalamt in Wiesbaden, Germany.

Palenik, C.S. and Michely, L. (2018) Analytical considerations for the elemental analysis and forensic comparison of automotive paints. Inter/Micro 2018, Chicago, IL.

White, K.M. and Palenik, C.S. (2018) Product Discoloration: Analysis of an Unknown Red Colorant. Inter/Micro 2018, Chicago, IL

Groves, E.G., Michely, L. and Palenik, C.S. (2018) A Survey of Elements Detected in Multi-layered Automotive Paint Samples by SEM-EDS. Inter/Micro 2018, Chicago, IL.

%White, K.M., Nytes, B.N., and Palenik, C.S. (2018) Applications of Glass Microspheres as Forensic Trace Evidence. Pittcon 2018, Orlando, FL.

%White, K.M. and Palenik, C.S. (2018) Forensic Study of Known Toner Particles. Pittcon 2018, Orlando, FL.

% Brinsko Beckert, K. and Palenik, C.S. (2018) Nanoparticles as trace evidence: Part I. Recognition and collection. Pittcon 2018, Orlando, FL.

% Brinsko Beckert, K. and Palenik, C.S. (2018) The Forensic Analysis of 3D Printer Dust Particles. Pittcon 2018, Orlando, FL.

%Palenik, C.S. (2018) Nanotrace Evidence in Forensic Investigations. National Association of Criminal Defense Laywers. Making Sense of Science XI: Forensic Science and the Law. Las Vegas, NV.

% Palenik, C.S. (2018) High Order Trace Transfers: Considerations for the analysis of subvisible and nanoparticles. American Academy of Forensic Science 70th Annual Scientific Meeting, Seattle, WA.

% Palenik, C.S. (2018) Fulgurites in litigation. American Academy of Forensic Science 70th Annual Scientific Meeting, Seattle, WA.

Palenik, C.S. (2017) Fulgurites and Forensic Science: A Novel Application of Forensic Geology. Inter/Micro-2017, Chicago, IL.

Insana, J. and Palenik, C.S. (2017) Application of Rietveld Refinement to Forensic Samples. Inter/Micro-2017, Chicago, IL.

White, K.M. and Palenik, C.S. (2017) A Forensic Study of Known Toner Nanoparticles, Inter/Micro-2017, Chicago, IL.

Brinsko Beckert, K. and Palenik, C.S. (2017) The forensic analysis of 3-D printer dust particles. Inter/Micro-2017, Chicago, IL.

#Palenik, C.S. (2017) Scientific Foundations Session 1, National Commission on Forensic Science. National Institute of Justice, Washington, DC.

#Palenik, C.S. (2016) Counterfeit materials and their relation to forensic science. Interpol Forensic Science Managers Symposium, Lyon France.

#Palenik, C.S. (2016) The invaluable role of a technician in forensic science. Fall Annual Meeting of the Midland Section of the American Chemical Society, Midland Michigan.

*Palenik, C.S. (2016) Forensic microscopy and the lost art of observation. Fall Annual Meeting of the Midland Section of the American Chemical Society, Midland Michigan.

#Palenik, C.S. (2016) Advanced trace evidence analysis: from micro to nano. Asian Forensic Sciences Network Annual Meeting 2016, Bangkok, Thailand.

#Palenik, S.J. and Palenik, C.S. (2016) The Utilization of Microscopy in Developing Investigative Leads from the Examination of Microscopic Trace Evidence in Forensic Investigations. Microscopy and Microanalysis 2016 Meeting, Dayton, OH.

Hargrave, K.H., Nytes, B.N., Hopen, T., Palenik, C.S. (2016) Applications of Glass Microspheres as Forensic Trace Evidence. Presentation at Inter/Micro 2016, Chicago, IL.

Groves, E.G. and Palenik, C.S. (2016) A practical approach to forensic dye identification: method and validation. Presentation at Inter/Micro 2016, Chicago, IL.

Palenik, C.S., Groves, E.G., and Palenik, C.S. (2016) Dye Identification in Casework: How far can you go? Presentation at Inter/Micro 2016, Chicago, IL.

Scott, K.R., Palenik, C.S., Palenik, S., Morgan, R.M. (2016) A multidisciplinary approach to the collection and analysis of aquatic trace evidence from clothing exhibits. Australian and New Zealand Forensic Science Society International Symposium. Auckland, New Zealand.

Scott, K., Morgan, R., Palenik, C.S. and Palenik, S.J. (2015) Developing the techniques available for the collection and analysis of forensic evidence in freshwater crime scene environments. National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.

Fallon, B.L., Palenik, C.S. and Palenik, S.J. (2015) Jute and its Substitutes in Common Goods. National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.

Palenik, C.S. (2015) Decreasing the Scale and Increasing the Scope of Trace Evidence. National Institute of Justice Impression, Pattern and Trace Evidence Symposium (IPTES), San Antonio, TX.

^Palenik, C.S. (2015) Surrounded by Spheres: Microspheres and nanospheres in the world around us. Inter/Micro 2015. Chicago, IL.

Nytes, B.N., Palenik, C.S., Palenik, S.J. (2015) Microchemistry: Not such a small thing. Inter/Micro 2015. Chicago, IL.

Hargrave, K., Palenik, S.J., Beckert, J., Palenik, C.S. (2015) Characterization of Extracted Dyes by Capillary Microspectrophotometry: Proof of Concept. Inter/Micro 2015. Chicago, IL.

Fallon, B.L., Palenik, C.S., and Palenik, S. (2015) A Tale of Two Corchorus Species: Jute and Its Substitutes in Common Goods. Inter/Micro 2015. Chicago, IL.

^#Palenik, C.S. (2015) Keynote Address. Microscopy and the lost art of observation. SCIX 2015, Providence Rhode Island.

#Palenik, C.S. (2015) Microscopy: My Professional Hobby. State Microscopical Society of Illinois monthly speaker series. Chicago, IL.

Palenik, C.S. and Palenik, S.J. (2015) Microtrace to Nanotrace: Extracting information at increasingly smaller length scales. American Academy of Forensic Sciences Annual Meeting, Orlando, FL.

^,#Palenik, C.S. (2014) Identification and Significance of Colorants in Forensic Casework. World Forensic Festival (IAFS 2014, AFSN 2014, APMLA 2014), Seoul, Korea.

Palenik, C.S. and Palenik, S.J. (2014) Seeing Color: Practical Methods in Pigment Microscopy. Inter/Micro 2014, Chicago, IL.

Hargrave, K., Beckert, J., Palenik, C.S., White, K., Sigman, M. (2014) The Comparison of Similarly Colored Fabrics and Yarns Using Comparison Microscopy and Microspectrophotometry. Inter/Micro 2014, Chicago, IL.

Nytes, B., White, K.M., and Palenik, C.S. (2014) You Found WHAT in Your Pizza?: Characterization of a condom allegedly baked into a pizza. Inter/Micro 2014, Chicago, IL.

White, K.M., Palenik, C.S., Beckert, J.B., and Hargrave, K. (2014) Evaluating Different Methods of Comparison for Fibers with Subtle Variations in Dye Concentration. Inter/Micro 2014, Chicago, IL.

#Palenik, C.S. (2014) Food Forensics: Key Considerations for Consumer Complaint Sample Analysis. Food Labs Conference at PittCon, Chicago, IL.

#Palenik, C.S. (2013) Applications of colorant identification in forensic science. SCIX 2013 Annual Meeting, Milwaukee, WI.

Groves, E. and Palenik, C.S. (2013) The use of blue light curing resins in forensic sample preparation, Inter/Micro 2013, Chicago, IL.

Palenik, C. and Beckert, J. (2013) Between the fringes: overlooked topics in microspectrophotometry, Inter/Micro 2013, Chicago, IL. (abstract accepted, talk not given due to illness)

Groves, E. and Palenik, C.S. (2013) Colorant basics: chemical organization of a dye and pigment database, Inter/Micro 2013, Chicago, IL.

Palenik, S. and Palenik, C.S. (2013) Development of a systematic approach to forensic dye identification, Inter/Micro 2013, Chicago, IL.

Nytes, B., Palenik, S.J. and Palenik, C.S. (2013) Fitting the Mold: An Exploration into Sourcing of Glass Fragments, Inter/Micro 2013, Chicago, IL.

Palenik, C.S. (2013) Microanalytical methods of materials characterization in forensic science. International Cement Microscopy Association Annual Meeting, Rosemont IL.

#Palenik, C.S. and Palenik, S.J. (2013) Applications of Forensic Microanalytical Methods to the Identification and Sourcing of Particulate Matter in Pharmaceutical Products, Microscopy & Microanalysis 2013 sponsored by the Microscopy Society of America, Indianapolis, IN.

Palenik, C.S. (2013) Systematic in situ Identification of Pigments in Paint by Raman Microspectroscopy, AAFS, American Academy of Forensic Sciences National Meeting, Washington, DC.

Palenik, C.S. and Beckert, J.B. (2012) The Forensic Analysis of Paint Evidence Using Micro-Raman Spectroscopy, MAFS 2012, Milwaukee, WI.

Groves, E.G., Herb, J., Palenik, C.S. (2012) Benefits of Using Cross-Sectioning in Forensic Analysis of Automotive Paints, Inter/Micro 2012, Chicago, IL.

Palenik, C.S., Buzzini, P., Herb, J., Groves, E. (2012) The Forensic Analysis of Paint Evidence Using Micro-Raman Spectroscopy Part I: Development of Libraries and Application Methods, Inter/Micro 2012, Chicago, IL.

Buzzini, P., Palenik, C.S., and Massonnet, G. (2012) The Forensic Analysis of Paint Evidence Using Micro-Raman Spectroscopy Part II: Case Examples, Inter/Micro 2012, Chicago, IL

Sliwa, S., Groves, E., Palenik, M.C. (2012) Mapping Elemental and Refractive Index Variation in Container Glass, Inter/Micro 2012, Chicago, IL.

Herb, J., Palenik, C.S., and Palenik, S.J. (2012) Four Score and Seven Years Ago" or Was It? : Authenticating President Abraham Lincoln's Signature, Inter/Micro 2012, Chicago, IL.

Palenik, C.S. and Palenik, S. (2012) Development of a Pigment Classification Scheme by Raman Spectroscopy. American Academy of Forensic Sciences National Meeting. Atlanta, GA.

#Palenik, C. (2011) Forensic Soil Examination at the NIJ Sponsored Elemental Analysis Working Group Meeting Miami, Florida – October 12-13, 2011.

Buscaglia, J., Palenik, C.S., Brokus, S.A., Silletti, D.K., Cooper, D.E., Purcell, D.K., Peaslee, G.F. (2011) Applications of Cathodoluminescence (CL) Microscopy and Spectroscopy to Forensic Evidence. Presented at Cathodoluminescence (CL 2011), a topical conference (TC) of the Microbeam Analysis Society (MAS), co-sponsored by the Australian Microbeam Analysis Society (AMAS) held at the National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA on October 24-28, 2011.

#Palenik, CS. Beyond Comparison: Developing Investigative Leads from Trace Evidence. Eastern Analytical Symposium. Somerset, New Jersey.

Palenik, CS, Palenik, S., Herb, J., Beckert, J., Nytes, B. Chemical Classification of Pigments by Raman Spectroscopy for Forensic Applications. NIJ Trace Evidence Symposium, Kansas City, MO (2011).

Palenik, CS, Palenik, S., Beckert, J., Nytes, B., Groves, E. (2011) Improvements in analytical precision in the forensic analysis of glass through the use of metal filters in μ-XRF analysis. NIJ Trace Evidence Symposium, Kansas City, MO.

Jantzi, S.C., Trejos, T., Zdanowicz, V., Dalpe, C., Palenik, C.S., Koons, R., Wong, D., Hanlon, C., Pollock, E., Becker, S., Almirall, J. (2011) Inter-Laboratory Comparison of LA-ICP-MS, μXRF and LIBS methods for Bulk Soil Analysis

Ernst, T., Trejos, T. Valadez, M., Koons, R., Buscaglia, J., Olsson, K., Ryland, S. Berman, T., Eckert-Lumsdon, T. Hanlon, C., Palenik, C., Almirall, J. (2011) When is a peak, a peak? Calculating detection and quantification limits for micro X-ray fluorescence spectrometry of glass samples.

Herb, J.N. and Palenik, C.S. (2011) Use of surface enhanced Raman spectroscopy (SERS) applied to the study of fluorescing pigments and dyes. American Academy of Forensic Sciences National Meeting, Chicago, IL.

Nytes, B.N, Beckert, J., Palenik, C.S., and Palenik, S. (2011) Obtaining investigative forensic information from the analysis of rodents in food products. American Academy of Forensic Sciences National Meeting, Chicago, IL.

Palenik, CS, Wilke, B. (2010) Raman spectroscopy of organic pigments. American Academy of Forensic Sciences National Meeting, Seattle, WA.

Palenik, CS, Nytes, B.N., Beckert, J., Bonta, H, and Palenik, S (2009) Raman spectroscopy of Forensic Evidence. Trace Evidence Symposium (National Institute of Justice (NIJ), Clearwater Beach, FL.

Buscaglia, J., Palenik, C.S., and Peaslee, G. (2009) Trace evidence applications of cathodoluminescence (CL) microspectrophotometry. Trace Evidence Symposium (National Institute of Justice (NIJ), Clearwater Beach, FL.

Wilke, B. and Palenik, C.S. (2009) Organic Pigments: Analytical characterization and classification by Raman spectroscopy. Inter/Micro 09, Chicago, IL.

Palenik, CS, Bonta, H, and Palenik, S (2009) Microanalysis of Architectural Tinting Pigments. American Academy of Forensic Sciences National Meeting. Denver, CO.

#Palenik, CS (2008) Food Forensics: Applications of microscopy and microchemistry to contamination issues in the food industry. Presented to the Griffth Laboratory Global Summit Meeting, Lombard, IL.

#Palenik, CS (2008) Big Picture Clues from Microscopic Particles: Applications of Geology to Forensic Science. Colgate University, NY.

Peaslee, GF, Buscaglia, J, Palenik, CS (2008) Cathodoluminescence as a Forensic Tool. 2008 Joint Meeting of The Geological Society of America, Soil Science Society of America, American Society of Agronomy, Crop Science Society of America, Gulf Coast Association of Geological Societies with the Gulf Coast Section of SEPM. Houston, TX.

Bales, H. and Palenik, CS (2008) Planar Section of Multilayer Paint Chips. Inter/Micro 2008, Chicago, IL.

Palenik, S. and Palenik, CS (2008) A Practical Technique for the Recognition of
Modern Sculptures Proffered as Ancient Works of Art. Inter/Micro 2008, Chicago, IL.

Palenik, CS and Bonta, H. (2008) Microanalytical Characterization of Architectural Paint Pigments. Inter/Micro 2008, Chicago, IL.

#Palenik, CS (2008) Workshop on Raman Spectroscopy of Forensic Evidence. International Association of Forensic Sciences Conference Proceedings. New Orleans, LA.

Peaslee, GF, Palenik, CS, and Buscaglia, J (2008) Application of Cathodoluminescence Microspectrophotometry for Forensic Comparison of Concrete Samples. International Association of Forensic Sciences Conference Proceedings.

Palenik, CS, Palenik, S., and Nytes, B. (2008) An introduction to the in situ identification of pigments in automobile and architectural paints by Raman microspectroscopy. Proceedings of the American Academy of Forensic Sciences National Meeting, Washington DC.

Palenik, CS and Nytes B (2007) The *in situ* identification of pigments in CMYK printing inks. Inter/Micro 2007, Chicago, IL.

Palenik, CS and Palenik, SJ (2007) Ensuring the Continued Role of Science in the Forensic Examination of Trace Evidence. Proceedings of the 2007 American Academy of Forensic Sciences National Meeting, San Antonio, TX.

Palenik, SJ and Palenik, CS (2007) Developing Investigative Leads through Trace Evidence. Proceedings of the 2007 American Academy of Forensic Sciences National Meeting, San Antonio, TX.

#Palenik, CS (2007) Forensic Trace Evidence: Big Picture Clues from Microscopic Particles. Saturday Science Fun Lecture Series, Freedom Hall, Park Forest, IL.

#Palenik, CS (2006) Trace Evidence for the Public Defender. Missouri State Public Defender Winter Workshop, St. Louis, MO.

#Palenik, CS (2006) Forensic Microscopy of Fibers. Presentation at Philadelphia University seminar series.

#Palenik, CS (2006) Cathodoluminescence in Forensic Science. Presentation Soil Analysis workshop at California Association of Criminalists Fall Seminar.

Palenik, S.J. and Palenik, C.S. (2006) Developing Forensic Investigative Leads through the Microscopical Examination of Trace Evidence. Geological Society of America National Meeting, Philadelphia, PA. GSA Abstracts with Programs 38 (7).

Palenik, C.S. (2006) Novel applications of cathodluminescence microscopy. Inter/Micro-06, Chicago, IL.

Palenik, C.S. and Buscaglia, J. (2006) Cathodoluminescence in Forensic Science. American Academy of Forensic Sciences National Meeting, Seattle, WA.

Mooney, K.E., Koons, R.D., Buscaglia, J. and Palenik, C.S. (2006) Discrimination of Automobile Side Windows by Micro-XRF. American Academy of Forensic Sciences National Meeting, Seattle, WA.

Palenik, C.S. (2006) From PhD to Professional: Bridging the Gap. 3rd Annual Northwestern University PLU Career Forum.

#Palenik, C.S. (2005) Applications of microscopy and microchemistry in forensic science. Talk given at Chemistry Dept. seminar, University of Wisconsin Platteville.

Egan, J.M., Mooney, K.E., Palenik, C.S., Rickenback, M.P., Golombeck, R.A. and Mueller, K.T. (2005) Synthesis, Isolation, and Characterization of Chlorinated Products of Bank Security Dye Packs Upon Bleaching, Pittcon - 2005, August, 2005.

Palenik, C.S. and Buscaglia, J. (2005) Cathodoluminescence microscopy in forensic science. 2006 Annual meeting of the American Academy of Forensic Sciences. Seattle, WA.

#Palenik, C.S. and Buscaglia, J. (2005) Applications of cathodoluminescence in the forensic analysis of trace evidence. 2005 Annual meeting of SWGMAT (Scientific Working Group for Materials Analysis sponsored by the FBI), Washington, D.C.

*Palenik, C.S. and Buscaglia, J. (2005) Applications of cathodoluminescence in forensic geology. 2005 Goldschmidt Conference, Moscow, Idaho, Geochmica et Cosmochimica Acta.

Fayek, M., Palenik, C.S. and Ewing, R.C. (2005) Characterization of Nd, Te and U isotope ratios in UO_2 using SIMS. 2005 Goldschmidt Conference, Moscow, Idaho, Geochmica et Cosmochimica Acta.

Palenik, C.S., Fayek, M., Fleming, R. and Ewing, R.C. (2004) Isotopic composition and neutronics of the Okélobondo natural nuclear reactor. Geological Society of America, Fall National Meeting, Denver, CO.

Palenik, C.S. (2004) Microanalytical Characterization of a Natural Nuclear Reactor. Inter/Micro-04, Chicago, IL, Microscope, 52, 156.

*Ewing, K.A., Palenik, C.S. and Ewing, R.C. (2004) The natural fission reactors at Oklo, Gabon: Lessons for modeling the long-term behavior of a nuclear waste repository. International Geological Congress, Florence, Italy.

Palenik, C.S., Jensen, K.A and Ewing, R.C. (2004) The impact of uncertainties in geochemical modeling on performance assessments. Materials Research Society Spring Meeting, San Francisco, CA.

Jensen, K.A., Palenik, C.S., Fayek, M., Evins, L.Z., Janeczek, J., and Ewing, R.C. (2003) The spent nuclear fuel analogue of the Oklo-Okélobondo and Bangombé natural fission reactors. Nordic Geological Winter Meeting, Sweden.

Palenik, C.A., Fayek, M., Jensen, K.A., and Ewing, R.C. (2003) Analysis of Fission Products and Pu Migration in the Okelobondo Reactor Zone Using SIMS. Geological Society of America, Fall National Meeting, Seattle, WA, 35(6), 237.

Utsunomiya, S., Palenik, C.S., Ewing, R.C., Valley, J.W., Cavosie, A.J., and Wilde, S.A. (2003) Fate of Pb in an Archean Zircon. Geological Society of America, Fall National Meeting, Seattle, WA 35(6), 594.

Reich, M., Palenik, C.S., Utsunomiya, S., Becker, U, Stixrude, L. Kesler, S.E. and Ewing, R.C. (2003) Solubility Limit of Gold in Arsenian Pyrite from Carlin-Type and Epithermal Deposits: EMPA, SIMS, HRTEM and Quantum-Mechanical Constraints. Geological Society of America, Fall National Meeting, Seattle, WA 35(6), 358.

Palenik, C.S. and Stoecklein, W. (2003) Batch to batch differentiation of automobile paints. Inter/Micro-03, Chicago, IL

Jensen K.A., Palenik C.S., and Ewing R.C. (2003) Thermodynamic prediction of observed uranium minerals in the supergene-weathered Bangombé U-deposit: implications for blind prediction modeling. Uranium Geochemistry 2003, Nancy, France.

Palenik, C.S., Utsunomiya, S, Kesler, S.E. and Ewing, R.C. (2002) Gold nanoparticles in aresenian pyrite from a Carlin-type deposit observed by HRTEM. Geological Society of America, Fall National Meeting, Denver, CO.

Palenik, C.S, Jensen, K.A. and Ewing, R.C. (2002) Thermodynamic prediction of observed uranyl phases in the supergene-weatherd Bangombe U-deposit: Implications for Blind Prediction Modeling. International Mineralogical Association, Scotland, England.

Jensen, K.A., Palenik, C.S., Ewing, R.C. and Burns, P.C. (2001) Uranyl Phases in the Bangombe U-Deposit, Migration '01, Bregenz, Austria.

Jensen, K.A., Palenik, C.S., Ewing, R.C. and Burns, P.C. (2001) Oxidative Alteration of the Oklo-Okelobondo and Bangombe U-Deposits in Gabon: Observed and Predicted Mineralogy, American Chemical Society - Fall National Meeting, Chicago, IL.

Palenik, C.S., Lian, J. and Ewing, R.C. (2001) Microanalysis of radiation damage across a zoned zircon crystal. Materials Research Society, Fall National Meeting, Boston, MA.

Palenik, C.S., Lian, J. and Ewing, R.C. (2001) Zircon as a host for the disposal of Plutonium, Workshop on Engineering Mineralogy of Ceramic Materials, ISEPS, Siena, ITALY.

Jensen, K.A., Palenik, C.S., Ewing, R.C., Burns, P. (2000) The role of sulfates during supergene weathering in the Oklo-Okelobondo uranium deposits, Geological Society of America, Reno, NV.

Stoecklein, W. and Palenik, C.S. (1998) Forensic analysis of automotive paints: Evidential value and the batch problem. Presentation – 4th meeting of the European Paint Group. Paris, France, October 5-6.

Palenik, C.S., (1998) Analysis of Chrome-Bearing Spinel from the Allende Meteorite Geophysical Science Exposition '98, University of Chicago.

Simon, S.B., Grossman, L., Ebel, D., Palenik, C. (1998) Large Relict Chromium Spinel from Allende: A link to Murchison?, 29th Lunar and Planetary Science Conference, Houston, TX.

Palenik, C.S. and Olson, L. (1995) Identification of Gel-Based Inks, INTER/MICRO-95, Chicago, IL.

Palenik, C.S. and Olson, L. (1995) Developing procedures for the identification of gel inks, IMSA Presentation Day, Aurora, IL.

Palenik, C.S. Original Paint Finish Systems on Foreign Automobiles (1994) INTER/MICRO-94, Chicago, IL.

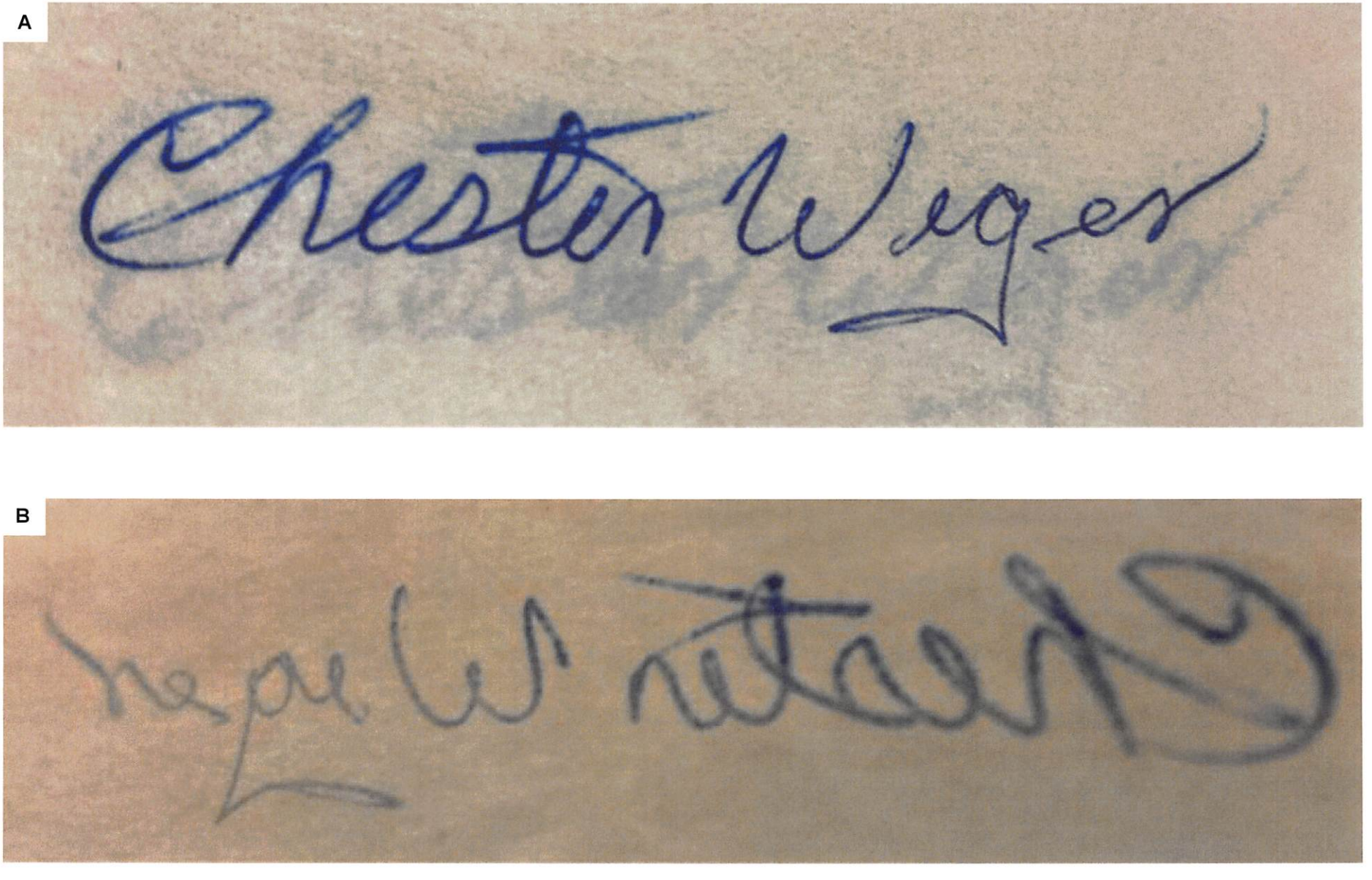


Figure 1. Example of Chester Weger signature that may be written with two different pens shown (A) from the front of the document and (B) from the back of the page. Note that "Weger" appears to be written with an ink that is a deeper blue and thinner stroke.

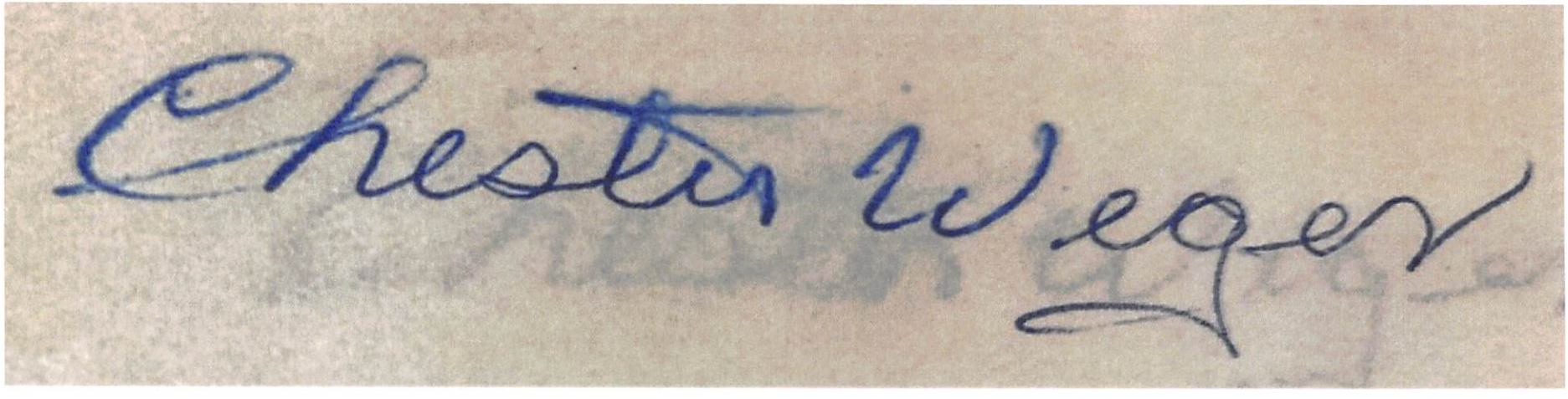


Figure 2. Example of Chester Weger signature that may be written with two different inks. Note that the "eger" in "Weger" appears to be written with an ink that is a deeper blue and thinner stroke.

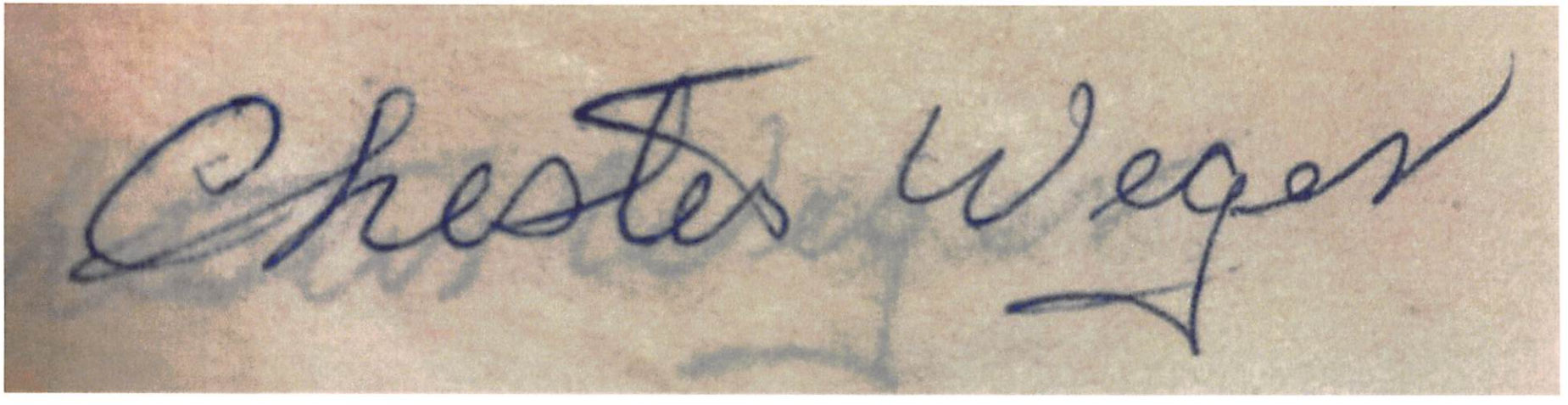


Figure 3. Example of Chester Weger signature that may be written with a single ink.

Gary Ridgway left microscopic paint evidence on the clothing of several of his victims that went undetected for decades. Chelsea Stahl / NBC News

U.S. NEWS

How a crime lab missed evidence that could have stopped the Green River Killer

Tiny paint spheres helped snare serial killer Gary Ridgway after at least 49 murders in Washington. The evidence was on his first victims, records show.

SAVE

March 3, 2023, 7:00 AM CST

By Lewis Kamb

SEATTLE – For nearly two decades, one of the country's most prolific serial murderers haunted the Pacific Northwest as a faceless specter of death, known only by his notorious nickname: the Green River Killer.

Even though a massive team of investigators had been assembled to track him down, the killer's identity remained a mystery during the 1980s and '90s, while dozens of girls and women disappeared from the streets around Seattle, only to turn up in wooded dumpsites months or years later as corpses or bones.

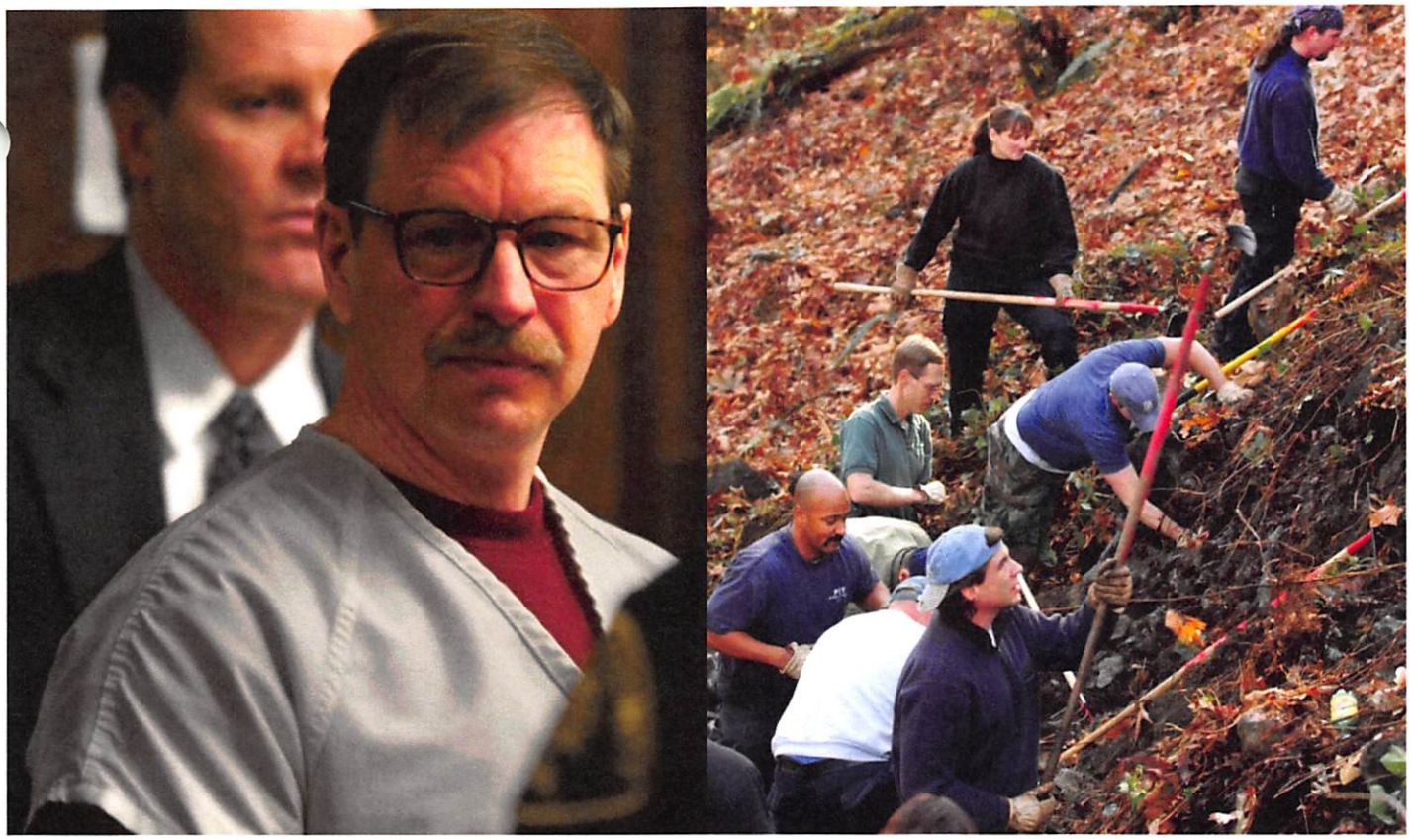
Then, in late 2001, long after the case had turned cold and the killings seemed to have stopped, officials announced the arrest of a commercial truck painter named Gary Ridgway. They credited the big break in the case – what they said had singled out Ridgway from a pool of 1,300 possible suspects – to advances in DNA fingerprinting techniques that didn't exist at the peak of the killings.

But an NBC News investigation shows the long-told narrative that forensic science had to catch up with the Green River Killer is false.

Nearly 20 years before Ridgway was arrested, the Washington State Patrol Crime Laboratory overlooked key microscopic evidence found on the clothing of his very first victim – and of seven others who followed – according to interviews and a review of thousands of pages of documents obtained through public records requests. The tiny spheres of a unique industrial spray paint linking Ridgway to their murders could have been detected back in the 1980s, forensic scientists involved in the case recently acknowledged, possibly preventing at least some of his 49 confirmed killings.

Even some longtime investigators assigned to the case said in interviews that until now, they had been in the dark about the missed opportunity to catch the killer sooner.

"I'm appalled I didn't know that that was even possible," said Frank Adamson, a retired King County sheriff's commander who supervised the Green River Task Force in the mid-1980s. "It would have been nice if we could've saved a life or two – or all of them."



— Gary Ridgway after his sentencing in Seattle in 2003. At right, members of the task force comb a hillside where Ridgway said he had left a body. Josh Trujillo / Pool via Getty Images; Elaine Thompson / AP

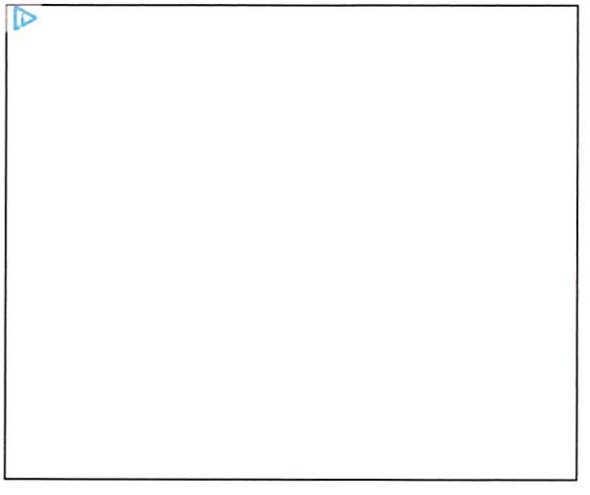
Only after the DNA match that led to Ridgway's arrest did a renowned trace evidence expert, brought in to help with the case, find the overlooked clues in 2003. The spray paint found on the victims' clothing wasn't sold to the public, and it was used only in the Seattle area on a wide scale in the early 1980s by Kenworth Truck Co., where Ridgway worked.

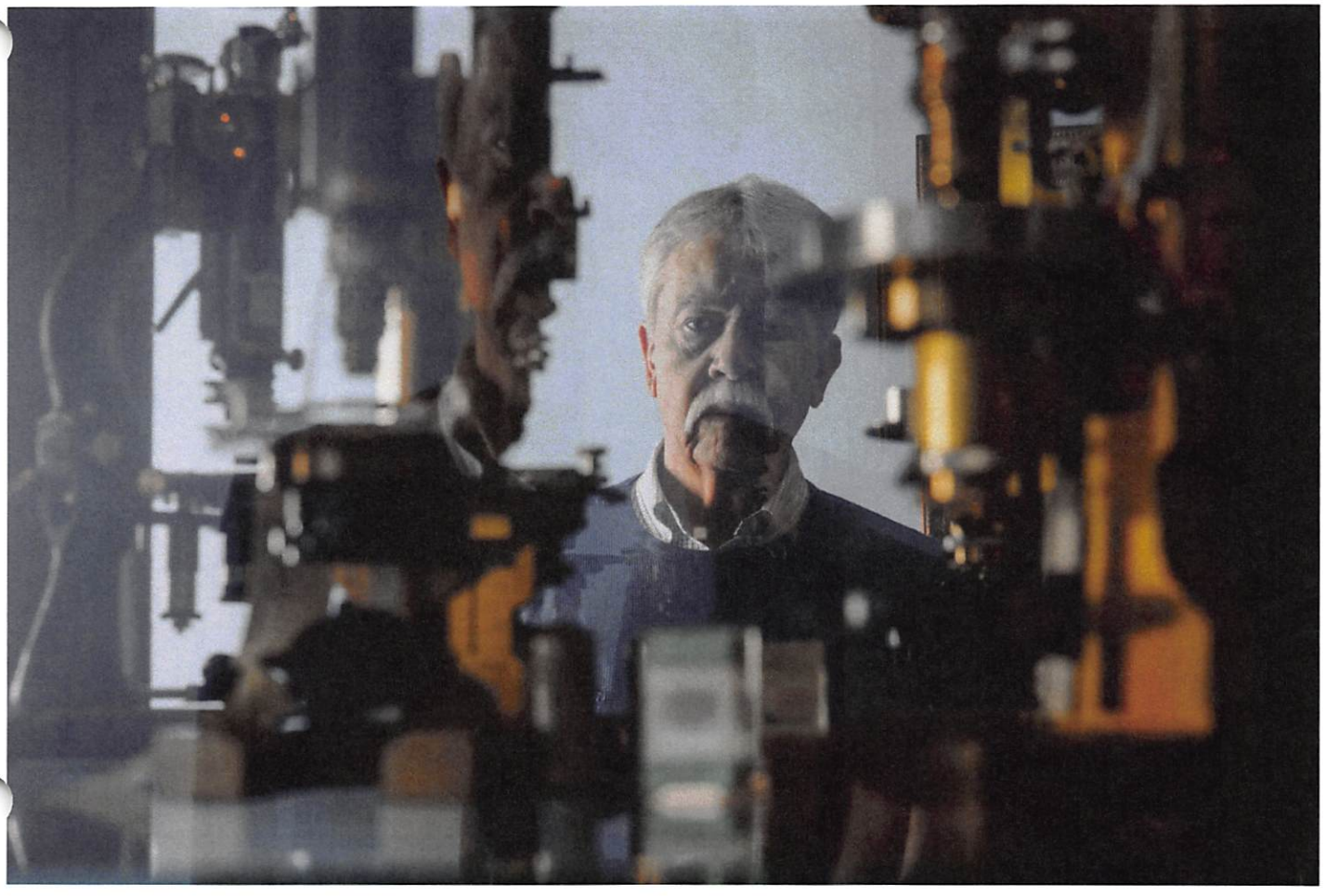
Authorities hailed the discovery publicly as another scientific breakthrough. It pressured Ridgway into confessing to 48 murders and leading detectives to four previously undiscovered bodies in exchange for sparing him the death penalty.

But in a recent interview, the trace evidence expert, Skip Palenik, said he could have done the same analysis, with the use of an infrared microscope, back in the 1980s. And he almost had the chance, he said.

Palenik said that in 1985, when he visited the Washington crime lab to train staff members in discovering microscopic trace evidence, the director said he'd bring him into the case if investigators identified a suspect.

But Palenik said the director never called. Seventeen years later, he said, "I get a phone call saying they want us to look at this case. And we ended up finding information that we could have found" back then.





— Trace evidence expert Skip Palenik first heard about the Green River murders in 1985 while training forensic scientists in Seattle. Taylor Glascock for NBC News

Jeff Baird, the retired King County senior deputy prosecutor who led the prosecution of Ridgway and ultimately brought Palenik into the case, said in a recent interview he'd never heard about Palenik's visit to the crime lab in the 1980s or knew the paint spheres could've been found then.

"It's very conceivable that if those things had been more carefully examined at the time, the investigation would have taken an earlier, more productive turn that pointed directly to Ridgway," Baird said.

Asked about the overlooked evidence, a spokesperson for the Washington State Patrol Crime Lab said in an email that "with so much time having passed, we are reluctant to speculate on the mindsets and specific investigative strategies of past forensic leaders from so many years ago."

Chesterene Cwiklik, the scientist who supervised the lab's trace evidence work at the time, acknowledged in a recent interview, "We never looked at those really fine particles that Skip did."

Sisters of Patricia Yellow Robe, Ridgway's last known victim, said the revelations are upsetting but mean little now.

"If this would've been presented to us at a different time, there probably would be outrage," Rona Yellow Robe said. "But there's been a lot of time and space and healing that I wouldn't want to give up to something that I can't control."

— LuAnna Yellow Robe, left, and her sister, Rona Yellow Robe, at the 2003 court hearing where Gary Ridgway admitted to murdering their sister, Patricia. Elaine Thompson / Pool via Getty Images

1982-86: A decision about evidence

In July 1982, the body of Ridgway's first known victim was pulled from the Green River in suburban Seattle, a pair of blue jeans knotted around her neck.

Embedded in the denim used to strangle 16-year-old runaway Wendy Lee Coffield were the tiny spheres of spray paint that would take more than two decades to detect.

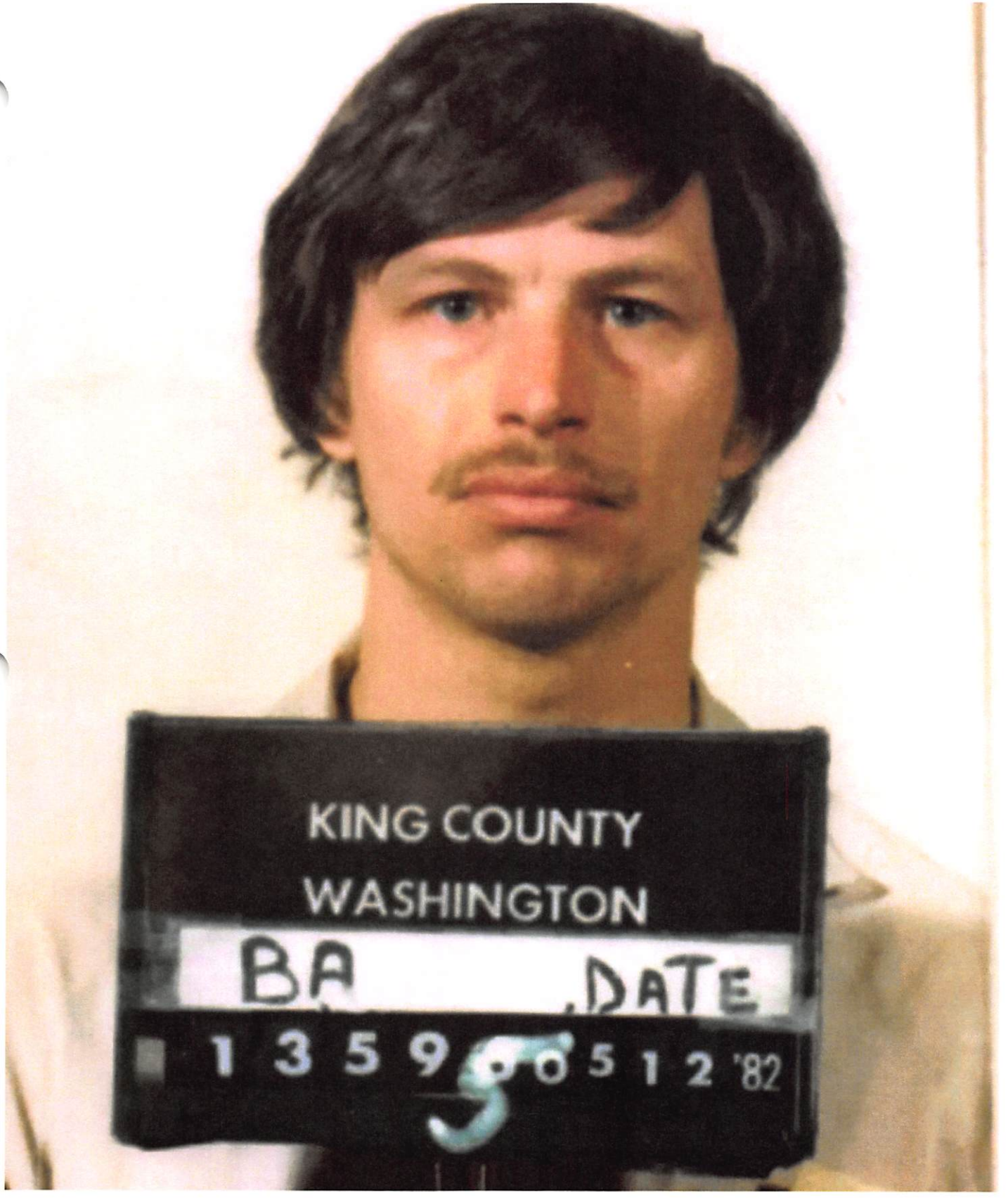
After four more bodies were found dumped in and along the Green River within a month, the King County sheriff assembled a task force to track down a serial killer.

The killer kept preying on vulnerable women and girls, many of whom were runaways or had been involved in street prostitution, leaving the bodies in remote, wooded stretches. Investigators compiled a list of hundreds of potential suspects and amassed a mountain of evidence from the dumpsites, turning much of the material over to state forensic scientists for analysis.

Ridgway first came to the task force's attention in 1983, when 18-year-old Marie Malvar disappeared after she got into a pickup truck with a man on Pacific Highway South. Her boyfriend and pimp later spotted what he thought was the same truck in front of Ridgway's house and reported it to police.

Ridgway told a detective he knew nothing about Malvar's disappearance, but he kept resurfacing in tips and brushes with sex workers over the next several months. He voluntarily spoke with detectives and acknowledged he'd been arrested before for soliciting a prostitute. He said he'd continued to routinely pick up girls working the street and had even encountered two of the killer's presumed victims. But he denied having harmed them. In 1984, he agreed to take a lie detector test – and passed.

By then, the killer had left behind key microscopic evidence that could have helped unmask his identity, records and interviews show. Along with the jeans used to strangle Coffield, the paint spheres were trapped in the weaves of fabric eventually found with seven other bodies and bones, records show. A purple shirt. A pair of jeans. A black knit sweater.



— Gary Ridgway in a booking mugshot after his arrest in 1982 for soliciting prostitution.
King County Sheriff's Department, via AP

But with the volumes of evidence, the staffing constraints and the workload of other cases statewide, crime lab officials had to choose what evidence to analyze, said Cwiklik, the lab's trace evidence supervisor at the time.

They opted to focus on analyzing hairs and fibers, which "usually would have been the most fruitful," Cwiklik said in a recent interview.

The analysts assigned to the case "actually did an amazing job" of sorting, analyzing and comparing thousands of individual hairs, fibers and chunks of paint and other collected debris, she said.

But focusing analysis on hairs and fibers meant the lab "basically ignored" smaller particles and dust on clothing and other items, Cwiklik said.

In early 1985, Ridgway drew suspicion again after another woman reported that a man who showed her his Kenworth employee identification card tried to strangle her after he had paid for sex in 1982. When a detective questioned him, Ridgway claimed he choked the woman only after she bit him. The woman declined to press charges, according to the detective's report.

The same year, Palenik, the renowned trace evidence expert, learned about the case. Palenik, then a senior researcher at the Chicago-based McCrone Research Institute – a leader in microanalysis – taught workshops around the country. He'd just finished teaching a basic forensic microscopy course at the crime lab in Seattle when George Ishii, then the director, told him about the Green River murders, Palenik said in a recent interview.

Before he left town, Palenik said, Ishii vowed to seek his help if a suspect emerged. But he never heard about the case again from Ishii, who died in 2013. Ridgway is known to have killed at least four women after 1985, when Palenik visited Seattle.

— Microscope slides with various materials on Skip Palenik's desk at Microtrace.
Taylor Glascock for NBC News

"Imagine in '85, after I was out there, if George sent this stuff back to us, we'd find and identify the spheres as this unusual urethane paint," Palenik said. "And then when they bring in a suspect and it's Gary Ridgway – well, where does he work? He works at a place where he sprays the very same unusual paint on trucks all day."

But without that forensic testing, Ridgway slipped through investigators' grasp and kept killing.

1987-90: 'We should have done it'

By 1987, Ridgway's penchant for prostitutes and past brushes with known victims and other tips were enough to help investigators get a warrant to search his home, vehicles and workplace.

In an affidavit, investigators wrote that they wanted to compare trace evidence collected from various dumpsites that might be tied to Ridgway, including green polyester carpet fibers and aluminum fragments.

But the hair, fibers, clothing and other evidence that were seized didn't definitively tie Ridgway to any victims, and he slipped back into the slush pile of suspects as the decade ended.

In hindsight, Cwiklik said, the crime lab should have shifted its focus from hairs and fibers and turned to analyzing smaller particles in the trace evidence recovered from the dumpsites.

By 1990, Cwiklik said, the crime lab was using an infrared microscope, capable of detecting finer details than an optical microscope. For years, the lab also had been using techniques to capture smaller fractions of trace evidence that could have helped to detect the paint spheres, she said. But it still would have needed an outside specialist, like Palenik, to identify and trace them back to their source, she said.

"Really, we were capable of finding these things, but we didn't because we didn't look at the small, small fractions," she said. "It always bugged me that we didn't do that, but it would have been hard to argue that we should prioritize that."

"But later on, when nothing was fruitful," she said, "we should have done it."

— Investigators search for the remains of one of Gary Ridgway's victims.

King County Prosecutor's Office via Getty Images

1990s: A rejected request

By the early 1990s, when a new wave of bodies and bones were found, the Green River Task Force had already disbanded. But a smaller group of detectives who feared the killer was still at work quietly kept the probe alive. They focused on a prime suspect: Ridgway.

In November 1992, detectives formally requested that the crime lab compare hairs collected from Ridgway to those recovered from the new wave of victims, according to a detective's memo to the lab obtained through a public records request. But officials for the crime lab, which by then had spent years futilely analyzing hairs and fibers in the case, rejected the request as a pointless endeavor, retired King County sheriff's Detective Tom Jensen said.

Jensen, who dedicated most of his career to the case, was stunned to learn recently from an NBC News reporter that the capability to detect the paint spheres that linked Ridgway to some of the victims had existed years earlier.

He couldn't recall lab officials' ever having mentioned to detectives that smaller particles of trace evidence hadn't been analyzed, he said.

"I should think we would have done the testing if we knew about it," Jensen said. "We were doing everything we could to come up with a shred of evidence."

As the '90s wore on, Jensen was left to investigate the Green River murders on his own as leads dried up.

Jensen's list of the killer's suspected victims grew to nearly 90, including dozens of homeless or drug-addicted girls and women who'd disappeared or were dumped in remote places across western Washington.

Near the end of the decade, the killings seemed to stop. But they hadn't.

When Patricia Yellow Robe's body was found in bushes outside a wrecking yard south of Seattle in 1998, she wasn't considered a victim of the killer. The medical examiner ruled her death an accidental overdose.

Yellow Robe grew up in Montana as the oldest of nine siblings in a family splintered by alcoholism. By 38, she'd been in and out of rehab and had suffered chronic health problems. She spent her last days couch-surfing and frequenting dive bars, police records show.

— Patricia Yellow Robe, the eldest of nine siblings, was a protective big sister and a talented seamstress who struggled with addiction. Courtesy LuAnna Yellow Robe

After Yellow Robe's sisters viewed her body at the funeral home, they had doubts about how she died. "She looked beat up," Rona Yellow Robe recalled, noting a bruise on her face. A deputy discounted it at the time, telling Rona the bruise was most likely a byproduct of her sister's "lifestyle," she said.

2000s: Catching the killer

By 2001, improvements in DNA science allowed the crime lab to better analyze small and degraded genetic samples. That prompted Jensen to submit evidence collected from several victims' bodies, along with a piece of gauze Ridgway had chewed on when the warrant was served in 1987.

With the new technology, scientists were finally able to match DNA from Ridgway's saliva to sperm recovered from two victims found in the river in 1982 and another victim from a dumpsite in 1983.

Based on the results, Ridgway was arrested and charged with the aggravated murders of all three victims, as well as another found just feet away from the two in the river. He pleaded not guilty, claiming through his lawyers that he'd "dated" – but hadn't killed – the victims linked to him based on his DNA.

As he prepared to put Ridgway on trial, Baird, King County's lead criminal prosecutor on the case, enlisted several outside forensic labs in 2002 to help examine the mass of evidence in the case. By chance, Baird said, he "stumbled" on Palenik, who by then was running his own lab, Microtrace, which had worked on high-profile cases, including the Unabomber investigation and the Atlanta child murders.

— Family members of victims confronted Gary Ridgway in court after he confessed to 48 murders. From top right, Virginia Graham, sister of Debra Estes; Jose Malvar Jr., brother of Marie Malvar; and Carol Estes, mother of Debra Estes. Pool via Getty Images; EPA

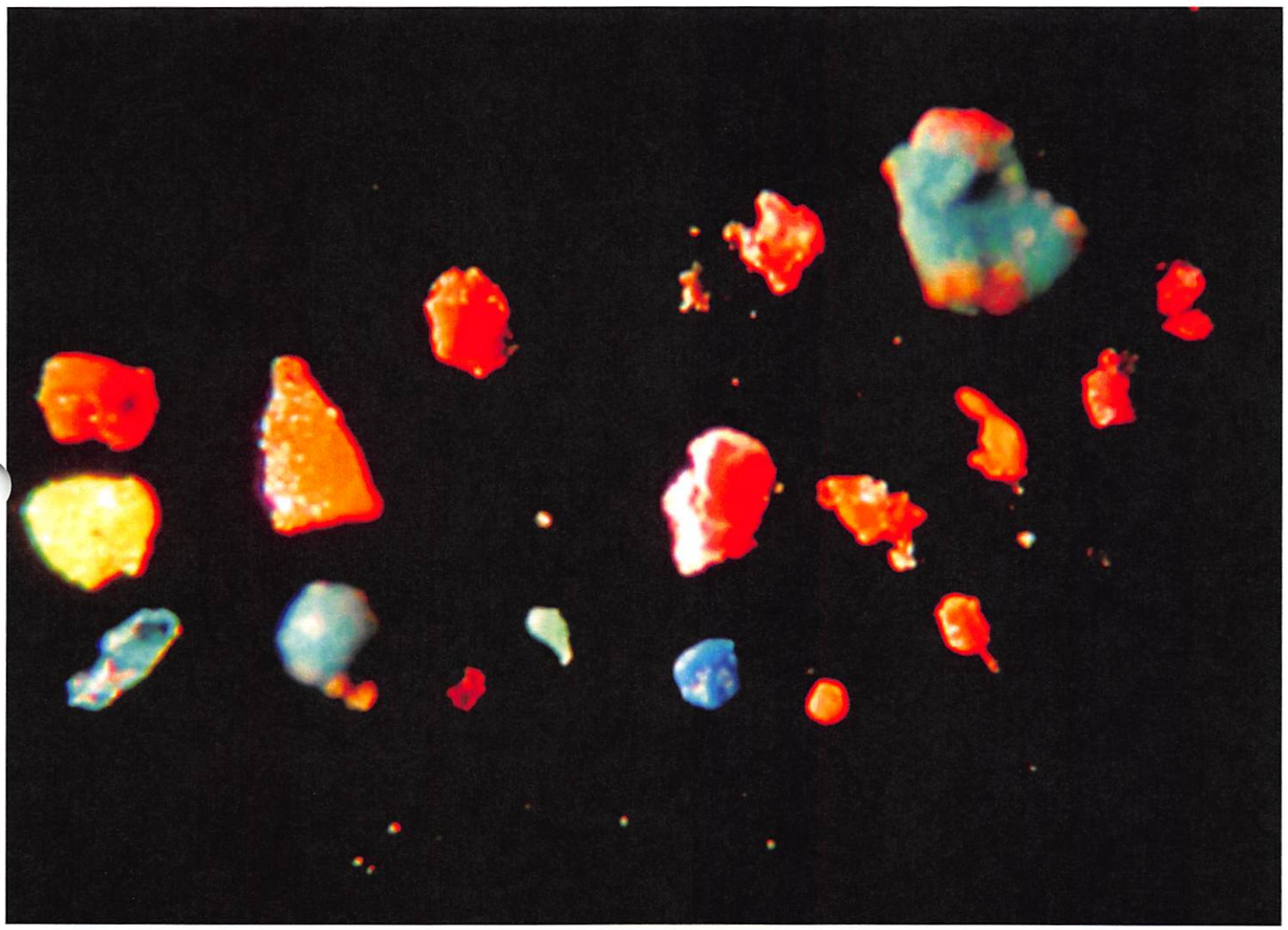
For the next several months, Microtrace analyzed paint gathered from Ridgway's home, workplace and vehicles to create a reference library and then compared it with paint fragments collected in or around the dumpsites where victims were found. Nothing matched.

So Palenik decided to change tactics: vacuuming the dust from the suspect's and the victims' clothing and analyzing the tiny particles under a microscope equipped with an infrared device used to detect colors and compositions of substances.

Since the late 1970s, Palenik had been routinely using the vacuuming process with such infrared instruments to find and identify tiny particles that helped investigators crack cases, he said. In 2003, he used the same techniques with modern versions of the tools when he analyzed Ridgway's clothes and items found with 13 Green River victims.

After having vacuumed the clothing, he plucked the tiny particles captured in special vacuum filters and then used an infrared spectrometer to identify them as unusual multicolor paint spheres. He found the spheres on Ridgway's clothes and clothing from five of the victims. They matched.

Palenik soon determined the glossy acrylic urethane spheres were air-dried droplets of a distinct commercial automotive spray paint, made by DuPont and called Imron.



— Trace evidence expert Skip Palenik discovered these tiny spray-paint spheres in the dust he vacuumed from the clothing of some Green River victims. Microtrace LLC

Chemists for the company later informed Palenik that DuPont had patented the high-end, specialty product and believed no one else in the world was making paint with Imron's unique composition or pigments.

Some of the victims' clothing had "dozens and dozens of these spray-paint spheres" in blue, green, red, orange and white, Palenik said. "And that's just not normal." It indicated the spheres came from a source that widely used DuPont Imron and in various colors, he said.

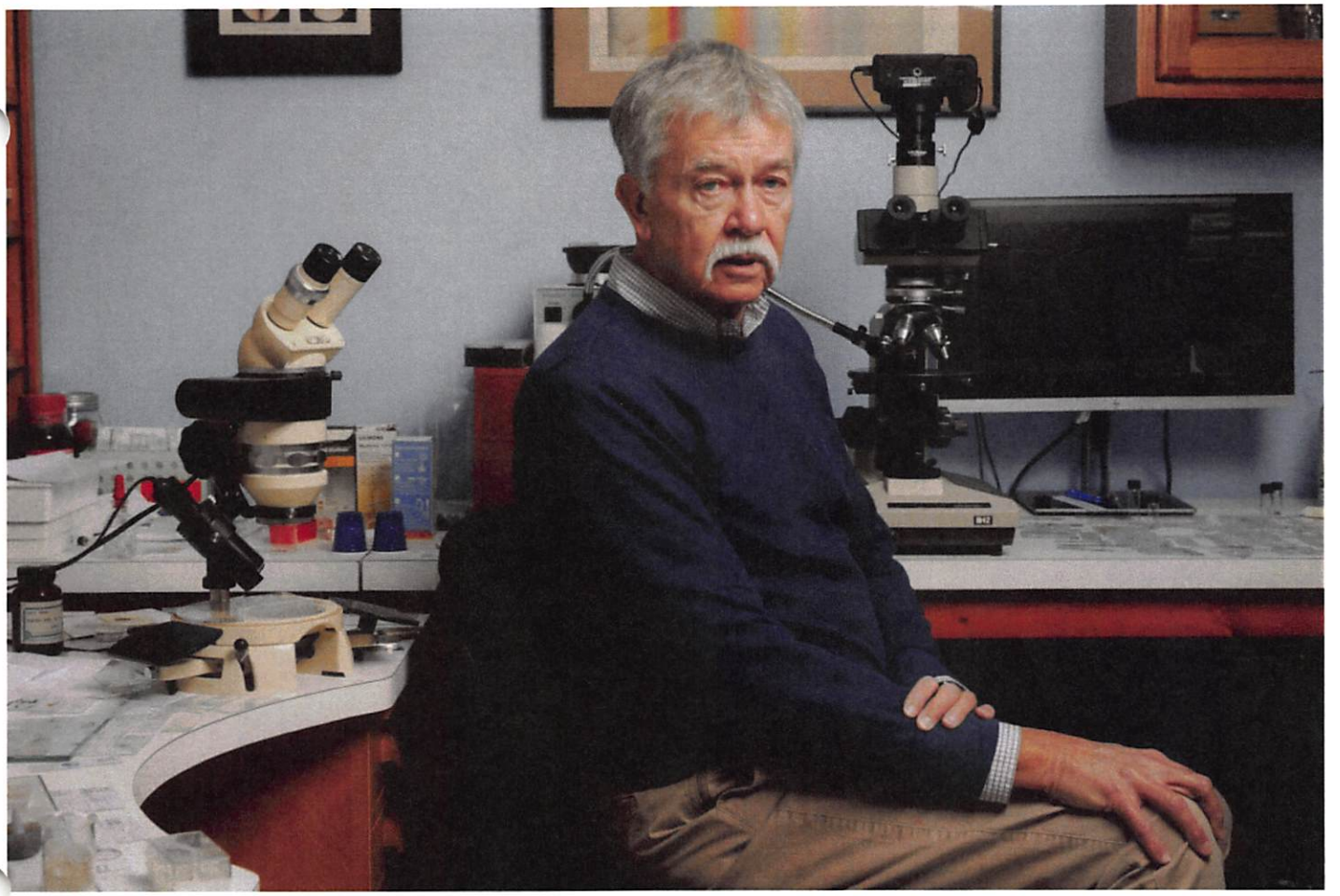
The paint wasn't sold to the public in 1982, and Kenworth, where Ridgway worked, was "the only place in the Seattle area using this spray paint on a large scale in the early 1980s," he said.

After Palenik informed Baird about his findings, prosecutors charged Ridgway with three more murders, catching his defense team off-guard.

One of his lawyers, Mark Prothero, later wrote in a book that even though his team downplayed the paint spheres, "the prosecutors couldn't have found anything much worse for our client, short of a Polaroid picture of him strangling a woman."

Baird recently described Palenik's findings as "pivotal." The paint spheres were "very, very powerful evidence" that, to Baird, was in many ways better than DNA because it was "not an arcane or highly technical forensic science but nevertheless very convincing on a gut level," he said.

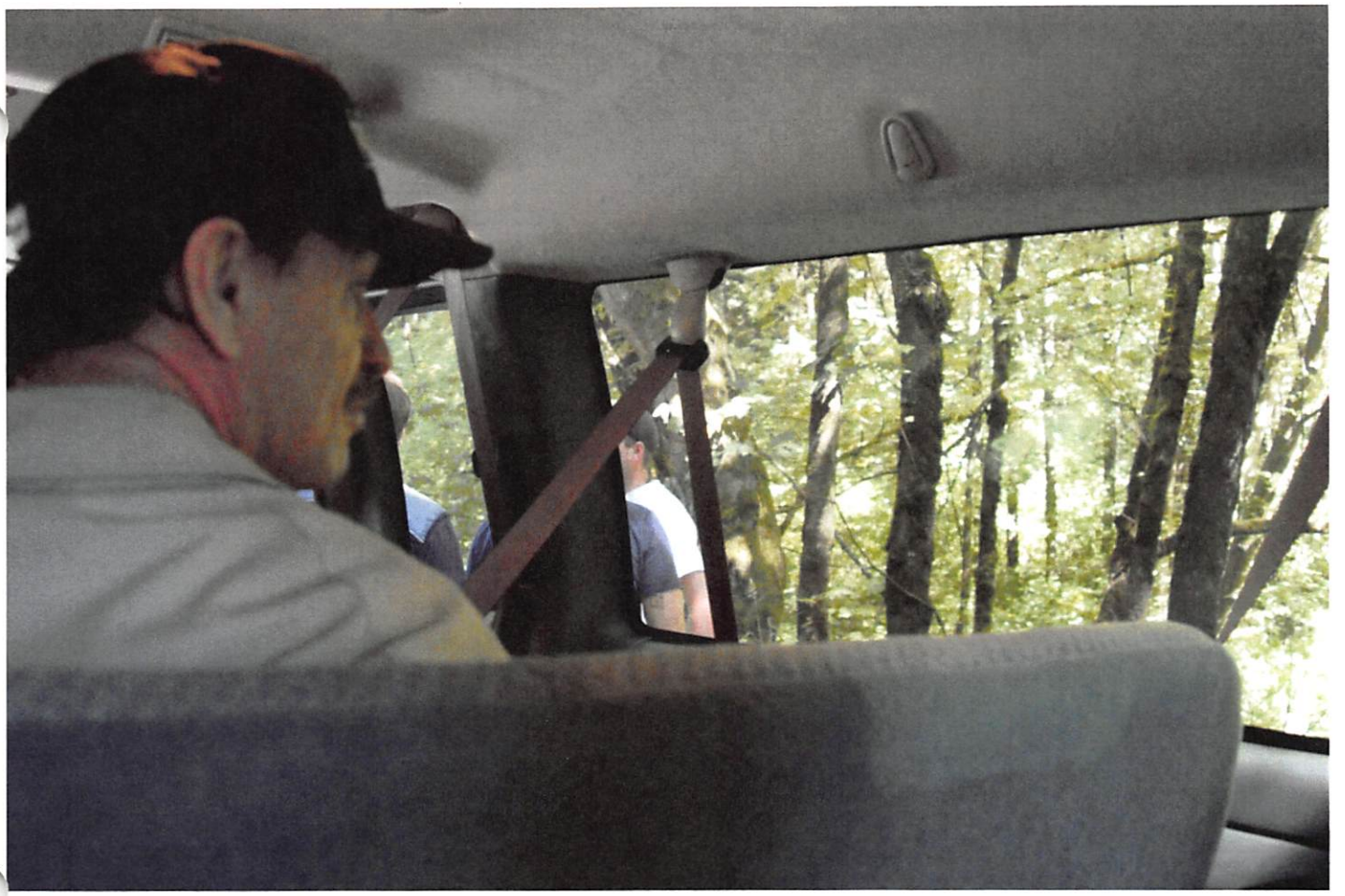
"These women were not employed at a paint store or involved in spray-painting activities, so the common thread was someone who was directly linked to Kenworth," he said. "It's just much more instinctive and accessible to a juror to make that connection. It's just common sense."



— Trace evidence expert Skip Palenik's discovery pressured Ridgway into admitting he was the Green River Killer. Taylor Glascock for NBC News

Soon after the additional charges were filed, defense lawyers approached prosecutors with a proposal. Ridgway would agree to confess to as many killings as he could remember having committed in King County and secretly help investigators find more victims if prosecutors spared him a death sentence.

Palenik said Baird called and confided: "'You can't tell anyone about this, but what if I told you that based on your report, Ridgway confessed to being the Green River Killer?'"



— After agreeing to a secret plea deal, Gary Ridgway took investigators to several remote sites where he said he'd dumped his victims' bodies. King County Prosecutor's Office via Getty Images

Over the next five months, Ridgway detailed his slayings and led detectives to the remains of four victims, including Malvar, the teenager whose disappearance in 1983 first alerted police to him. After a detective sent Palenik more clothing items, he found the paint spheres tied to three more victims, bringing the total to eight.

Ridgway told detectives that paint sometimes covered his face and work clothes when he sprayed it on the cabs of semi-trucks at Kenworth. He often went "patrolling" for sex workers right after work, he said.

Sometimes, he'd gone to lengths to evade detection, including clipping the fingernails of victims who had scratched him before he dumped their bodies. But he left behind some of his victims' clothing, discarded at dumpsites or wrapped like ligatures around their necks. "They were just rags to me," he told detectives. "Just rags."

In November 2003, King County Prosecutor Norm Maleng announced the plea deal that sent Ridgway to the Washington State Penitentiary in Walla Walla, where he is serving 49 life sentences. (Ridgway, 74, didn't respond to an interview request sent in a letter to him in prison.)

Without the deal, more than 40 of Ridgway's murders most likely would have gone unsolved, Maleng said.

Among them was the murder of Yellow Robe, the last woman Ridgway said he could remember having killed.

2023: Learning the full truth

Patricia Yellow Robe's sisters had mourned her loss back in 1998, when they were told she'd overdosed.

But they still privately questioned how Trisha – the family peacemaker who had aspired to be a seamstress, sang Supremes songs off-key and snorted when she laughed – really died.

They finally learned the truth from a newspaper reporter's phone call in late 2003.

At first, LuAnna Yellow Robe said, she thought the caller had dialed the wrong number. Trisha died of an overdose five years earlier, she told him.

Until that day, prosecutors had kept the details of Ridgway's confession secret even from her, a paralegal in their office.

The truth was her sister was strangled and was counted as the last of Ridgway's victims.

When her anger and shock wore off, her family's doubts about Trisha's death finally made sense, LuAnna said.

— "She wanted us to know the truth," said Patricia Yellow Robe's sister, Rona, right, standing with another sister, LuAnna. Jovelle Tamayo for NBC News

After Ridgway confessed, the medical examiner's office acknowledged that, despite toxicology results that detected large amounts of opiates and alcohol in her bloodstream, it may have missed signs that Trisha had been strangled.

"She wanted us to know the truth," Rona Yellow Robe said, "and I'm glad I know it."

That truth, LuAnna and Rona recently learned from an NBC News reporter, now includes another detail: about the tiny, overlooked evidence that could have tied a killer to his crimes long before he ever murdered their sister.

"Does it make me angry?" LuAnna asked. "It's too bad they didn't do what they should have done. But being angry now won't bring my sister back."