

## CASE REPORT

### CRIMINALISTICS; ANTHROPOLOGY

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## Integrated DNA and Fingerprint Analyses in the Identification of 60-Year-Old Mummified Human Remains Discovered in an Alaskan Glacier

**ABSTRACT:** This report describes the identification of a merchant mariner who perished in 1948 when Northwest Airlines Flight 4422, a DC-4 carrying 24 seamen and six crew members crashed into Mount Sanford, Alaska. Fifty-one years later, a human forearm and hand were found close by the wreckage of the plane, prompting identification efforts using DNA and fingerprints. There were significant challenges to both the fingerprint and DNA analyses. The hand was badly desiccated, making fingerprint friction-edge detail almost invisible and the remains had been embalmed upon discovery, making DNA amplification difficult. We present the results of an interdisciplinary approach that successfully addressed these challenges and ultimately led to the identification of the remains. These efforts relied on efficient fingerprint rejuvenation and imaging techniques that improved print resolution, as well as new DNA extraction techniques optimized for aggressively embalmed remains.

**KEYWORDS:** forensic science, fingerprint analysis, low copy number STR, mitochondrial DNA, ancient DNA, embalming, interdisciplinary, forensic genealogy, merchant mariners

At 9:14 P.M. on March 12, 1948, Northwest Airlines Charter Flight 4422, en route from Shanghai to New York City, crashed in the Wrangell Mountains of Alaska. The Douglas DC-4 was carrying six crew members and 24 seamen returning home after a mission on the oil tanker *SS Sarsvet* of the Overseas Tankship Corp. After a fuel stop, the plane took off from Anchorage, Alaska at 8:12 P.M. At 9:03 P.M., the plane was spotted flying at 11,000 feet above the Gulkana Civil Aeronautics Administration range station, 159 miles northeast of Anchorage. Eleven minutes later, the plane impacted Mount Sanford, a 16,237-foot peak located 200 miles northeast of Anchorage. The next day, aeronautic officials flew over the crash site. From the air, they observed the wreckage lying at an elevation of 8500 feet on the west slope of the mountain, below a section of smoke-blackened snow and ice at 11,000 feet that likely corresponded to the point of impact. A rescue operation

was ruled impossible because the scene of the accident was inaccessible by air. No ground search was initiated as it was determined that the active glacier would bury the wreckage in a matter of days. However, a positive identification of the wreckage as that of Flight 4422 was made by the Northwest Airlines insignia on the plane's vertical stabilizer observed from the air.

Fifty-one years later, the wreckage was rediscovered by Kevin McGregor and Marc Millican, two former United States Air Force pilots. In 1997, after three unsuccessful expeditions, the two men finally located pieces of the plane, including a radial engine and a propeller at an altitude of 6200 feet. Two years later, they returned to the site and discovered a frozen human left forearm and hand amid the wreckage (1,2).

Alaskan State Troopers recovered the remains and delivered them to the Office of the Medical Examiner in Anchorage, Alaska. X-rays of the arm showed extensive damage to the bones (Fig. 1). Fingerprint images were also taken of the hand and were compared to the fingerprints of 22 of the 24 merchant mariners. The mariners' fingerprints had been collected at the time of their enlistment and archived at the National Maritime Center in Arlington, VA. Unfortunately, in 1999 no match was obtained, most likely because of the difficulty of resolving details from the fingerprints of the damaged remains in combination with the poor quality of the enlistee fingerprint cards. Following these examinations, the remains were aggressively embalmed by submersion for 5 days in a solution composed of Metasyn Normal (20 index), Metalflex, Restorative (Dodge Chemical Company, Cambridge, MA), and water (Fig. 2).

The effort to identify the flight 4422 remains was first revived in 2002 when the hand and forearm were sent to a commercial

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Received 23 Oct. 2008; and in revised form 15 May 2009; accepted 17 May 2009.

# Using Dna To Identify Human Remains Answers

**RJ Shavelson**



## **Using Dna To Identify Human Remains Answers:**

**The Handy Forensic Science Answer Book** Patricia Barnes-Svarney, Thomas E. Svarney, 2018-09-01 A practical accessible and informative guide to the science of criminal investigations Covering the fundamentals science history and analysis of clues The Handy Forensic Science Answer Book Reading Clues at the Crime Scene Crime Lab and in Court provides detailed information on crime scene investigations techniques laboratory finding the latest research and controversies It looks at the science of law enforcement how evidence is gathered processed analyzed and viewed in the courtroom and more From the cause manner time of a death and autopsies to blood toxicology DNA typing fingerprints ballistics tool marks tread impressions and trace evidence it takes the reader through the many sides of a death investigation Arson accidents computer crimes criminal profiling and much much more are also addressed The Handy Forensic Science Answer Book gives real world examples and looks at what Hollywood gets right and wrong It provides the history of the science and it introduces the scientists behind breakthroughs An easy to use and informative reference it brings the complexity of a criminal investigation into focus and provides well researched answers to over 950 common questions such as What is the difference between cause of death and manner of death How did a person s skull fit into criminal evidence in the early 1800s When were fingerprints first used to identify a criminal How is the approximate time of death of a crime scene victim determined What is forensic serology What is the National Missing and Unidentified Persons System Can a forensics expert look at skeletal remains and tell whether the person was obese How can a simple knot analyzed in the crime lab be used as evidence Can fingerprints be permanently changed or destroyed How fast does a bullet travel How was a chemical analysis of ink important in the conviction of Martha Stewart What types of data are often retrieved from a crime scene cellphone Can analyses similar to those used in forensics be used to uncover doping in athletics What is the Personality Assessment Inventory What are some motives that cause an arsonist to start a fire What state no longer allows bite marks as admissible evidence in a trial What is the Innocence Project Why are eyewitness accounts not always reliable Who was Jack the Ripper Providing the facts stats history and science The Handy Forensic Science Answer Book answers intriguing questions about criminal investigations This informative book also includes a helpful bibliography glossary of terms and an extensive index adding to its usefulness **The Handy Biology Answer Book** Patricia Barnes-Svarney, Thomas E.

Svarney, 2014-07-21 Easy to use and friendly guide explains the inner workings of cells bacteria viruses fungi plants animals as well as evolution the environment DNA and chromosomes genetics and genetic engineering laboratory techniques and much much more Gene therapy Forensic DNA profiling Biochemistry Biotechnology Cloning Stem Cells Super Bugs Genetically modified food Botany Zoology Sex The study of life and living organisms is ancient broad and ongoing Biology combines the Greek word for life bios with the suffix ology or science study knowledge of The new completely revised and updated The Handy Biology Answer Book examines explains and traces mankind s understanding of this important topic

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LANGUAGE & LITERATURE Class 10th Pushpendra Kaur,2014-01-01 Keeping in mind the immense importance and significance of the NCERT Textbooks for a student Arihant has come up with a unique book containing only and all Question Answers of NCERT Textbook based questions This book has been designed for the students studying in Class X following the NCERT Textbook of English Language Literature The present book has been divided into two parts according to the syllabi of English Language Literature Term I and Term II further divided into Prose Poetry and Supplementary Reader sections This book has been worked out with an aim of overall development of the students in such a way that it will help students define the way how to write the answers of the textbook based questions This book has answer to each every question covered in the chapters of the textbook for Class X English Language Literature Also each chapter in the book begins with a summary of the chapter which will help in effective understanding of the theme of the chapter and to make sure that the students will be able to answer all popular questions concerned to a particular chapter whether it is Long Answer Type or Short Answer Type Question The book has been designed systematically in the simplest manner for easy comprehension of the chapters and their themes As the book has been designed strictly according to the NCERT Textbook of English Language Literature for Class X and provides a thorough and complete coverage of the textbook based questions it for sure will help the Class X students in an effective way for English Language Literature **DNA Analysis for Missing Person Identification in**

**Mass Fatalities** Amanda C Sozer,2014-01-28 Advances in DNA technology have expanded such that forensic DNA profiling is now considered a routine method for identifying victims of mass fatalities Originating from an initiative funded by a grant from the U S Department of State DNA Analysis for Missing Person Identification in Mass Fatalities presents a collection of training modules that supply comprehensive instruction in these complex techniques The book begins with a concise overview of DNA analysis methods and their use in identifying victims of mass fatalities It then goes on to explore Mass fatality response operations including body recovery mortuary operations family assistance the identification of human remains and psychosocial support for families Best practices in DNA sample collection and the different types of reference

samples that can be used to identify a reported missing RM individual Autosomal short tandem repeat STR DNA profile analysis and interpretation and procedures to ensure data accuracy Major steps involved in generating a DNA profile and the complex aspects of data analysis and interpretation The importance of data management using information technology tools and tips for maintaining quality operations Accreditation and standards and the major elements of a DNA quality program Setting up a laboratory operation including planning staffing identifying types of equipment and supplies and the procedures for ensuring that laboratory equipment performs appropriately The book includes a discussion of the key steps in the preparation delivery and evaluation of training sessions for personnel responding to a mass fatality human identification event It also provides a comprehensive vocabulary list with terms related to mass fatality DNA identification This text is a must read for organizations contemplating the use of DNA in human identification initiatives following mass fatalities It is also a tremendous value to emergency manager planners medical legal authorities and forensic DNA laboratories

*Multidisciplinary Approaches to Forensic Archaeology* Pier Matteo Barone, W. J. Mike Groen, 2018-10-24 This book will present the most advanced research on forensic archaeology presented during the annual European meetings in the last 3 years Thanks to the broad nature of the chapters presented this book will show not only different approaches and different crime scenes around Europe but also how every single European law enforcement has faced forensic investigations This book shows forensic archaeology as practiced in this legal context emerging and solidifying in many European countries differing in some respects because of differences in legal systems but ultimately sharing common grounds Differently from similar books this will be not only a collection of research and case studies in which forensic practitioners demonstrate the extent and complexity of the various aspects of forensic archaeology but also it will show the necessity of co operation as a condition for any work in forensic archaeology among scientists of different disciplines and law enforcers *Encyclopedia of Forensic and Legal Medicine* ,2015-09-29 Encyclopedia of Forensic and Legal Medicine Volumes 1 4 Second Edition is a pioneering four volume encyclopedia compiled by an international team of forensic specialists who explore the relationship between law medicine and science in the study of forensics This important work includes over three hundred state of the art chapters with articles covering crime solving techniques such as autopsies ballistics fingerprinting hair and fiber analysis and the sophisticated procedures associated with terrorism investigations forensic chemistry DNA and immunoassays Available online and in four printed volumes the encyclopedia is an essential reference for any practitioner in a forensic medical healthcare legal judicial or investigative field looking for easily accessible and authoritative overviews on a wide range of topics Chapters have been arranged in alphabetical order and are written in a clear and concise manner with definitions provided in the case of obscure terms and information supplemented with pictures tables and diagrams Each topic includes cross referencing to related articles and case studies where further explanation is required along with references to external sources for further reading Brings together all appropriate aspects of forensic medicine and legal medicine Contains color

figures sample forms and other materials that the reader can adapt for their own practice Also available in an on line version which provides numerous additional reference and research tools additional multimedia and powerful search functions Each topic includes cross referencing to related articles and case studies where further explanation is required along with references to external sources for further reading All Hands ,1993-07 Encyclopedia of Forensic Sciences ,2012-12-28 Forensic science includes all aspects of investigating a crime including chemistry biology and physics and also incorporates countless other specialties Today the service offered under the guise of forensic science includes specialties from virtually all aspects of modern science medicine engineering mathematics and technology The Encyclopedia of Forensic Sciences Second Edition Four Volume Set is a reference source that will inform both the crime scene worker and the laboratory worker of each other s protocols procedures and limitations Written by leading scientists in each area every article is peer reviewed to establish clarity accuracy and comprehensiveness As reflected in the specialties of its Editorial Board the contents covers the core theories methods and techniques employed by forensic scientists and applications of these that are used in forensic analysis This 4 volume set represents a 30% growth in articles from the first edition with a particular increase in coverage of DNA and digital forensics Includes an international collection of contributors The second edition features a new 21 member editorial board half of which are internationally based Includes over 300 articles approximately 10pp on average Each article features a suggested readings which point readers to additional sources for more information b a list of related Web sites c a 5 10 word glossary and definition paragraph and d cross references to related articles in the encyclopedia Available online via SciVerse ScienceDirect Please visit [www.info.sciencedirect.com](http://www.info.sciencedirect.com) for more information This new edition continues the reputation of the first edition which was awarded an Honorable Mention in the prestigious Dartmouth Medal competition for 2001 This award honors the creation of reference works of outstanding quality and significance and is sponsored by the RUSA Committee of the American Library Association **Koenig and Schultz's Disaster Medicine** Kristi L. Koenig,Carl H. Schultz,2016-02-16 As societies become more complex and interconnected the global risk for catastrophic disasters is increasing Demand for expertise to mitigate the human suffering and damage these events cause is also high A new field of disaster medicine is emerging offering innovative approaches to optimize disaster management Much of the information needed to create the foundation for this growing specialty is not objectively described or is scattered among multiple different sources This definitive work brings together a coherent and comprehensive collection of scientific observations and evidence based recommendations with expert contributors from around the globe This book identifies essential subject matter clarifies nomenclature and outlines necessary areas of proficiency for healthcare professionals handling mass casualty crises It also describes in depth strategies for the rapid diagnosis and treatment of victims suffering from blast injuries or exposure to chemical biological and radiological agents **Clinical Tuberculosis** Peter D. O. Davies,Stephen B Gordon,Geriant Davies,2014-04-30 Completely updated and revised Clinical Tuberculosis continues to provide the TB

practitioner whether in public health laboratory science or clinical practice with a synoptic and definitive account of the latest methods of diagnosis treatment and control of this challenging and debilitating disease New in the Fifth Edition Gamma interferon based      *Workout for the New PSAT/NMSQT* The Princeton Review,2015-08-25 THE PSAT IS CHANGING IN 2015 Be prepared to beat the exam boost your National Merit Scholarship chances AND get a jump on the New SAT with this practice book of all new drills for the all new exam This eBook edition is optimized for on screen learning with cross linked questions answers and explanations Starting in October 2015 a new version of the PSAT is being rolled out nationwide The good news is that the New PSAT is being redesigned to look more like the New SAT meaning that taking this exam will give you a valuable glimpse into what the New SAT will look like The bad news of course is that it s a whole new test format to get familiar with Created specifically for the redesigned exam The Princeton Review s *Workout for the New PSAT* provides plenty of practice to get you ready to tackle the test including Essential information about the major exam changes including an overview of new PSAT basics scoring and content 275 practice questions covering all subject areas Answers and detailed explanations to help you learn from your mistakes A Pre College Insider section filled with useful guidance and advice Everything you need to know about National Merit Scholarships Inside you ll find essential information about the new PSAT material to show you what to expect on the exam and all the practice you need to help get the score you want      **Sedona Pack - Books 6-9** Lisa Kessler,2023-05-09 After the destruction of the Nero Organization the world of shifters struggles to remain hidden from the human world The Sedona Pack is faced with rebuilding and healing old wounds while banding together to fight off rogue jaguar assassins bent on revenge But the real enemy could be the American government who stands on the brink of de classifying the controversial Operation Moonlight project and with it bringing shifters into the spotlight not as upstanding citizens but as cold blooded killers A new Alpha will rise from the ashes and the diversity of this Pack may be the only hope against the coming storm Now you can dive into the final 4 books from the Sedona Pack series for a super price Voted 2019 Best Shifter Series Paranormal Romance Guild Set includes Sedona Sacrifice Sedona Suspect Sedona Sanctuary Sedona Salvation      *Forensic Pathology* Max M. Houck,2016-09-23 Forensic Pathology the latest volume in the Advanced Forensic Science series that grew out of the recommendations from the 2009 NAS Report serves as a graduate level text for those studying and teaching forensic pathology and is an excellent reference for forensic pathologists libraries or for use in their casework Coverage includes postmortem interval autopsy trauma causes of death identification and professional issues Edited by a world renowned leading forensic expert this series provides a long overdue solution for the forensic science community Provides basic principles of forensic science and an overview of forensic pathology Contains sections on postmortem interval autopsy trauma causes of death and identification Includes a section on professional issues such as crime scene to court expert witness testimony health and safety deaths in custody and suicide Incorporates effective pedagogy key terms review questions discussion questions and additional reading suggestions      **The Use of Forensic**

**Anthropology** Robert B. Pickering, David Bachman, 2009-01-22 A forensic investigation requires a team of specialists from many different scientific fields of study along with legal and law enforcement specialists In recent years the range of cases on which forensic anthropologists have been consulted has expanded dramatically The Use of Forensic Anthropology provides these professionals with guidelines for  
CUET PG Forensic Science - Question Bank (2400 MCQs Chapterwise) Mocktime Publication, 2400 MCQs CUET PG Question Bank Forensic Science CUEG PG Previous Papers CUET PG Syllabus CUET PG Exam Pattern  
Lessons Learned from 9/11 National Institute of Justice (U.S.), 2006

**Forensic Science and Humanitarian Action** Roberto C. Parra, Sara C. Zapico, Douglas H. Ubelaker, 2020-01-28 Widens traditional concepts of forensic science to include humanitarian social and cultural aspects Using the preservation of the dignity of the deceased as its foundation Forensic Science and Humanitarian Action Interacting with the Dead and the Living is a unique examination of the applications of humanitarian forensic science Spanning two comprehensive volumes the text is sufficiently detailed for forensic practitioners yet accessible enough for non specialists and discusses both the latest technologies and real world interactions Arranged into five sections this book addresses the management of the dead across five major areas in humanitarian forensic science Volume One presents the first three of these areas History Theory Practice and Legal Foundation Basic Forensic Information to Trace Missing Persons and Stable Isotopes Forensics Topics covered include Protection of The Missing and the Dead Under International Law Social Cultural and Religious Factors in Humanitarian Forensic Science Posthumous Dignity and the Importance in Returning Remains of the Deceased The New Disappeared Migration and Forensic Science Stable Isotope Analysis in Forensic Anthropology Volume Two covers two further areas of interest DNA Analysis and the Forensic Identification Process It concludes with a comprehensive set of case studies focused on identifying the deceased and finding missing persons from around the globe including Forensic Human Identification from an Australian Perspective Skeletal Remains and Identification Processing at the FBI Migrant Deaths along the Texas Mexico Border Humanitarian Work in Cyprus by The Committee on Missing Persons CMP Volc n De Fuego Eruption Natural Disaster Response from Guatemala Drawing upon a wide range of contributions from respected academics working in the field Forensic Science and Humanitarian Action is a unique reference for forensic practitioners communities of humanitarian workers human rights defenders and government and non governmental officials

**Manual of Forensic Odontology** Andzej Huczynski, 2017-11-15 The most exhaustive book on forensic dentistry the fourth edition of this volume covers the latest advances in the field including regulations affecting forensic dental practice and procedures in light of the Health Insurance Portability and Accessibility Act updated ABFO guidelines and new digital radiographic and photographic developments Th  
Xam Success English Class - 10 NEP-2020 Rajamohan Srivastava , Amit Ganguli, 2023-06-12 Section A First Flight Prose and Poetry FIRST FLIGHT A PROSE 1 A LETTER TO GOD G L Fuentes 2 NELSON MANDELA LONG WALK TO FREEDOM Nelson Rolihlahla Mandela 3 TWO STORIES ABOUT FLYING I HIS FIRST FLIGHT Liam O Flaherty II BLACK



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