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October 2, 2012

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DNA Information

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Deoxyribonucleic Acid (DNA) Typing

The forensic scientists at the Armed Forces DNA Identification Laboratory (AFDIL) use the latest DNA typing methods to provide for the identification of remains or other biological evidence. For the identification of current casualties, nuclear DNA (nucDNA) provides a tool for positive identification, when other forensic techniques, such as a fingerprint or dental comparison is not possible. Unfortunately, nucDNA is not a viable tool in older remains due to many environmental factors that cause the nucDNA to degrade. These factors include such things as ultra-violet light from the sun, heat, and moisture. For older remains, however, recovered from the battlefields of Korea, the Cold War, World War II, and Southeast Asia (SEA), mitochondrial DNA (mtDNA) has proved to be a useful investigative tool that adds additional detail towards a positive identification.

[nucDNA and mtDNA in Identification Process](#)

Background on DNA

There are only two copies of nucDNA per human cell, except for red blood cells, which have no nucleus. Half of the nucDNA component comes from the biological mother while the other half comes from the biological father. On the other hand, there are hundreds to thousands of copies of mtDNA per cell. Thus, mtDNA analysis is more successful on degraded remains (i.e., Korean War, Cold War and SEA losses) because the amount of mtDNA found in cells and required for analysis lasts a much longer period of time. It is possible that mtDNA stays viable in bones and teeth up to thousands of year if the environmental conditions are favorable.

In looking at nucDNA, a child is a biological copy of the mother and father's because of the inherited nuclear DNA. However, mtDNA is different in that it is only transferred maternally from the mother to the child. An important aspect of mtDNA is that it is an extremely stable genome. Scientists estimate that mutational changes in mtDNA will occur only once in every 40-60 generations, so as long as family relationships can be established, mtDNA provides forensic scientists the ability to go back generations in a family tree to observe these maternal relationships.

One limiting factor of mtDNA is that some DNA sequences are observed more frequently than others. In some of the more common mtDNA sequences, 4-6% of the population can have the same sequence even though they are not known to be maternally related to each other. As a result, mtDNA cannot be used by itself for positive identification and must be coupled with other forensic information to help establish the identity of an individual. However, it is an extremely valuable forensic tool in support of the identification process.

Typing of mtDNA

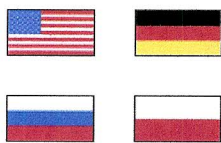
Typically, the sequencing of mtDNA begins by pulverizing approximately two to three grams of bone or a tooth. The powdered material is then treated with a chemical solution to release the DNA from the cells. Scientists purify this solution to a small volume of extract. Initially, the amount of extracted mtDNA is too small to analyze. Therefore, scientists will replicate a particular region, the "d-loop", of the mtDNA many millions of times using a special chemical process called the Polymerase Chain Reaction (PCR), which was invented in 1985. Technicians determine the sequence of the amplified portion of the mtDNA taken from the extract. Once scientists determine the sequence, they compare it to a family reference sequence to either exclude or provide supportive evidence of the maternal relationship to a particular family.

mtDNA's Support Towards Identifications

mtDNA sequencing is an important tool in DoD's identification process. Scientists count on the power of mtDNA to provide the additional evidence required in making an identification. As with nucDNA, environmental factors such as soil (acidic), weather (moisture), and condition of bones (fragmentation) will often provide extreme challenges to the forensic scientist. Southeast Asia has acidic soil and rain, which accelerates the breakdown of mtDNA. Korea's colder and drier environment, on the other hand, allows for better preservation of the DNA in the remains.

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Analysis of mtDNA is extremely accurate; however, mtDNA may not be unique to a single individual. Investigators then require additional presumptive evidence for identification. This presumptive evidence can include other documented findings that provide a logical reason to associate remains with an individual. However, the mtDNA sequence obtained from the biological materials provides the final key scientific evidence that will lead to an answer as to establishing the relationship of the remains with a family reference sequence.

[Identification of Remains](#)

Innovative Usage of mtDNA

Scientists can best use mtDNA on single loss incidents or on a small group of remains. When investigators focus their efforts to a narrowed group, based on presumptive or other collaborative evidence, mtDNA sequence comparison provides the significant additional supportive information towards making an identification.

In cases that involve large numbers of individuals, such as a large battlefield, with possible commingling of remains, there maybe little initial presumptive evidence to help investigators focus the identification process. In these type cases, mtDNA can be useful in grouping the recovered remains into smaller more manageable numbers, so other investigative means can better provide evidence to the identification process. Here scientists will use mtDNA sequences of the remains much earlier in the investigative process as the first step to divide a large group of commingled remains into smaller groups that have the same mtDNA. From scientific study of mtDNA, of the 8,100 American personnel missing in Korea, approximately 5% will have the same mtDNA typing. That is potentially 420 sets of individuals with the same mtDNA sequence. However, the rest of the remains will divide into smaller, more focused groups where investigators may concentrate their efforts. However, the assistance of families is critical if mtDNA is to be used in this manner.

mtDNA Database and Family Outreach

AFDIL scientists require a family database that includes a mtDNA family reference sample for each of the unaccounted-for servicemen to conduct comparisons between remains that have no other presumptive evidence. AFDIL will use the database to compare mtDNA sequencing to exclude or help to identify a returned remain in support of CILHI's identification process.

More than 8,100 servicemen remain unaccounted-for from the Korean War and more than 100 are missing from the Cold War of the 1950s and 60s. Since cessation of hostilities in Korea in 1953, the services have lost contact with many of the families. Consequently, DPMO and the services are conducting a "Family Outreach" program to locate the relatives for servicemen unaccounted-for from the Korean and Cold War. Once these families are located, the Service Casualty Offices will attempt to identify and obtain a maternal blood reference sample. With these samples AFDIL will be able to establish a comprehensive family reference database. Family members of these servicemen should contact the appropriate service casualty office to provide information relative to their loved one.

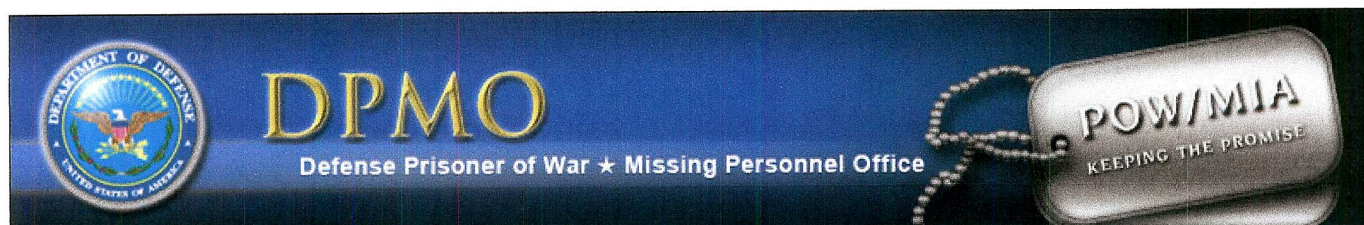
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The Use of Nuclear DNA (nucDNA) Typing and Mitochondrial DNA (mtDNA) Sequencing in the Identification Process

In current casework requiring the identification of human remains or other biological evidence, forensic scientists will use nuclear DNA typing methods to make an identification when other traditional forensic techniques, such as fingerprint and dental comparison cannot be used. In older cases, however, many different environmental factors, such exposure to the sun or heat, will destroy the nuclear DNA present in the biological material being studied. For most cases recovered from World War II, Korean War, Cold War, and Vietnam era losses, scientists normally use mitochondrial DNA sequencing to obtain the DNA results that can provide the additional evidence towards making an identification.

[Identification of Remains](#)

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JOINT POW/MIA ACCOUNTING COMMAND

ACCOUNTING FOR AMERICANS LOST DURING PAST U.S. CONFLICTS



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Family Reference Samples (FRS)

We can often identify individuals if we have a reference sample of a special type of DNA from surviving family members. This special DNA is called Mitochondrial DNA, or mtDNA, and it is inherited only from the mother. We use this type of DNA because it is long-lasting, abundant, and doesn't change much from generation to generation.

FRS Explained

How you can help

You may be able to help us identify America's missing heros. If you are a family member of an individual who is Missing in Action, we may be able to use a sample of your DNA to help us with our identification process. However, we do not need a sample from just any family member – we can only use samples from family members who share the same mtDNA as the missing service member. Mitochondrial DNA is only passed on through the [maternal line](#).

Anyone can help by selecting a casualty (perhaps from your home town, home state or a man that served in the same unit as you), and researching their family history to determine if there are living relatives who might be FRS donors.

Who can donate

The type of DNA we use to identify individuals is inherited only from the mother. This means that each person's mother, as well as brothers, sisters, sister's children and many other relatives share the same kind of mtDNA. This is useful because it means that mtDNA from relatives (sometimes quite distant ones) can be directly compared to mtDNA from unidentified remains. The downside is that children of a missing male cannot provide an mtDNA reference sample. The sex of the missing person and the donor are irrelevant. In a [family tree linking the donor to the missing person](#), every intermediate person linking the donor to the missing person must be a female.

A powerful tool

While mtDNA testing does not uniquely identify an individual like a fingerprint or other kinds of DNA testing, it does help us determine if an individual is related to surviving relatives. Combined with other evidence that we gather, this is a powerful tool that we use to identify the remains that we find. You might wonder why we can't quickly identify an individual from a DNA sample like forensic scientists do on TV. The short answer is that we would need a pre-existing sample of DNA from all the missing individuals we are trying to identify – and DNA samples were not routinely collected from our service men and women until the Gulf War.

Call for more information

We understand that this can be confusing. If you think you may be a suitable donor or you have any questions, all you need to do is contact a Department of Defense [service casualty office](#) for assistance. If you know people who are relatives of service members who are still missing in action, you can help by passing this information along.






Privacy assured

If you donate a sample of your mitochondrial DNA, you can rest assured that it will only be used for the purposes of assisting remains identification and will not be used for any other purpose or be released to other government agencies or any other organizations.

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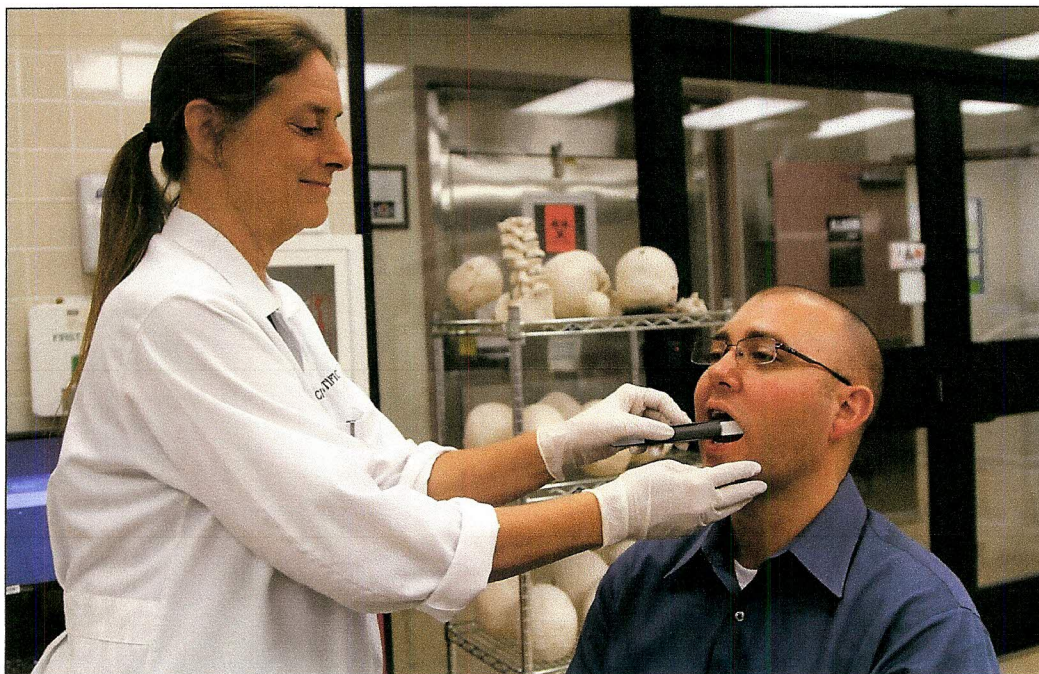
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YOU CAN HELP IDENTIFY AMERICA'S MISSING HEROES

JPAC FS-3

"Until They Are Home"



HOW TO HELP

You may be able to help us identify America's missing heroes. If you are a family member of an individual who is Missing in Action, we may be able to use a sample of your DNA to assist with the research and identification process. However, we do not need a sample from just any family member; JPAC can only use samples from family members who share the same mitochondrial DNA (commonly referred to as mtDNA).

WHO CAN DONATE?

The type of DNA we use to identify individuals is inherited only from the mother.

This means that each person's mother, siblings and many other relatives share the same kind of mtDNA. This technique is useful because it means that mtDNA from relatives (sometimes quite distant ones) can be directly compared to mtDNA from unidentified remains. The downside is that children of a missing male cannot provide an mtDNA reference sample. The sex of the missing person and the donor are irrelevant.

A POWERFUL TOOL

The Joint POW/MIA Accounting Command uses mtDNA because it is long-lasting, abundant, and doesn't change much from generation

to generation. While mtDNA testing does not uniquely identify an individual like a fingerprint or other kinds of DNA testing, it does help us determine if an individual is related to surviving relatives. Combined with other evidence, this is a powerful tool that JPAC uses to identify unidentified remains.

PRIVACY ASSURED

If you donate a sample of mtDNA, rest assured that it will only be used for the purposes of assisting remains identification and will not be used for any other purpose or be released to other government agencies or public organizations.

CONTACT INFORMATION

U.S. ARMY

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1(800) 892-2490

U.S. MARINE CORPS

HQ, U. S. Marine Corps
Manpower and Reserve Affairs
Personnel & Family Readiness
3280 Russell Road
Quantico, VA 22134-5103
1 (800) 847-1597

U.S. NAVY

Dept. of the Navy
Casualty Assistance Division
(OPNAV N135C)
POW/MIA Branch
5720 Integrity Drive
Millington, TN 38055-6210
1 (800) 443-9298

U.S. AIR FORCE

HQ, Air Force
Mortuary Affairs Operations
116 Purple Heart Drive
Dover AFB, DE 19902
1 (800) 531-5803

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NEWS ARTICLE

Army Seeks DNA Samples from Families of MIA Soldiers

By Kristen Noel
American Forces Press Service

WASHINGTON, March 19, 2008 – More than 6,300 families need to be located to collect DNA samples for the purpose of identifying missing soldiers from World War II and the wars in Korea and Vietnam, a U.S. Army official said yesterday.

The military maintains a database of mitochondrial DNA samples from family members of missing-in-action soldiers in the Armed Forces DNA Identification Lab, Army Lt. Col. Julius Smith, chief of past conflict repatriation for Army Casualty and Mortuary Affairs, said during a teleconference with online journalists and “bloggers.”

Smith explained that the DNA samples help the Army identify missing soldiers’ remains when they are uncovered, so they can be returned to the families.

The Joint POW/MIA Accounting Command continually sends anthropologists and forensic analysts to search past-conflict locations identified as potential recovery sites, provided the country where the conflict took place allows U.S. access.

Mitochondrial DNA is used for identification because it can be extracted from skeletal remains, which are the only kind of remains coming back from conflicts that happened more than 50 years ago, Linda Baublitz, chief of the Korean War section of the Past Conflict Repatriation Branch, explained.

The mitochondrial DNA source is passed only through the maternal line, Baublitz said, so the Army has to locate eligible donors from the mother’s side of the missing soldiers’ families.

The DNA samples are collected through an oral swab kit that is mailed to the donor, she said.

Baublitz also said the Army Past Conflict Repatriation Branch has launched an outreach program to try to locate more eligible donors from families of unaccounted-for soldiers from the Korean and Vietnam wars. Efforts to obtain family DNA samples for missing World War II soldiers are being handled on a case-by-case basis, Smith said.

The Army has a record of missing soldiers’ next of kin from personnel files, Smith said, but the lapsed time has made it difficult to track down current information on family members.

“It’s hard to keep in touch with (the families) now, because most of them ... are now getting older,” Carolyn Floyd, the Southeast Asia section chief for the Past Conflict Repatriation Branch, said. “You’re getting out of the line of having parents or wives.”

Though contracted professional and amateur volunteer genealogists, as well as volunteers from veterans’ groups, have helped the Army track down thousands of missing soldiers’ families, Smith said, public input is needed to identify families with missing soldiers and to keep family records updated.

Smith explained that the Army provides lines of communication for the public to come forward with information. Families with unaccounted-for soldiers, or anyone who knows of a family with an unaccounted-for soldier, should contact the Past Conflict Repatriation Branch by calling 1-800-892-2490 or sending an e-mail to tapscper@conus.army.mil, he said.

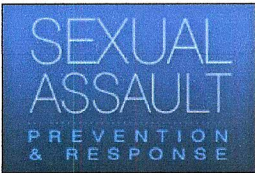
“The information you provide can be the difference in an identification being made and a soldier coming home,” Smith said.

(Kristen Noel works for the New Media branch of the American Forces Information Service.)

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IMMEDIATE RELEASE

No. 250-99
May 21, 1999

UNIDENTIFIED REMAINS DISINTERMENT POLICY ESTABLISHED

The Department of Defense today announced a policy to facilitate the use of DNA technology to identify Korean War and World War II remains previously classified as "unknown" and interred in national cemeteries. In 1995, the Department certified the use of mitochondrial DNA technology as a reliable forensic tool, and has improved and refined the use of mtDNA technology since then.

"This is a natural fulfillment of our commitment to the fullest possible accounting of America's missing in action servicemen," said Robert L. Jones, deputy assistant secretary of Defense for POW/Missing Personnel Affairs. "After our work in identifying the former Vietnam Unknown from the Tomb of the Unknowns, it became clear we could apply the same science to other unknowns, in particular, those buried in the Punchbowl cemetery in Hawaii," he added.

In 1998, the Department identified the Vietnam Unknown as U.S. Air Force 1st Lt. Michael Blassie, using mtDNA from the remains and matched sequences with those from his family. He was killed in Vietnam in 1972, classified as an unknown, and interred in the Tomb in 1984.

The cemetery with the greatest number of gravesites containing unknown remains is the National Memorial Cemetery of the Pacific, commonly called the Punchbowl. This cemetery contains 864 remains of unidentified soldiers from the Korean War. Most of these remains were received by the United States at the ceasefire in 1953. Another 204 were turned over by the North Koreans between 1991 and 1994 and are currently in the possession of the Central Identification Laboratory, Hawaii.

The records associated with each of the unknown remains in the Punchbowl cemetery will undergo rigorous evaluation before a decision is made to disinter. CILHI will first determine if there is strong circumstantial evidence associating a serviceman's name with a set of remains. Since mitochondrial DNA is expected to be used to identify most of these remains, a comparison blood sample must be obtained from a family member from the serviceman's maternal bloodline. Scientists believe approximately 70 cases may be candidates for disinterment.

The CILHI will direct the disinterment and will seek to identify each of the remains through forensic identification processes, including DNA. This laboratory identified the remains of Blassie in 1998. For the past five years CILHI has applied the science of mtDNA to approximately 45 per cent of its cases.

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IMMEDIATE RELEASE

No. 413-99
September 13, 1999

DISINTERMENT OF UNIDENTIFIED REMAINS BEGINS IN HAWAII

The disinterment of the remains of two Korean War servicemen previously classified as "unknown" begins Wednesday, Sept. 15 in Hawaii at the National Memorial Cemetery of the Pacific, commonly known as the Punch Bowl.

United States Pacific Command will conduct a Joint Services Disinterment Ceremony at 10 a.m. (Hawaii time), to honor the deceased servicemen. The ceremony will include a joint color guard and two joint Service casket bearer teams.

The Department of Defense announced in May a policy to apply mitochondrial DNA technology to identify Korean War and World War II remains previously classified as "unknown" and interred in national cemeteries. In 1995, DoD certified the use of mtDNA as a reliable forensic tool. Since then, further improvements and refinements in the use of mtDNA technology have occurred to enhance the possibility of positive identification.

"In applying the latest technology available to us, we hope to provide answers to family members who lost loved ones during the war -- some nearly 50 years ago," said Robert L. Jones, deputy assistant secretary of Defense for POW/Missing Personnel Affairs. "Our work in identifying the Vietnam Unknown from the Tomb of the Unknowns led us naturally to this work in the Punch Bowl cemetery," he added.

In 1998, the Department of Defense identified the Vietnam Unknown as U.S. Air Force 1st Lt. Michael Blassie using mtDNA from his remains and matching test results with those from his family. He was killed in Vietnam in 1972, classified as an unknown, and interred in the Tomb in 1984. Blassie's remains now rest at the Jefferson Barracks National Cemetery in St. Louis, Mo.

For the past five years, the Central Identification Laboratory, Hawaii, has applied the science of mtDNA to approximately 45 percent of its cases. The Armed Forces DNA Identification Laboratory in Rockville, Md., carries out the mtDNA laboratory work.

The cemetery with the greatest number of gravesites containing unknown remains is the Punch Bowl, which is part of the Department of Veterans Affairs, National Cemetery Administration. This cemetery contains 866 remains of unidentified soldiers from the Korean War. Following the cease-fire in 1953, most of these remains were turned over by the North Koreans.

The records associated with each of the unknown remains located in the Punch Bowl cemetery were subject to a rigorous evaluation before the decision was made to disinter. CILHI determines whether there is strong circumstantial evidence associating a serviceman's name with a set of remains. Since mtDNA is to be used to identify most of these remains, a comparison blood sample is needed. DoD continues to obtain mtDNA samples from family members from each serviceman's maternal bloodline. Scientists believe a total of 50-70 cases may be candidates for eventual disinterment.

The CILHI will direct the identification process and the actual disinterment action, which has been closely coordinated with the National Memorial Cemetery of the Pacific and the Department of Veterans Affairs.

Vietnam Unknown Disinterred

By Jim Garamone
American Forces Press Service

ARLINGTON NATIONAL CEMETERY, Va., May 14, 1998 – The Army Band played "Going Home" as a joint-service casket team carried the remains of the Vietnam Unknown to a waiting hearse.

The hearse, the final part of the May 14 disinterment ceremony here, delivered the remains to the Armed Forces Institute of Pathology at Walter Reed Army Medical Center nearby in Washington. Scientists there hope mitochondrial DNA tests will determine the serviceman's identity.

Defense Secretary William S. Cohen said his decision to disinter the Vietnam Unknown from the Tomb of the Unknowns was a tough one. "We disturb this hallowed ground with profound reluctance," he said at the Tomb. "We take this step only because of our abiding commitment to account for every warrior who fought and died to preserve the freedoms that we cherish."

A DoD Senior Working Group recommended Cohen decide to disinter the remains. The officials said evidence pointed to the remains being one of two men: Air Force 1st Lt. Michael J. Blassie or Army Capt. Rodney Strobridge. Both died May 11, 1972, during combat missions near An Loc, South Vietnam, where the remains were later found. Blassie flew an A-37; Strobridge piloted a Cobra helicopter.

Seven other American servicemen were lost within a 25-mile radius of An Loc. DoD will include them in scientific tests to determine identity, if possible.

Mitochondrial DNA testing was not available when the Vietnam Unknown was buried in 1984. DoD forensic scientists now routinely use the test to help determine identities of remains brought back from Southeast Asia and Korea. The test is not infallible, officials said, but a match lends credence to an identification because mitochondrial DNA is inherited only from mothers and doesn't change through the generations. The better-known genomic DNA is a random blend of millions of genes inherited from both parents.

A total of 18 family members from five of the nine families attended the service. The Blassies, who pushed for disinterment, felt they were bringing a family member home. "We are sure those remains are of Mike Blassie," said his sister Pat after the ceremony. "Michael Blassie is not unknown, and that is why we want to bring him home to St. Louis where he belongs."

David Amesbury of Albany, Ore., said all families of those missing in action have "a nagging doubt" about what happened to their loved ones. "You want to know what happened," he said. "You are always wondering." His father, Air Force Maj. Harry A. Amesbury Jr., was command pilot of a C-130 lost near An Loc.

Amesbury said he was affected by the ceremony. "That's someone's father or brother or son who died for his country," he said. "If they can have closure through this test, it should be done."

Cohen took the same position during his remarks. "If advances in technology can ease the lingering anguish of even one family, then our path is clear," he said. "We yield to the promise of science with the hope that the heavy burden of doubt may be lifted from a family's heart."

Arlington workers erected a privacy fence around the Tomb area May 13. During the night, workers removed the stonework, and cemetery workers exhumed the casket. A specialist from the Army's Central Identification Lab in Hawaii placed an evidence seal around the casket and workers draped an American flag over it.

Arlington Cemetery Superintendent John Metzler Jr. said the casket was in good condition. This bodes well for scientists attempting to extract DNA from the six bones in the casket.

By the time the cemetery opened on the morning of May 14, workers had replaced the Vietnam Unknown's Tomb stonework and the paving stones around it. The casket rested on a green bier directly in front of its former burial place. Tomb sentinels from the Army's 3rd Infantry Regiment guarded the site.

On the monumental tomb over the remains of the World War I Unknown is inscribed: "Here Rests in Honored Glory an American Soldier Known But to God."

Army Chaplain (Col.) Leo J. O'Keeffe, in his invocation, evoked God's help in the identification process. "If it be your holy will, make known the identity of this unknown Vietnam serviceman and bring peace to an American family," he said. "But if the answer we seek is not ours to know, let us hold fast to our belief that this serviceman is known to you, O God."



Ryan Amesbury, 2, waits with other family members for the Vietnam Unknown Disinterment Ceremony to begin May 14. Ryan's grandfather, Air Force Maj. Harry Amesbury, was lost within a 25 mile radius of An Loc, South Vietnam. Staff Sgt. Alicia K. Borlik, USA

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Defense Secretary William S. Cohen and Army Maj. Gen. Robert F. Foley, Military District of Washington commander, render honors during the National Anthem at the Vietnam Unknown Disinterment Ceremony May 14. Staff Sgt. Alicia K. Borlik, USA

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As the fog lifts over Arlington National Cemetery, the casket holding the Vietnam Unknown remains sits before the Tomb of the Unknowns. The remains were removed from the cemetery during ceremonies May 14. Staff Sgt. Alicia K. Borlik, USA

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