

# DID YOU KNOW

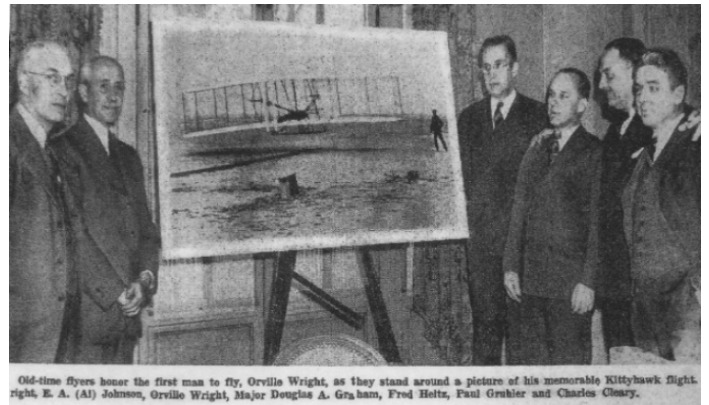
## *LEGACY, HERITAGE & CULTURE OF THE MATERIALS DIRECTORATE*

- **Charles Cleary worked with Orville Wright on Airplane Technologies**

*The ML scientist & engineer for whom our 1<sup>st</sup> & most important award for scientific excellence is named worked with Orville Wright in the early 1940s on technologies for US Air Corp aircraft. These technologies were vital to the nation as it entered WWII*

*During the work for the 2017 Centennial, the ML/RX history team discovered a photo of them together at the Dayton Engineers Club*

*Orville Wright, 2<sup>nd</sup> left, Charles Cleary on the right*



- **ABC News Space Consultant and NASA Astronaut (Dr. & Col.) Cady Colman conducted Polymer Research in ML**

*Cady logged more than 4,300 hours in space aboard the Space Shuttle and the International Space Station*

*On one of her Space Station missions she retrieved ML spacecraft materials which had been placed in orbit earlier to evaluate space degradation effects*

*Cady returned to ML to keynote the Awards Banquet*



- **Dr. Karl Strnat Discovered Samarium/Cobalt Rare-Earth Magnetic Materials**

*This new family of materials revolutionized the entire arena of the electronics industry where strong powerful magnetic fields are required: e.g., electric motors, magnetic recording, turbomachinery, high power military spacecraft electronic communication devices*

*The diversity of commercial applications ranges from high end Fender Stratocaster Guitars, high performance audio headphones, and competitive high-end slot-car racers*



- **Twelve ML Researchers have been elected to the National Academy of Engineering**

- **Dr. George Slenski, director of the ML Electronic Failure Analysis Laboratory appeared on national television with the FAA administrator to discuss the Tragic Explosion of TWA 800 and describe the ML role in the accident investigation**
- **General Bernard Schriever at ML**



**Gen. Schriever**

*In July 2021 when the new United States Space Force was created Schriever AF Base was renamed Shriever Space Force Base*

**Allinikov**

*Years earlier when Gen. Schriever directed all AF technologies and systems development as AFSC commander, he worked directly with ML ushering in the new world changing technology arena of advanced composites. For the US ICBM program which he had created a few years before that, ML also delivered several critical new technologies.*

*During this period, he visited ML twice:*

- *Presenting the Cleary Award to Sid Allinikov*
- *Delivering the keynote address at the national ML conference*



**w/ Sid**



**Lt. Gen Saxer**

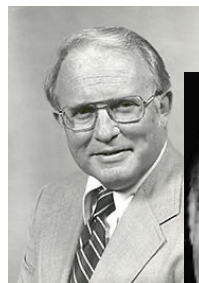


*Shortly after Gen. Schriever's retirement, Lt. Gen. Dick Saxer [ former ML commander - then colonel] became director of the US ICBM development program.*

- **ML was the first organization in the Air Force to launch a focused Organizational Development initiative for its employees. ML leaders, Al Lovelace, George Petterson, Jim Mattice and Vince Russo led this initiative for more than three decades.**

*The initiative focused on the workplace well-being of all ML employees. It was implemented across the entire organization over a period of several decades*

**Al Lovelace**



*Recognized national organizational development leaders and consultants from MIT and elsewhere assisted ML in developing and implementing the initiative*



**George Peterson**

*These ML leaders also developed and presented effective, highly regarded seminars such as 'Splendid Leader' across the aerospace industry, the Federal Executive Institute and other Air Force organizations*

*AF system program offices and other AF S&T organizations followed the ML lead in the arena launching similar initiatives focusing on the individual and organization wellbeing and organizational effectiveness*



**Vince Russo**



**Jim Mattice**

- **Dr. Al Lovelace and Gen. Jim Abrahamson at NASA Headquarters**

After ML director Al Lovelace departed the Laboratory, he moved to AF Headquarters as deputy AF Secretary to become director of all AF Laboratories also serving as the principal architect of overall AF S&T Strategy

Soon thereafter he became NASA Associate Administrator and, for a period the NASA Administrator. He was a member of the National Academy of Engineering

During Al's NASA Headquarters tenure, Gen. James Abrahamson became NASA Deputy Administrator and Director of the Space Shuttle Program. ML worked closely with Gen. Abe in joint programs for the Shuttle. When Gen. Abe became the 1<sup>st</sup> director of the F-16 program and also led the Missile Defense Agency ML worked closely with him on many different technical issues



- **Peral Harbor December 7<sup>th</sup>, 1941**

Donald Forney a distinguished international authority on non-destructive inspection/evaluation - a key element of aircraft structural design - begins his memoir this way: "I am very pleased to have the opportunity to share my recollections of one of the most significant experiences of my life when I was, at that age of 12, in the midst of the Japanese surprise attack at Pearl Harbor and Hickam Field on December 7, 1941". A member of the Pearl Harbor Survivors Association, he was encouraged by his family, friends and colleagues, he presented his 'Eyewitness to History' story at many schools, civic gatherings and the Engineers Club of Dayton



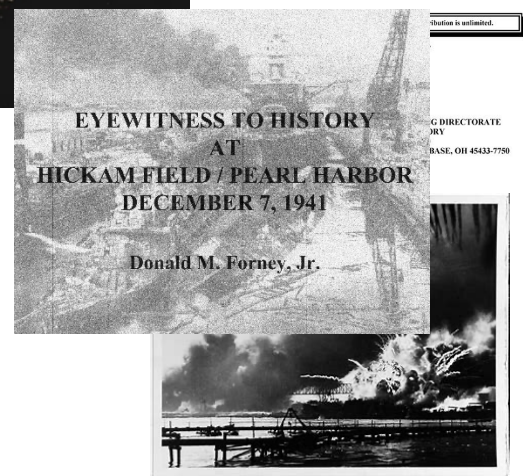
As chief of the NDI/E Branch of the Air Force Materials Laboratory, he directed the tremendous growth of the program in the Air Force and in partnership with other agencies. This technology is the fundamental baseline of the inspection processes to assure dependable safe operation of all aerospace systems whether commercial or military. These processes are used continually in all Air Force missiles, spacecraft, rockets, turbine engines and aircraft.

Don authored the highly regarded authoritative 'primary source' document on the history and application of NDI/E and the contributions of the Materials Laboratory and the nation. Don devoted a full chapter in his book highlighting the people who worked with him over the years.

AFRL-ML-WP-TR-2006-4145  
 NONDESTRUCTIVE EVALUATION  
 TECHNOLOGY INITIATIVES  
 PROGRAM II (NTIP II)  
 Delivery Order 10, Task 010-015: In Search of  
 Excellence - An Historical Review  
 Donald Forney  
 Universal Technology Corporation  
 1270 North Fairfield Road  
 Beavercreek, OH 45422-2400



MAY 2006  
 Final Report for 01 February 2006 - 31 May 2006



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G DIRECTORATE  
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- **Modern Military Historians note that the ICBM Program was one of the Most Successful Programs in the History of the Department of Defense. ML had a Very Important Role in this Development**

*In 1958, Brenden Forsch at Vought Aerospace, discovered (accidentally) that when a plastic/ceramic fiber composite was pyrolyzed it produced a carbonaceous residue with unusual mechanical properties*

*In 1963, LTV, NASA and the AF under Don Schmidt's direction substituted newly discovered carbon fibers for the ceramic fibers producing a revolutionary new class thermal protection (TPS) materials: Carbon/Carbon - 'C/C'. These composites revolutionized the thermal protection system arena providing the key to success for ICMBs, rocket propulsion and the Space Shuttle.*

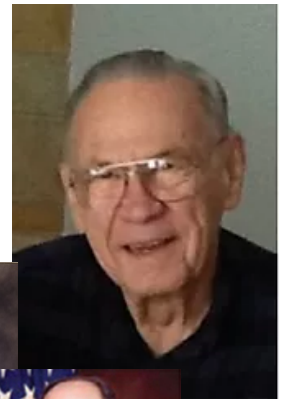
*Schmidt was recognized by the aerospace community as a 'Pioneer and Innovator' for his contributions.*

*The ML thermal group (Dr. M.L. Minges and Dr. Gary L. Denman) formed by Dr. Al Lovelace developed new C/C TPS system engineering tools and became an important technology transfer 'trusted agent' for the AF ICBM program office and the AF Ballistic Missile Division.*



**Mark 12/Mk 21**

**Don Schmidt**



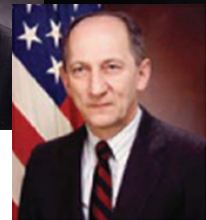
**Al Lovelace**



**Merrill Minges**



**Gary Denman**



- **Dr. Sonny Pierce, assistant MT division Chief Chosen to be 1<sup>st</sup> Director of Manufacturing for the F-16 Fighter Program**

*The first F-16 program office director, Gen. James Abrahamson, chose Dr. Pierce to be chief of manufacturing for this new DOD production program destined to be the largest AF aircraft program in history delivering over 5000 aircraft for US and international partners.*

*Some years later during combat operations in Iraq and Bosnia, another ML senior manage, Dr. M. L. Minges, served as F-16 technical director, focusing multi-billion-dollar modification, upgrade and sustainment programming to meet Air Combat Command needs. Important real-time ML and AFRL expertise was a vital element of this support*

*As part of an expanding program delivering F-16s to 23 US allies, Dr. Minges served as editor of the program office Strategic Plan.*



**Dr. Sonny  
Pierce**

- **ML System Support assistant division chief, Maj. Tom Ferguson, promoted to the rank of Lt. General was appointed commander of ASC (later AFLCMC)**

*Tom was a command pilot with over 4000 hours flying time who flew many B-52 combat missions in Southeast Asia*

*His experience in ML lead him to call on the Laboratory frequently. ML technical expertise was of high value to the Center focused on operational aircraft sustainment issues in many different ASC SPOs.*

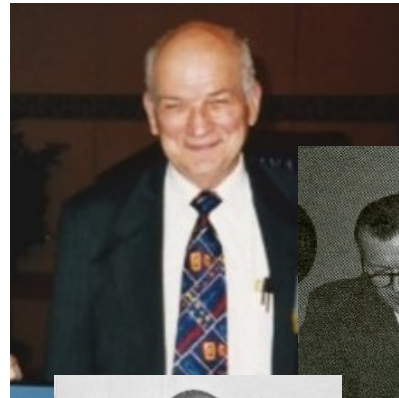
*ML also organized a high level international technical interchange forum for Gen. Franch Ferguson with the French Ministry of Defense.*



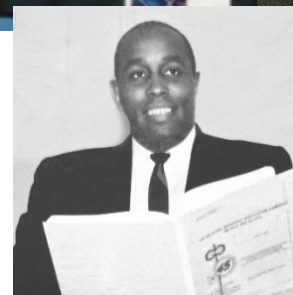
- **Dr. Jack Lincoln Inducted into the Engineering and Science Hall of Fame Recognizing Worldwide Acceptance of the Design Processes he Developed Assuring Military & Commercial Aviation Safety & Airworthiness**

*The Aircraft Structural Integrity Program (ASIP) established by Dr. Jack Lincoln has been adopted by the Air Force and worldwide for both commercial and military aircraft ensuring aircraft structural airworthiness. The USAF's unparalleled worldwide aircraft structural safety record since 1980 is directly attributable to Dr. Lincoln's work. Recognized internationally as an expert in structural integrity and a champion of aviation safety, he began his career piloting a DC-3. As a leader in his field and a mentor to aspiring young engineers and maintenance personnel his vision, demeanor and leadership he guided the design and maintenance philosophy of today's aircraft.*

**Jack  
Lincoln**



*The System Support Division of ML, directed by Walt Conrardy, was a vital partner for Dr. Lincoln throughout his career. The structural non-destructive testing, design information and corrosion degradation experts from the Division provided key fundamental information on aircraft in the field which formed the basis for Dr. Lincoln's fail-safe risk analyses. Ed Dugger led the AF Handbook Initiatives which made all this authoritative vital information conveniently available for aircraft system design and sustainment programs in the Air Force and the aerospace industry*



**Ed  
Dugger**



**Walt  
Conrardy**

*For the Air Force and NATO partners the design tools Dr. Lincoln developed for the C-5, B-1B, F-15E, F-16, T-46, C-17, F-22 and the F-35 have assured long, economical and safe aircraft life. He chaired the C-5A Structural Enhancement Program providing the path extending the operational life of the C-5A by 20 years. Using his structural integrity design tools F-16 combat operations were assured.*

*For commercial aviation, at the request of the FAA, he used unique damage tolerance analyses in an independent damage tolerance assessment of the Boeing 747 structure producing detailed inspections key to safe long-term operation. He made direct contributions to the FAA Airworthiness Directives for both the 737 and 727 following the Aloha Airlines and DC-10 Sioux City Iowa mishaps.*

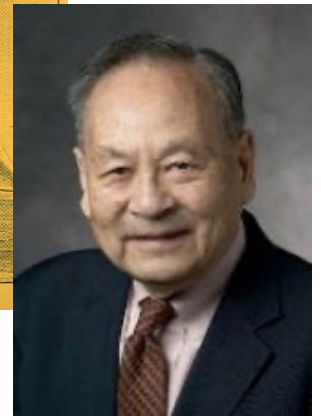
- **ML Chief Scientist, Dr. Steve Tsai, Helps the San Francisco Yacht Club design Revolutionary Composite Dual Rudder's for the America's Cup Challenge**

*Dr. Steve Tsai, a member of the National Academy of Engineering is an international authority on advanced composite engineering design. His expertise was one of the most important factors in ML's successful initiatives transitioning this technology into military and commercial aircraft*

*He and his wife, Iris, both gourmet chefs opened the Mandarin Kitchen in the Dayton Arcade*

*One of their sons is an internationally known chef and host of the popular PBS program 'Simply Ming'. The James Beard award restaurant, Blue Ginger, near Boston was established by Ming.*

*Dr. Tsai is Stanford University Emeritus Professor of Aeronautics and Astronautics and founding editor of the Journal of Composites*



- **During the Viet Nam War, Air Force Pilots Visited ML seeking Technologies to Eliminate Lethal Combat Threats**

*A-10 Gunship & forward observation aircraft pilots in close air support along the Ho Chi Minh Trail and elsewhere reported significant threats from surface to air missiles*

*ML electro-optical specialists reviewed combat engagement footage and conducted extensive face to face interviews with combat pilots.*

*Effective solutions were quickly identified and introduced in the field.*

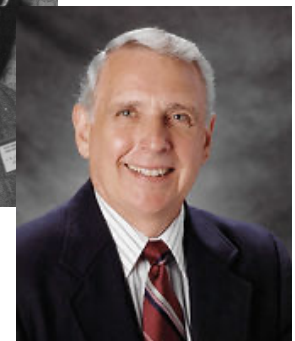
*The specialized facilities established for this effort remain in operation at ML today*



- **2 AFRL Leaders Reached the Highest Position in the Air Force for S&T Policy Management – Both were from ML: Dr. Al Lovelace & Jim Mattice**

*In the Office of the Secretary of the Air Force, the deputy assistant Secretary has responsibility for developing and implementing overall AF S&T policy and programming.*

*It is a '3-star' level position which also provides oversight of the Air Force Research Laboratory. These two ML managers are the only leaders from AFRL who have held this position*



Often significant issues affecting ML arose, such as assuring a robust AF ManTech. These and other significant AFRL strategy and programming issues were successfully resolved

- **Internationally known ML Composite Materials Expert Inducted into the Engineering and Science Hall of Fame**

Dr. Nicholas Pagano was the first to recognize the importance of interlaminar phenomena in high performance composite materials. His discovery led to new practices to reduce delamination, one of the most feared failure modes of composite materials. He formulated the exact 3D mathematical theory of elasticity models to describe this phenomenon

He also developed the analytical models describing the twisting and bending of laminated composites that are the reference for all subsequent work in the mechanics of laminated composites. He made major contributions describing the mechanical response of brittle matrix composites

The successful and pervasive use of composites changed the civilian and military world from bicycles to bridges. Dr. Pagano's contributions established the systems engineering foundation which permitted the safe and reliable use of composite structures in modern military and civilian aircraft, space and rocket systems. The Boeing 787 Dreamliner aircraft, for example, is composed of 80% by volume of composite materials. This application is a proven example of the precision and importance of the system design tools developed by Dr. Pagano.



- **Dr. Bill Fredericks ML division Director and Nationally Known Expert on Infra-red Electro-Optics is Chosen Chief Scientist of the Missile Defense Agency**

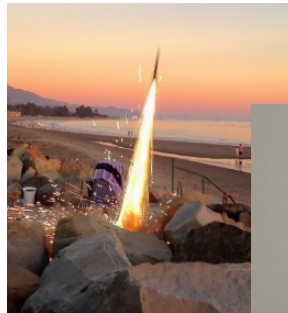
In 1958 a revolutionary new class of infrared sensor material, mercury-cadmium-telluride, was discovered in the UK. In the US the chief of the ML Electromagnetic Materials Division Bill Fredericks formed a new group of skilled electro-optical experimentalists & theoreticians to exploit this discovery for strategic surveillance and other AF applications.

Dr. Gail Brown led the fundamental physics developments of 'superlattice' hetero-structural materials key to practical high performance IR sensors. She was awarded the AF Basic Research Award and elected a fellow of the American Physical Society in recognition of her accomplishments

Dr. Frank Smolowitz of the University of Dayton Research Institute was the leading semiconductor theoretician in the large ML team.

Within a few short years the tremendous potential of this complex IR sensor family was confirmed. Dr. Fredericks developed ML inhouse, industry and AF ManTech programming which included DARPA and MDA funding. An important long-term partnership was established with the Army Night Vision Laboratory leading to many Army applications

The ML expertise and accomplishments propelled the Laboratory to the forefront in the US and internationally developing revolutionary new infra-red sensor systems



**Dr. Bill Fredericks**



**Dr. Gail Brown**

The ML developments proved vital for USAF strategic surveillance, for tactical surveillance (in partner with the Army Night Vision Laboratory) and for the Missile Defense Agency

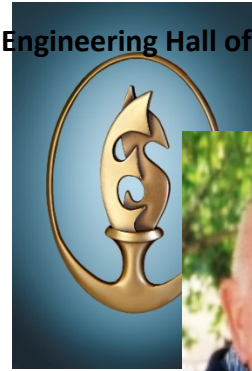
- **ML Director George Peterson Inducted into the Science and Engineering Hall of Fame**

This honor was in recognition of George's career long dedication directing national programs which have brought advanced composites into all Air Force systems. He has been elected to the National Academy of Engineering

These programs were extraordinarily successful not only for the Air Force but for the broader US aviation industry and around the world.

Well after WWII aircraft systems were still built entirely of metals. George's programs offered industry cost effective high performance composite options to replace metallic structures. Today for both the civil & military arenas the percentage of composites in aircraft spacecraft & missiles is well over 50%

His advocacy of this technology early in the 1960s convinced Gen. Schriever to embrace George's vision and aggressively support new ML initiatives



- **Gen. Jim Abrahamson, Director of MDA, Visits ML**

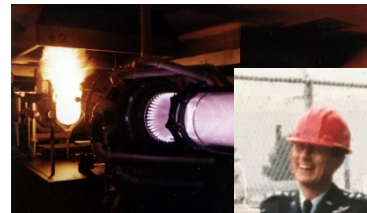
The director of the Missile Defense Agency toured the ML Laser Hardening facility which was undergoing major upgrades funded by MDA to meet new AF and missile defense requirements.

The key information this new facility provided was two-fold:

- 1) how powerful did laser weapons have to be to destroy enemy laser weapons
- 2) how vulnerable were US systems to laser weapons threats

Quantifying these key laser effects enabled ML to lead the development of new technologies to protect ('harden') AF aircraft, space craft and missiles from these threats

Parallel ML developments in strategic surveillance technologies were vital to MDA and the AF as well



Gen Abe  
John Speers  
Gary Denman

- **The Materials Laboratory establishes its first Co-located Engineering Operation in Gen. Schriever's New AFMC Headquarters in Los Angeles**

To make strong direct connections to AF systems customers ML established it's first of many permanent co-located engineering offices in Los Angeles

Other successful co-located engineering offices were established by ML In AF Program Offices across the Nation.

Paul Propp served as director of the very successful 'West Coast Office' for many years





*His sailboat at King's Harbor in Redondo Beach became known as the 'ML Yacht'*

**Paul Propp**

- **Dr. Gary Denman, former ML director, becomes director of DARPA**

*Gary began his ML career in the System Support Division's Thermal Systems Engineering Group making important contributions to the transition of new ML developed C/C composites for the US ICBM system.*

*Some years later he broadened the focus of this group to apply its ICBM expertise to the newly emerging missile defense arena.*

*Partnering with other Air Force Laboratories, DARPA & AF Headquarters he established a major new ML in-house facility: the Laser Hardened Materials Evaluation Facility – LHMEF. This laboratory provided key information on laser weapons effectiveness and the threat these devices posed for AF systems. Gary's successful decade long ML 'laser hardening' program provided technologies to protect AF systems from these threats*

*After departing DARPA Gary became President and CEO of GRCI Aerospace Corporation*

- **Dr. Russo, leading the AF team creating AFRL in 1997, incorporated OD into the operating principles of the new integrated Laboratory.**



**Merrill Minges**

**Gary Denman**

**Bill Woody**