

The Asmus File

John Asmus, out of Los Alamos and the U of Calif, has become a real friend of mine over the last 4 years ... because of his great knowledge and interest in art, and the fact he comes to Hanford from time to time to consult using Lasers to "clean up" the site.

Acknowledgments

So, John came up this week for this conference and he and I spent 3 days together and I only wish more PhD's here at Hanford were as much fun to hang with. I got Dale Travous and Peter Beavis over for one day to catch 2 of John's lectures. Also John gave Dale a major bunch of LASER electronic gear which I have stored here at my studio (long story to tell in person).

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Vice Chair - Registration	Patty Squire, ASNT
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Secretary	Wayne Akerson, IEEE
Treasurer	Evelyn Hirt, IEEE

John asked me to be one of his references, along with 2 nobel prize winners and I thought that was pretty cool, in a time in which art isn't considered to be very important.



The American Society of
Mechanical Engineers



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COLUMBIA BASIN COLLEGE
APPLIED TECHNOLOGY DIVISION

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TECHNICAL CONFERENCE & TRADE SHOW

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**Red Lion Inn &
Columbia Basin College
Pasco, Washington**

March 28 & 29, 1995

LASER Track

Decontaminate with LIGHT

A Serious Laser/Light Show

For the first time this year, the CBTC will include a one-day seminar on LIGHT AIDED DECONTAMINATION. Several technical papers will be presented on this twenty year old technology, with emphasis on recent Industrial Applications. Vendors will demonstrate various components and/or complete systems which use high energy light for coatings removal, equipment size reduction (cutting), and as surface decontamination tools. These demonstrations will be scheduled to complement the seminar sessions.

Components on display throughout the Trade Show will include Lasers, Fiber Optic Delivery Systems, Xenon Flash Paint Strippers, Manipulators, Robotics, Remote Operations Tools, Real-Time Debris Analysis, CCTV Controls, Reuseable Filter Systems, and others.

This has been properly defined as "STAR WARS Technology, TODAY." The comparison with the fictional high energy weaponry of 1975 movie fame is cryptic. That comparison is almost as appropriate as the technology's real origins in association with the Strategic Defense Initiative (SDI) high energy laser development programs. For the nuclear clean-up effort, these processes have the potential for approaching theoretical minimum final waste volumes, while releasing the cleaned structure for classic industrial disposition.

KEYNOTE SPEAKER

Dr. John F. Asmus

Professor Emeritus, UCSD, La Jolla, California

Dr. Asmus will present two talks, encompassing the extremes of the technology, covering the past and the future. John was there "in the beginning" when the first lasers were invented in 1960, and later when the initial concepts of laser cleaning were tested. In his first presentation he will provide a history of this development, which started at a dinner party for members of a Presidential Commission on Military Lasers in 1972.

Dr. Asmus' second talk at the end of the seminar will tell of his 1994-1995 development of the Pinch Plasma Lamp. This device goes a step beyond the laser and Xenon Flash, to a single light source that exceeds 150 Megawatts of light output, approaching the theoretical maximum light possible from a single unfocused source.

SEMINAR SCHEDULE

LIGHT-AIDED DECONTAMINATION

March 28, 1995

Paper Time

Author/Title

8:00 a.m.

Dann J. Flesher

Introduction

Schedule for Demonstrations

000 8:15 a.m.

John F. Asmus, Ph.D.,

Professor Emeritus UCSD/Scripps Inst.

The History of Light Aided Cleaning and Decontamination

From a Presidential Commission on Lasers dinner party to Venice Italy to Hanford: A review of the development of high energy light as a decontamination tool. The process started as a method for the slow, careful, and effective cleaning of famous and invaluable works of art. The speed and availability of the technology have progressed up to the industrial wonders of the 1990s. These radiation-ablation techniques have the advantages of being a noncontact, nonabrasive, and amendable to remote operations.

001 8:45 a.m.

R. Demmer, Russ Ferguson,

Idaho National Engineering Laboratory (INEL)

H.M. Pang, & M.C. Edelson,

Inst. of Physical Research & Technology

AMES Laboratory, Iowa State University

Laser Decontamination of Metals

Minimization of secondary waste and restricted use of hazardous chemicals drive the need to identify new/effective methods of decontamination. Light ablation is a novel approach to radioactive decontamination which satisfies many criteria. INEL and Ames Laboratory, a leader in radioactive decontamination, tested both simulated (SIMCON) and radioactive metal coupons using high power, short pulsed, laser beams. When exposed to an intense photon source, material is ablated from the surface. The ablated material can be collected via HEPA filtration, preventing re-deposition. High decontamination factors (DF) were achieved. Future work will develop equipment handling, application methods, and fiber optic delivery systems.

002 9:05 a.m.

N. Scott Cannon, Ph.D.,

Westinghouse Equipment Development

Concrete Layer Removal

The use of lasers for removing radioactive contamination from concrete surfaces is being investigated at DOE's Hanford Reservation. A major advantage of a laser decontamination process is that no additional waste is generated. Test results using 50 and 600 W YAG lasers have been extrapolated to more powerful commercially available units. Minimum removal rate concrete in air is estimated at 420 cm²/h (0.45 ft²/h) to a depth of 0.64 cm (0.25 inches); underwater rates would be considerably reduced.

(schedule continued on next page)

SEMINAR SCHEDULE (continued)

003 9:25 a.m. Nick Eutizzi,
Mare Island Naval Shipyard, Vallejo, CA.
Paul Denney, D.J. Smith,
& J. Singh
Applied Research Laboratory,
Pennsylvania State University,
High Energy Processing Department

Coatings Removal in Navy/Marine Applications

Many previously common coating materials have been found to be hazardous or toxic to humans and/or wildlife. Examples include Polychlorinated Biphenyls (PCBs), lead, anti fouling and chromate paints, and asbestos insulation. One method which can eliminate or minimize these hazards and/or reduce secondary decon waste is to reduce or ablate the material from the surface using lasers.

9:45 a.m. (15 minute break)

004 10:00 a.m. Dave Van Alstyne,
Polygon Industries Inc.

The Commercial Xenon Flash

We face a monumental task in adapting to stricter environmental regulations. Demands are made for clean up and removal and disposal of toxic contaminants, while many chemicals and solvents used in classic cleaning operations are no longer permitted. The Cold War's end has also brought emphasis on the dismantling and decontamination of America's nuclear weapons production facilities. Ironically, new tools to meet these challenges have come directly from the defense programs. Polygon's flash lamp system is based on orphaned technology from Strategic Defense Initiative (SDI) programs. High energy light is used as a scouring tool; no abrasive or liquids required. The system is effective and versatile; a thumb wheel controls flash rates, varying speed of removal. One system can strip coatings, ablate or vitrify concrete, or destroy organic contaminants like PCBs. Light weight hand held or manipulator controlled heads are easily maintained and can be disconnected and wiped down or immersed for final clean up.

005 10:20 a.m. Gordon Mcfadden,
LAMPS Corp., Bremerton, WA

Integrated Remote Laser/ Fiber Optics Systems

The high energy laser is a valuable tool for welding, cutting and cleaning. Until recently, equipment was limited to line-of-sight or rigid (straight line) optics. Now the high energy light beam can be guided to remote locations just as easily as high energy electrical power can. Flexible Fiber Optics cables with built-in diagnostics permit remote operations over hundreds of feet from the laser itself. The power and control equipment can reside in an accessible, non-hazardous area, while a small "hand-held" end effector tackles decontamination, cutting, or welding problems over 450 feet away. The importance to both human and equipment safety of this development (ALARA) will be discussed.

006 10:40 a.m. Leonard Reed, Ph.D.
International Technical Associates,
Santa Clara, CA

A Portable Integrated Coatings Removal System

Removal of coatings have undergone a transformation from low technology drudgery to high technology wizardry driven by costs and environmental concerns. Lasers are one of several candidates for effective environmental acceptable coating removal for the future. Lasers have proven to be an environmentally sound, cost effective method of removing coatings from a variety of substrates. This paper describes some of the lasers that have been utilized for coating removal, how this process can be implemented, system issues in translating this technology into real world applications, and a discussion of the system's efficiency in comparison with other removal techniques.

11:00 a.m. 10 minute break

007 11:10 a.m. Alan Hill, Ph.D.,
Plasmatronics Corp., Albuquerque, NM

The LADS: A CO₂ Laser for Aircraft Stripping

The Laser-Aided Decoating System (LADS) was developed for the U.S. Air Force for the removal of coatings (epoxy paints) from jet aircraft nose cones (epoxy substrate). Using a CO₂ laser and a stationary robotic handling system, the unit reduces the time required for coating removal by 75 percent, and totally eliminates the necessity of toxic or environmentally hazardous chemicals. The volume of waste generated is a fraction of that produced by alternative processes. Despite the chemical similarity of the coating and substrate, the removal is complete and there is no damage to the underlying material.

008 11:40 a.m. John Sellar
PowerPulse/InterPro, Golden CO

The Laser Miner: An Option for Facility Decon & Disposal

The mining industry has been searching for technology to break the restrictive drill and blast cycle. PowerPulse has investigated the use of lasers to achieve this objective under a contract with the Electric Power Research Institute (EPRI). Test work has revealed that, pulsed lasers may reduce the need for "drill and blast," and will simultaneously carry out some of the energy-intensive commotion work right at the rock face. The tool, known as the Laser-Water Jet, involves pulsing a laser inside a high pressure water jet which activates five separate rock excavation mechanisms at the same time. These mechanisms will produce a continuous stream of small rock particles which can be removed from the area by a vacuum system and pump. With energy delivered by fiber optics, the tool will have directional flexibility and be able to cut any shaped opening, including large or small diameter boreholes, whether straight or sinuous. The Laser-Water Jet represents the biggest break through in hard rock excavation since the discovery of explosives. It is basically silent, produces no ground vibrations, and does not release dust, fumes or chemicals into the environment.

Noon

Lunch break

**009 1:30 p.m. Paul Denney, Ph.D.
or Jim Schultens, DOD**

**Results of Debris Capture from
Light Ablation Processes:
Physical and Chemical Analyses**

An investigation has been conducted by researchers at the Applied Research Laboratory, The Pennsylvania State University (ARL, Penn State) for the U.S. Navy utilizing Nd:YAG lasers for treating various shipboard coatings/substrate combinations. Research has centered on Nd:YAG laser processing. Quantitative and qualitative results from feasibility studies will be presented and discussed. Possible future applications and "industrialization" of the process will also be discussed.

010 1:45 p.m. Jacek Borysow
Department of Physics,
Michigan Technological University

In-Situ Real Time Analyses

The LAD process is amenable to concurrent or intermittent real-time, in-situ analysis. Laser-induced plasma spectroscopy has been used for the detection of heavy metals and metal compounds. The technique employs laser-induced plasma as a source for desorption, excitation, and dissociation of metal bearing complexes from the contaminated surfaces. Subsequently, the diode laser is used to identify liberated atoms, some (e.g.: Cesium) with isotopic specificity. (The process can also be used for the profile analysis of cores or for smaller samples.)

011 2:00 p.m. Tom Roeske
Pall Advanced Separation Systems

**A Better Filter for LAD:
Further Waste Volume Reduction**

Light-Aided Decontamination will reduce the volume of decontamination wastes to the point where the HEPA filters can become a significant fraction of the total waste volume. Pall has been a leader in the development of reusable filters: sintered metal, woven metal, and metal felt products. The New Market Development group will provide special design, reusable, low pressure drop, metal filters with HEPA/sub micron capture capability. These filters will further reduce the waste volume from LAD processes. The capability of this and other metal filter systems will be discussed.

012 2:15 p.m. John F. Asmus
Professor Emeritus UCSD
/Scripps Oceanography Inst.

**The Future: Pinch Plasma Lamp
Technologies**

Laser and Xenon Flash systems are available now, but recent progress has also been made in a third, more efficient, high-performance light source. After evaluating O-pinch, Z-pinch, and surface flashover plasma radiation sources as laser substitutes, it has been concluded that the Laser-Guided Gas-Embedded Plasma Pinch Lamp has favorable characteristics for surface preparation applications. Data are presented on the design, performance, and scaling of these plasma radiation sources. The results of coating ablation tests with a gas-embedded plasma-pinch test device are described together with the prognosis for high-performance surface treatment systems based on this new optical radiation source.

2:30 p.m. Dann J. Flesher
Demonstration Schedule Review
Close Session
Break/Move to Demo 1 Area

EQUIPMENT DEMONSTRATIONS

March 29, 1995

Morning Session - 8:30-11:30 a.m.

Columbia Basin College, Room L-102

Demonstration 1:

The Xenon Flash System/POLYGON

Demonstration 2:

The Portable Laser System/INTA

Demonstration 3:

The Navy's Remote YAG System/DOD...

Demonstration 4:

The Mystery Demo.... (TBD)

POSTER SESSION

Afternoon Session - 1-4 p.m.

Columbia Basin College, Room L-102

Poster/Video Sessions

P: Posters V: Video

201	INTA
V	Graffiti Removal
202	POLYGON
V	Paint Removal
203	Plasmatronics
V	The LADS System
204	PowerPulse
V	Mining Laser Development (Galloping Gertie)
205	Robotech
V	Robotic Crawlers
205	LAMPS
P	Light-Aided Decon Engineering Support Services
206	BDM
P	LAD Project Management

4:30 p.m. Meet the Speakers

Many of the speakers will be available at the beginning of the Poster session to answer your questions or discuss specific topics.

Technology Bulletin

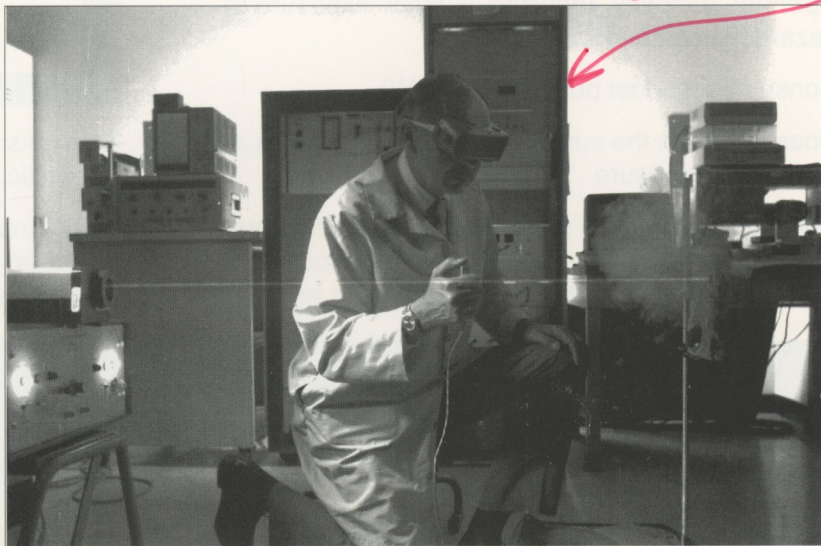
September 1994

Westinghouse Hanford Company

Light-Aided Decontamination

Hanford scientist Dann Flesher, along with the private sector, university researchers, and other DOE sites, is adapting a technology, originally developed to clean art objects, for potential use at a variety of site decontamination projects. During FY94, Hanford's general purpose light-aided decontamination (LAD) laboratory will test the ability of laser and xenon flash light ablation systems to remove radioactive contaminants.

Light-aided decontamination uses high-energy light to raise surface temperatures and melt or vaporize coatings or contaminants without harming the surface being cleaned. The heat from the process can actually reduce secondary wastes and convert added organic material (i.e., paints or dyes) to harmless vapor. In ventilation-controlled areas, a vacuum device filters the remaining offgases. LAD may be used alone or in conjunction with other decontamination methods such as CO₂ pellet blasting.



At Hanford, the advanced technology light-aided decontamination laboratory will assess the application of this promising technology to specific Hanford problems and issues, where LAD could be used to significantly reduce daily operator exposure to contamination. At N Reactor, the advanced technology group will test LAD's ability to clean radioactive contaminants from basin concrete and remove contaminated paint. Other potential uses at Hanford include maintenance and repair of contaminated equipment and reclamation and reuse of scrap materials.

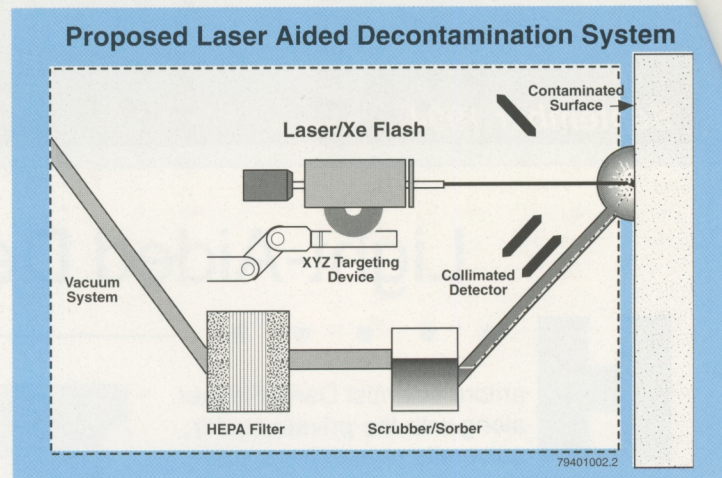
Summary Status

- As of December 1993, remotely operable laser and xenon flash LAD systems are commercially available. They can also be engineered for specific applications and fabricated from readily available components.
- Application goals include reduction of personnel exposure, optimized separation of high-level contaminants from low-level substrates, and the eventual recycling of contaminated metals for DOE.
- Ames Laboratory at Iowa State University, which is conducting research on LAD and recycling contaminated metals for DOE, is participating in technical exchanges and review of Hanford's LAD projects.
- The University of California at San Diego is developing liquid pinch plasma, a stable bright light source that uses the ultraviolet spectrum. The new light source, which should be available commercially in two to four years, is particularly effective for removing bright white or reflective coatings.
- During FY95, personnel will assess LAD technology for application to specific Hanford problems. A prototype demonstration is planned to present the technology at Hanford and INEL.
- Use of LAD will reduce the costs of decontamination efforts by limiting personnel entry and reducing the volume of secondary waste.



Features, Advantages, and Benefits of Light Aided Decontamination:

1. Reduces costs (e.g., personnel entry costs, secondary waste treatment/disposal costs, and field decontamination costs)
2. Produces only minimal secondary wastes—requires no abrasives, acids, or chemicals. Secondary wastes and offgases are collected with a vacuum device
3. Operates remotely, reducing workers' exposure to hazardous contaminants
4. Consumes modest power (20-40 kW)
5. Does not harm the surface being cleaned, even after prolonged exposure
6. Removes a variety of soils; paints, including epoxies; accumulated airborne pollutants; marine fouling; rust and corrosion; and transparent nerve gas residuals



7. Works on many surfaces, including metal, stone, plastic, leather
8. Differentiates between physically and chemically similar surfaces and can clean selectively (e.g., can remove paint by layers or colors)

Removal Data from K-West Concrete Core Sample Chips

Specimen Condition	Laser Type (W)	Pulse Power (W)	Average Power (J)	Total Energy (s)	Test Time (mm ²)	Target Area (g)	Weight Removed (mm)	Final Depth
Dry	Pulsed	1,593	1.86	4,690	2,523	5.1 x 5.1	0.173	2.29
Dry	Pulsed	2,579	3.01	7,590	2,523	5.1 x 5.1	0.296	3.91
Dry	Pulsed	3,710	4.33	10,920	2,523	5.1 x 5.1	0.426	6.05
Wet*	Pulsed	2,857	3.33	8,410	2,523	5.1 x 5.1	0.062	0.89
Dry	Pulsed	3,711	4.33	11,690	2,700	15.2 x 15.2	0.759	NA
Dry	CW	NA	620	18,600	30	17.8 x 25.4	1.546	NA

* Specimen under 1.3 cm (0.5 in.) of water.

**> Note: Printing error; to read correctly move all units one column to right.

Technical Status

- In 1991, limited demonstrations of LAD on the Hanford Site clearly indicated the technology's selectivity in removing deposits with certain properties without damaging the underlying surface.
- During FY93, the test capabilities of the xenon flash system were established, and the plan for the general purpose LAD laboratory was generated

(TIPS funds of \$100,000 under cost account 1MDDDD).

- During FY93, N Reactor sponsored LAD system tests to clean concrete and remove paint and developed requirements and conceptual design for a prototype demonstration test (N Reactor funds of \$150,000 under cost account 1KN201).

Contacts

Technical: Dann Flesher – Engineering Applications, Engineering Development (509) 372-3640 Administrative: Bill Allan – Subcontracted Technology Infusion (509) 376-9456
Reference # 79401002 DOE Document # RL-W94-024 September 1994

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INSTITUTE FOR PURE AND
APPLIED PHYSICAL SCIENCES, 0360

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LA JOLLA, CALIFORNIA 92093-0360
FAX: (619) 534-7649

DIRECTOR
LU J. SHAM

ASSOCIATE DIRECTOR
C. FRED DRISCOLL

January 25, 1995

December 28, 1994

Mr. James Acord
P.O. Box 159
Richland, WA 99352

Dear Jim,

It's been a long time now that Barbara and I haven't seen you or heard anything of your nuclear project. How are things going in your life and work? Have you heard anything from the Guggenheim Foundation?

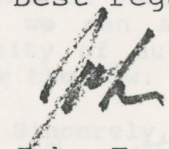
I talked to Dann Flesher a couple of weeks ago, and he said that he had seen you, recently. I hope that it follows that I'll be seeing you at his fair taking place 28-29 March 1995 in Pasco.

I've just finished up a year-long plasma pinch project here at UCSD for CAL/EPA and Southern California Edison. Next, is the restoration of a Frank Lloyd Wright house in Los Angeles (removing asbestos and lead coatings from cast stone).

UCSD has decided that it's time for my academic review and they asked for the names of colleagues who are familiar with my "outside" activities. Would it be all right for me to give the committee your name and address?

I hope to hear from you and look forward to seeing you in March.

Best regards,


John F. Asmus
Research Physicist

1/28/95
Enclosures



INSTITUTE FOR PURE AND
APPLIED PHYSICAL SCIENCES, 0360

DIRECTOR
LU J. SHAM

ASSOCIATE DIRECTOR
C. FRED DRISCOLL

James Acord, Artist
P.O. Box 159
Richland, WA 99352

Dear Mr. Acord:

This department is considering Dr. Asmus for merit to Research Physicist, Step IV effective July 1, 1995. For this purpose, the University of California requires that we demonstrate the high quality of the individual's research and creative activities. We would appreciate it if you would assist us by providing a frank assessment of the significance of Dr. Asmus' research and of his professional standing.

It is my hope that you will be able to provide a critical evaluation of Dr. Asmus' work rather than general statements of uncritical praise. To aid you, I am enclosing a copy of his curriculum vitae.

I realize that this is an extra burden to impose upon you. I apologize for this but the University of California system relies very heavily upon the evaluation of academic members by outside reviewers. Under University of California policy, the identity of authors of letters of evaluation which are included in the personnel review files will be held in confidence. A candidate may, upon request and at certain prescribed stages of the academic personnel review process, be provided access to such letters in redacted form. Redaction is defined as the removal of identifying information (including name, title, institutional affiliation, and relationship to the candidate) contained either at the top of the letterhead or within and below the signature block of the letter of evaluation.

The full text of the body of your letter will therefore be provided to the candidate if so requested. Thus, if you provide any information that tends to identify you in the body of the letter that information may become available to the candidate. If you wish, you may provide a brief factual statement regarding your relationship to the candidate at the end of your letter but below the signature block. This brief statement will be subject to redaction and will not be made available to the candidate.

Although we cannot guarantee that at some future time a court or governmental agency will not require the disclosure of the source of confidential evaluations in University of California personnel files, we can assure you that the University will endeavor to protect the identity of authors of letters of evaluation to the fullest extent allowable under the law.

Sincerely,

Lu J. Sham, Director

LJS:dlb
Enclosures

JOHN F. ASMUS

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(Office)

Institute for Pure and Applied Physical Sciences
University of California, San Diego
9500 Gilman Dr.

La Jolla, CA 92093-0360

(Laboratory)

Institute for Geophysics and Planetary Physics
Scripps Institution of Oceanography
9500 Gilman Dr.

La Jolla, CA 92093-0225

EDUCATION

BS/Electrical Engineering, Caltech, 1958

MS/Electrical Engineering, Caltech, 1959

Ionospheric Studies, Tech. Univ. Copenhagen, 1960

PhD/Physics & Quantum Electronics, Caltech, 1965

(Thesis advisers were Roy Gould and Nicholas George.)

FULL-TIME POSITIONS

1975-Present, Research Physicist, Univ. of Cal. S.D.

Taught courses in lasers, laser applications, nonlinear optics, and holography under the aegis of EECS and APIS Depts. as well as individual lectures in art conservation technology in the Visual Arts Dept. Guided graduate students in thesis research and undergraduate students in independent research in cross-disciplinary art/science fields such as Benin bronze nuclear isotopes, photoacoustic spectroscopy of artworks, and laser effects in theater. Currently conducting research on a superbright plasma pinchlamp for the destruction of toxic substances under the sponsorship of Cal EPA and So. Cal. Edison (earlier support from ONR and AFOSR). Sponsored research projects in computer image enhancement include the Mona Lisa (CBS News), Lascaux paintings (Nat. Sci. Foundation/Peabody Mus.), Rembrandt self portraits

(IBM), Giulio Romano fresco (Arecon), Pordenone fresco (Arecon), and OEOb stencil designs (Office of the President). Sponsored research in laser surface divestment include Venetian sculpture (S.H. Kress/NEA/Int. Fund Mon./Friends of Venice, Inc.), in-situ laser conservation of Etruscan artifacts (Nat. Mus. Act/Smithsonian), Cal. Cap. Dome and Rotunda (Cal. GSA), Ming Dynasty statues (Seattle Art Museum), Warships (Long Beach Naval Shipyard), Metal artworks (Franklin Mint), Serbian icons (Balboa Art Conservation Center), and whale branding (Bureau of Marine Mammals). Photoacoustic spectroscopy of paintings (Fleet Foundation). Sponsored research in ultrasonic sounding of Vasari wall painting (S.H. Kress Foundation/Hammer Foundation). Co-founder, Center for Art/Science Studies. Together with UCSD consultants (G. Stout and R. Buck), joined with the Putnam Foundation to found the Balboa Art Conservation Center.

1973-1974, Lecturer, Univ. of Cal, Davis

Taught courses in laser theory and applications in the Dept. of Applied Sciences. Delivered individual lectures in art conservation technologies at UCD Laboratory for Art Conservation.

1971-1973, VP, Board Member, Science Applications Internat.

Managed 30-scientist office. Developed corporate business in military laser weapons programs (\$50M). As a consultant (1973-present) assisted corporation in entering chemical weapons defense programs, an annual business level of \$1.4B (1993), and Fortune 500 status.

1969-1971, Staff Member, Institute for Defense Analyses

Provided staff support to the Director of Defense Research and Engineering, Advanced Research Projects Agency (ARPA), Presidential Science Adviser, and Defense Intelligence Agency on technology assessment. Organized and ran monthly meetings involving as few as 10 and as many as 500 scientists, engineers, military officers, and managers to review scientific research in aerospace fields within the USA, USSR, and NATO. Reported meeting results to DoD (and sometimes to Congressional Committees), evaluated ongoing programs, and provided recommendations. Generated Commerce Business Daily announcements, Requests for Proposals, and resulting proposal evaluations for about \$27M p/a in ARPA programs. Visited virtually all aerospace contractors to monitor progress and collect information. Together with P. Kelley (MIT) and K. Watson (UCB) developed plans for a National Laser Laboratory (at the request of Presidential Science Adviser, E.E. David) which a decade later came into being as the SDIO ("Starwars Office").

1964-1969, Laser Dept. Manager, General Atomic

Created a laser program at GA and managed a department of 10 scientists and engineers. Worked on the ORION nuclear-propulsion

deep-space exploration concept. Performed research on the CASABA/HOWITZER directed nuclear weapon. Developed the highest power laser in existence in 1965 (2 billion watts) and employed it to produce laboratory micrometeorites at a world-record velocity of 120,000 MPH. Studied the effects of meteorites on spacecraft. Produced the first data on laser-produced damage to aerospace vehicles. Performed feasibility experiments on isotope separation by lasers for Gulf Oil Corp. Studied the feasibility of a laser lunar miner for NASA/Bureau of Mines. Demonstrated laser-induced coal gassification and oil shale refining for Gulf Oil Corp.

PERSONAL INFORMATION

Born: January 20, 1937; Chicago, IL
Primary Education: San Diego, CA, Public Schools
California Scholarship Federation
American Legion Speech Award (Medal, Cash Award)
Boy Scout, Explorer Scout
Varsity Letter (Rifle Team)
Band/Orchestra (Trombone)
Radio Amateur Operator (Ham)

Married: 1963

Wife: Barbara (Flaherty) Asmus
MA/Music, Northwestern Univ., 1957
Winner, Met Opera Auditions (Midwest Region, 1957)
Portland Light Opera Lead Performances
Soloist, Portland Symphonic Chorale
Soloist at Alan Hovhaness Premiers
Public School Teacher (Music, English), 15 yrs.
Daughter: Joanne (Asmus) Barron
BA/History, UCSD, 1988
Restaurant Owner and CPA
Daughter: Rosemary Asmus
BA/Education, Lloyla Marymount Univ., 1989
5th Grade Teacher, Los Angeles (Watts)

Memberships (Past and Present)

Caltech Alumni Assn. (Life Member)

Common Cause

Smithsonian Associates

Friends of the UCSD Libraries

Southern California Karate Assn.

Southern California Sports Car Club

American Assn. Advancement Science

American Assn. Physics Teachers

SPIE (Also, Imaging Subgroup)

IEEE (Formerly Inst. Radio Eng.)

AIC (American Institute for Conservation)

IIC (International Institute for Conservation)
WAAC (Western Association for Art Conservation)
Bay Area Art Conservation Guild
Nat. Trust for Hist. Pres.
Nat. Geo. Soc.
Friends of Venice, Inc.
Venice Society (Int. Fund for Mon.)
Electronic Imaging Association
Knight of the Holy Sepulchre
DDR&E Special Advisory Group on Optical Masers
American Physical Society
UCSD Chancellor's Associates
Council: UCSD Catholic Community

Languages

English: Mother Tongue
Spanish: Rudimentary
Danish: Was fluent, 1960-61
German: Rudimentary, 1973-75 (Tech. Reading Exam, 1961)
French: Rudimentary, 1973 and 1985 (Reading Exam, 1962)
Italian: Fluent, 1977-1991
Chinese: Rudimentary, 1989-90

ADVISORY PANEL POSITIONS

1970-1973, Special Group on Optical Masers (SGOM)
DoD Advisory body for the coordination of all Federally-funded Laser R&D.

1970-1973, JASON Panel
DDR&E (Director Defense Research & Engineering) Summer Study Panel to address strategic issues such as ASAT, ABM, SST, SSC, etc.

1985-1990, Advanced Light Source Users Panel
LBL (Lawrence Berkeley Laboratory) Advisory Panel on the Advanced Ultraviolet Synchrotron Source.

CONSULTING AND PART-TIME EMPLOYMENT

1954-1964, US Naval Ordnance Laboratory, Corona, CA
Worked on design and testing of first US guided missiles (Bat, Sparrow, Sidewinder). Designed, tested, and operated ionospheric sounding RADAR at Tech. Un. of Copenhagen to monitor Soviet nuclear weapons tests and ballistic missile launches (1960-1).

1971, Los Alamos National Laboratory, Los Alamos, NM
Consulted for the Associate Director (K. Boyer) on the design of

the ANTARES laser and the ROVER deep-space explorer.

1971-72, Ente Nazionale Idrocarburi, Rome, Italy
Produced in-situ, life-sized archival holograms of Venetian statues (Prof. Urbani).

1972, TRW, Redondo Beach, CA
Marketing of art holograms (Dr. Wuerker).

1973, U. Pietra Dura, Florence, Italy
Laser-cleaned Donatello prophet from the Duomo (Prof. Galli).

1973, San Salvi Church, Florence, Italy
Laser removal of glue facing from fresco (Prof. Dini).

1973, Victoria and Albert Museum, London, UK
Laser stone-cleaning tests for environmental exposure (Mr. Hempel).

1973, IRPA (Royal Inst. Artistic Patrimony), Brussels, Belgium
Laser-cleaning tests of lead sarcophagus (Mr. Sneyers).

1973, Bavarian Nat. Museum, Munich, Germany
Laser-divestment tests on polychrome woodcarvings (Dr. Wackernagel).

1974, Lawrence Livermore National Laboratory, Livermore, CA
Designed and tested X-ray diagnostics for NOVA X-ray Laser (Dr. E. Teller).

1975, The J.P. Getty Museum, Malibu, CA
Produced holograms of Greek antiquities for use at Sutton Place (Mr. Rinne).

1975, Fort. del Basso, Florence, Italy
Ultrasonic detachment mapping in San Salvi fresco (Prof. Baldini).

1976, Istituto Centrale del Restauro, Rome, Italy
Conservation work on frescos of the Lower Church of the Basilica of St. Francis of Assisi (Prof. Urbani).

1977, Palazzo Ducale, Venice, Italy
Laser-divestment of capital (Prof. R. Padoan).

1977, The J.P. Getty Museum, Malibu, CA
Laser-divestment of marble Roman head (Dr. Twilley).

1978-85, Maxwell Laboratories, Inc., San Diego, CA
Chief Scientist/Acting Laser Department Manager (20 scientists and

engineers). Responsible for managing \$5M in contracts for the design and evaluation of the world's most powerful ultraviolet lasers. Was also involved in the development of X-ray lithography system (with IBM), robot/flashlamp aircraft depainting system (with McClellan AFB), flashlamp food processing and the founding of Foodco (with General Foods Corp.), flashlamp-cleaning of the Dallas County Courthouse, flashlamp-cleaning of Arches National Park pictograph (NPS), laser-cleaning tests on the US Capital Building (Mr. G. White), laser-cleaning tests on white stripes on Philae stones (Prof. Saleh/Mr. White/UNESCO), X-ray diagnostics for underground nuclear weapons tests (DOE), X-ray laser weapon lethality tests (DNA), X-ray laser commercial marketing study (Princeton Un.), laser-removal of graffiti from NYC monuments (Commissioner Norton), laser-cleaning of lead coins (Louvre Mus.), laser-cleaning of silver coins (Treasure Salvors, Inc.), laser decontamination of ANTARES laser to recover original performance (Los Alamos), and flashlamp destruction of chemical warfare agents (Aberdeen Proving Grounds). During tenure as Chief Scientist and consultant, corporate business grew from \$13M to \$73M p/a.

1982, Carrara Marble, Inc., Los Angeles, CA
Restored South African granite in lobby of Warner Center in Canoga Park (Mr. Caruso).

1983, National Geographic Magazine, Wash., D.C.
Edited laser and holography manuscripts (Mr. Schneeberger).

1985, Argot, Inc., Rochester, NY
Flashlamp treatment of X-ray fusion laser at Laboratory for Laser Energetics, Univ. of Rochester (Mr. Gutacker).

1985, Universal Restoration, Inc., Washington, D.C.
Flashlamp removal of creosote from ALCOA plant in Englewood, NJ (Mr. Eisenberg)

1984-86, Virginia Polytechnic Institute, Blacksburg, VA
Thesis Adviser/Lecturer in Food Technology Department on xenon flashlamp sterilization of foods and packaging (Prof. Costa).

1986, Jaycor, Inc., San Diego, CA
Laser weapons-effects survey (Dr. F. Felber).

1987, Bluesword, Inc., NY, NY
Computer image enhancement of possible Titian painting.

1988, Vasari Trust, Monterey, CA
Computer image enhancement of Madonna dell Divino Amore by Raphael (Ms. C. DePetris).

1988, Pulitzer Estate, Lausanne, Switzerland
Computer image enhancement of Isleworth Mona Lisa (Mr. F. Diday).

1988, Arecon, srl., Padova, Italy
Laser-divestment of facade of S. Lorenzo in Vicenza (Arch. Calcagno).

1989, Xian EMIT, Xian, PRC
Laser-divestment of Qin-Dynasty polychrome terra cotta treasure trove artifacts (Mr. Wen Rei-Tang).

1989, Xian EMIT, Xian, PRC
Laser-divestment of 12th C. Buddhist artifacts at Fa Men Temple (Mr. Wen Rei-Tang).

1990, Arecon, srl., Padova, Italy
Laser-divestment of facade of Cremona Cathedral including 12th C. carvings by Wiligelmo (Mons. Voltini).

1990, University of Padova, Padova, Italy
Lecturer in computer image enhancement in the Dept. of Electronics and Computer Science (Prof. G. Cortelazzo).

1990-92, Rolls-Royce, plc., Bristol, UK
Designed, developed, installed, and tested a laser/robotic machine vision system for the production of advanced turbine blades (Mr. Stroud).

1991, Arecon, srl., Padova, Italy
Laser-divestment of the stone crests within the courtyard of the Palazzo Bo' at the University of Padova (Arch. Calcagno).

1991-93, Westinghouse Hanford Co., Richland, WA
Consultant on laser techniques for the nuclear and chemical decontamination of the Hanford Nuclear Weapons Facility and its conversion to an Environmental Demonstration Park (Mr. Flesher).

1992-93, Illinois Dept. of Transportation, Springfield, IL
Consultant on laser/robotic removal and containment of lead paints from Illinois bridges (Mr. Janssen).

1993, Fremont Fine Arts Foundry, Seattle, WA
Consultant on a Christos-scale "Nuclear Sculpture" to be created at the Fast Flux Test Reactor in the Hanford Reservation to mark the transformation of the weapons facility into an environmental park (Mr. Acord).

PRIZES, HONORS, AND COMMENDATIONS

NEW 1994

1993-94, Jay Defeo Estate/San Francisco Art Inst., SF, CA
Ultrasonic imaging of the interior of the encased Defeo piece, "The Rose", prior to conservation (Ms. L. Levy).

1993-94, Trust for Preservation of Cultural Heritage, LA, CA
Testing laser techniques for environmentally-safe removal of asbestos/lead coating from the Ennis-Brown House of Frank Lloyd Wright (Ms. Tani).

1994, International Technical Associates, Santa Clara, CA
Comparative study of aircraft paint stripping techniques for USN (Dr. Robinson).

MUSEUM EXHIBITIONS

1974, "Lasers for the Good of Man", Reuben H. Fleet Museum.
San Diego, CA

1976, "Beyond the Artist's Hand", California State University,
Long Beach, Long Beach, CA

1976, 7, 8, & 9, "Laser Art Restoration", Parents' Day/Open House
UCSD, Mandeville Center, San Diego, CA

FEATURE FILMS

1978, Visions, United States Information Agency (15 min.)

1979, The Lasers, AT&T (30 min.)

TV DOCUMENTARIES

1978, Strobe, PBS (30 min.)

1981, Walter Cronkite's Universe, CBS (10 min.)

1989, Around Los Angeles, Fox Cable (30 min.)

1990, Innovation, PBS (30 min.)

1990, Enterprise, BBC for Rolex (7 min.)

1991, Invention, Discover Channel (5 min.)

PRIZES, HONORS, AND COMMENDATIONS

Sigma Xi (National Science)
Tau Beta Pi (National Engineering)
Schlumberger Fellow (Caltech)
Tektronix Fellow (Caltech)
Institute Scholar (Caltech)
Drake Scholar (Caltech)
Maharishi Award for Creativity
Graduation with Honors (Caltech)
Best Scholarly Article, 1988 (Soc. Tech. Comm.)
Getty Fellow, 1989 (J.P. Getty Museum)
Visiting Scholar (North West University, Xian)
Winner, IBM Supercomputing Competition 1989 (IBM)
Mellon Fellow, 1990 (Oberlin Coll.)
Rolex Laureate for Enterprise, 1990 (Montres Rolex)
Antonio Stradivari Medal (Mayor of Cremona, 1991)
Who's Who in America
American Men and Women of Science
Who's Who in Frontiers of Science & Technology
Gold Medal, So. Cal. Coll. Swimming Championships (1958)
Varsity Letter, Swimming (Conference Champions, 1958, Caltech)
US Delegate to ASPAC (Seoul, 1978)
San Diegan To Watch in 1988, San Diego Magazine

NEW 1994

"Honorary Councilor", Shaanxi Cultural Relics Assn. (1993)
George Eastman Memorial Lecturer, 1994 (Optical Soc. of Am.)

LEGAL EXPERIENCE

Expert witness testimony in 17 Superior Court cases in San Diego, San Bernardino, and Santa Barbara Counties.

PATENTS

Inventor or co-inventor in 20 patents held by General Dynamics Corp., Maxwell Laboratories, Inc., and Regents of the University of California in the fields of lasers, laser applications, chemical processing, semiconductor processing, food processing, toxic chemical destruction, space propulsion, and plasma pinch devices.

NEW 1994

United States Patent #5,204,506 (Plasma pinch surface treating apparatus and method of using same), Dated 4/20/93, but received during current year.

INVITED LECTURES (Partial University Listing)

University of California Sys., UCSD, UCLA, UCSB, UCD, UCR
Stanford Un.
Yale Un.
MIT
Harvard Un.
Un. of Illinois (Chicago Campus)
Un. of Texas (Dallas Campus)
Princeton Un.
NYU
Un. of Rochester
Un. of New Mexico
Loma Linda Un.
New Mexico Technical Un.
Coll. of So. Idaho
San Diego State Un.
Jesus Coll., Oxford
Un. of Bristol
Un. of Padova
Un. of Pisa
Un. of Strassbourg
Un. of Bordeaux
Un. of Madrid
Un. of Edinburgh
Rolls-Royce Technical Institute
Un. of Hull
Un. of Southampton
Un. of Colorado
Un. of Georgia
Washington Un.
Un. of Missouri (Rolla)
George Washington Un.
USC
Cal Poly (Pomona)
Marylhurst College

INVITED LECTURES (partial laboratory listing)

Lawrence Livermore National Laboratory
Los Alamos National Laboratory

Sandia National Laboratory (Albuquerque & Livermore)
Brookhaven National Laboratory
Wright-Patterson AFB
Warner-Robbins AFB
TRW
RAND Corp.
GM Tech Center
IBM (Yorktown Heights & Palo Alto)
Varian Associates
Stanford Research Institute
M/A COM Link-A-Bit
Hewlett Packard
San Diego Supercomputer Center
NASA/JPL
Rembrandt Research Project
Canadian Conservation Institute
Culham Laboratory
Clarendon Laboratory
CNR/Venice (Pal. Papadopoli)
Battelle NW Lab.
US Naval Research Lab.

INVITED LECTURES (partial museum listing)

San Diego Fine Arts Museum
Boston Museum of Fine Arts
De Young Museum
Portland Art Museum
Los Angeles County Museum of Art
Natural History Museum (Smithsonian)
Sydney Art Gallery
New Zealand National Museum (Wellington)
Victoria & Albert Museum
Palazzo Strozzi (Florence)
Ashmolean Museum (Oxford)
Fort Vancouver
La Jolla Museum of Modern Art
The Prado

NEW 1994

San Francisco Art Institute

INVITED LECTURES (grade, middle, and high schools)

Approximately 200 demonstration lectures given in California, Oregon, and Washington schools during past 20 years.