# SECOND SYMPOSIUM ON RESEARCH AND DEVELOPMENT AT APL (NOVEMBER 2–3, 1993)

In its more than fifty years of existence, APL has gone through at least three stages of policy on research and development. In the first stage, the single-minded objective was to push a single idea rapidly into full-scale production and use. The wartime proximity fuze, brought into operational use in less than three years, blunted the Kamikaze attacks on ships and defanged the V-1 attacks on London. There was no time then for research or scientific articles, even though the APL staff had a substantial academic research background.

The second phase began with the proposal to develop supersonic guided missiles for the defense of ships. We realized as early as 1944 that a successful solution to this problem would require entry into new technical areas in supersonic aerodynamics, in ramjet propulsion, and in guidance. In parallel with the development effort a closely linked research program was needed to explore little-understood technologies for which knowledge of principles and useful design information did not exist. This resulted in the development of a multifaceted applied research program and the setting up of a number of technical panels with representation from many establishments in the United States to carry out the needed exploratory research.

In addition to this focused effort, a small group of APL employees interested in doing basic research in promising new fields was selected to staff a newly established Research Center. Their task was to immerse themselves in efforts that might later prove useful to ongoing developments or lead to new ventures.

Indeed, in several instances this investment in curiosity-driven research led to spectacular scientific successes and to new programs. Around 1950, in a series of cosmological papers on the consequences of the "Big Bang," researchers predicted the existence of the cosmic background radiation.[1] Within a decade, cosmic background radiation was discovered experimentally; it was measured with exquisite precision last year. The intricacies of chemical reactions and coupled flows inside the thin reaction zone of a flame were disentangled for the first time.[2,3] A substantial effort was put into detecting and characterizing "free radicals," the highly reactive intermediaries in chemical transformations.[4,5]

Using newly available rockets for transporting instruments to high altitudes above the Earth, APL began its long-time involvement with space research.[6] By tracking the first Soviet satellite and inverting the interrogation process, a successful satellite system for precisely locating objects on Earth was developed.[7] This led subsequently to many satellite-based explorations of the planets (including the Earth) and the solar system.[8,9]

The third phase of APL research policy was begun in the 1960s with the start of a number of new large-system developments. Each Technical Department found it desirable, even necessary, to assign some of its talented staff to undertake investigations that were unrelated to current developments. Promising new technical areas were explored. Efforts were directed toward learning and applying new scientific techniques that were expected to be of value in future developments.

The second Symposium on Research and Development at APL (November 2–3, 1993) had the objective of exposing the entire APL technical staff to the many research efforts under way throughout the Laboratory, with the expectation that this would lead to a transfer of knowledge among persons not accustomed to working together and unaware of work going on nearby. It covered recent developments from the Milton S. Eisenhower Research Center. Most of the contributions, however, came from the various Technical Departments. Financial support for these projects was obtained from either the APL Independent Research and Development funds, whose objective is to promote inquiries that may lead to useful developments, or from direct contracts or grants from interested sponsors.

Presentations were grouped into nine topics (Sensors and Sensing; Space Physics and Satellite Technology; Advances in Electrical, Optical, and Structural Materials; Environmental Research; Information Science and Applications; Mathematical and Physical Sciences; Advanced Computing and Information Visualization; Biomedical Research; and Transportation), either as fifteen-minute oral presentations or as half-day poster sessions. Altogether, 160 topics were discussed. The complete program is appended.

WALTER G. BERL

REFERENCES


[1] Alpher, R. A., Bethe, H., and Gamow, G., "The Origin of Chemical Elements," *Phys. Rev.* **73**, 803 (1948).

[2] Fristrom, R. M., and Westenberg, A. A., *Flame Structure*, McGraw-Hill, New York (1965).

[3] Hart, R. W., and McClure, F. T., "Combustion Instability: Acoustic Interactions with a Burning Propellant Surface," *J. Chem. Phys.* **30**, 1501 (1959).

[4] Foner, S. N., and Hudson, R. L., "Mass Spectrometry of the $HO_2$ Free Radical," *J. Chem. Phys.* **36**, 2681 (1962).

[5] Jen, C. K., "Electron Spin Resonance Studies of Trapped Radicals," in *Formation of and Trapping of Free Radicals*, Academic Press (1962).

[6] Van Allen, J., "Exploratory Cosmic Ray Observations at High Altitudes by Means of Rockets," *Sky and Telescope* **7**, 7 (1948).

[7] Black, H. D., "The Transit System 1977: Performance, Plans and Potential," *Philos. Trans. Roy. Soc.* (London) **A294**, 217 (1980).

[8] Beal, R. C., "Space Borne Imaging Radar: Monitoring Ocean Waves," *Science* **208**, 1373 (1980).

[9] Lanzerotti, L. J., and Krimigis, S. M., "Comparative Magnetospheres," *Johns Hopkins APL Tech. Dig.* **7**, 335 (1986).

## SYMPOSIUM PROGRAM

### Tuesday, November 2, 1993

### Opening Remarks (G. L. Smith)

### Session A: Sensors and Sensing (T. J. Kistenmacher, Chair)

*Oral Presentations*

"Ultraviolet Imaging and Spectrographic Imaging (UVISI) Experiment," **J. F. Carbary**, E. H. Darlington, K. Hefferman, T. J. Harris, C. I. Meng, M. J. Mayr, P. J. McEvaddy, and K. Peacock
"A Compact Polarization Image Detector," **K. E. Thompson** and D. M. Rust
"Characterizing Corrosion in Aging Aircraft by Time-Resolved Infrared Radiometry," **J. W. M. Spicer**, R. Osiander, and J. C. Murphy
"Transform Method of Processing Speckle Strain Rate Data," **D. D. Duncan**, S. J. Kirkpatrick, F. F. Mark, and L. W. Hunter
"Conceptual Design of a Fourier Transform Raman Spectrometer Based on Fiber Optic Interferometry," **H. I. Heaton**

*Poster Presentations*

"Optical Design and Performance of the UVISI Spectrographs," **K. Peacock**
"MSX 5-Band Beacon Receiver System," **C. R. Valverde**, R. K. Stilwell, A. A. Russo, J. Daniels, and T. R. McKnight
"Phase Coherent, Optical Magnetometer Using a Solid-State Sensor Element," **J. Miragliotta**
"SAW Device for the Detection of Trichloroethylene Vapor," **W. A. Bryden**, J. J. Suter, and T. J. Kistenmacher
"Biosensor for Automated Biomedicine in Space," **J. Giannini**, C. Kilgus, J. Wagner, P. Shull, and R. Schwartz
"Time-of-Flight Mass Spectrometer," **R. C. Benson**, T. E. Phillips, O. M. Uy, and R. J. Cotter
"Atomic Interferometry," **B. C. Jacobs** and J. D. Franson
"Thermal Imaging of Subsurface Microwave Absorbers in Dielectric Materials," **R. Osiander**, J. W. M. Spicer, and J. C. Murphy
"Design of an Infrared Spatial Light Modulator Using Vanadium Oxide Films," **D. W. Blodgett**, M. J. Elko, and P. J. McNally
"A Tuned Sapphire Resonator for Parametric Displacement Measurement," **L. P. Martin**, J. J. Suter, and M. Rosen
"Compact Bends for $TE_{01}$ Mode Overmoded Waveguide," **J. W. Warren**, W. A. Huting, and J. A. Krill

### Session B: Space Physics and Satellite Technology, I (D. G. Mitchell, Chair)

*Oral Presentations*

"Special Sensor Ultraviolet Spectrographic Imager (SSUSI)," **L. J. Paxton**, C. I. Meng, G. H. Fountain, B. S. Ogorzalek, E. H. Darlington, S. A. Gary, J. O. Goldsten, D. Y. Kusnierkiewicz, S. C. Lee, L. A. Linstrom, J. J. Maynard, K. Peacock, D. F. Persons, and B. E. Smith
"Precision Quartz Oscillators and Their Use in Spacecraft," **J. R. Norton** and J. M. Cloeren
"Atomic Oxygen Erosion of Polymer Matrix Blends," **J. T. Sanders**, R. Fainchtein, and S. D. Wajer
"Design, Fabrication, and Space Qualification of the TOPEX Laser Retroreflector Array," **M. T. Boies**, P. J. Biermann, J. D. Kinnison, J. J. Maynard, and C. E. Willey
"Demodulation of Laser Radar Backscatter Using Instantaneous Frequency Estimation and Time-Frequency Distributions," **A. S. El-Dinary** and T. D. Cole

### Opening Remarks (S. Krimigis)

### Session B: Space Physics and Satellite Technology, II (M. R. Peterson, Chair)

*Oral Presentations*

"Technical Innovations on the Mid-course Space Experiment (MSX) Spacecraft," **C. T. Pardoe**
"Spaceborne Microwave Transmitter Technology," **R. S. Bokulic**, R. F. Sloan, and J. H. Sinsky
"Calibration and Characterization of a Quadrupole Mass Spectrometer for Satellite Contamination Studies," **J. S. Morgan**, M. T. Boies, J. D. Kinnison, R. C. Benson, and O. M. Uy
"Monitoring Cleanliness of Critical Hardware for Contamination Control," **J. H. Cranmer**
"Testing the MSX Spacecraft," **R. K. Huebschman**

## *Poster Presentations*

"Model-Based Image Inversion Using a Parallelized Constrained Optimization Algorithm," **C. J. Chase**, E. C. Roelof, and B. H. Mauk

"The Role of Triton in Neptune's Magnetosphere," **R. B. Decker** and A. F. Cheng

"Magnetic Field Experiment Data Analysis System," **D. Holland**, L. Zanetti, L. Suther, T. Potemra, and B. Anderson

"Freja MFE: A Simple Auroral Zone Detector," **L. Zanetti,** the JHU/APL Freja MFE Team

"Correlation of Magnetic Fluctuations with Auroral Particle Precipitation: Toward a Simple Auroral Zone Detector," **B. Anderson**, P. Bythrow, D. Holland, T. Potemra, J. Sharber, D. J. Winningham, W. Radford, and L. Scheer

"The Flare Genesis Experiment: Studying the Sun from the Stratosphere," **D. M. Rust**, D. A. Lohr, G. A. Murphy, and K. Strohbehn

"Neutral Density Structures in the Lower Thermosphere at High Latitudes," **G. Crowley**, J. Schoendorf, and R. G. Roble

"Production of High Latitude Ionospheric F-Region Patches During the March 1990 Storm," **K. Baker**, G. Crowley, M. Ruohoniemi, and R. A. Greenwald

"Variations in the Intensity Ratios of Different OH Meinel Emissions in the Night Airglow," **J. E. Johnston**, J. H. Yee, G. J. Romick, and G. G. Sivjee

"Special Sensor Ultraviolet Spectrographic Imager (SSUSI)," **D. G. Kupperman**, L. J. Paxton, C. I. Meng, G. H. Fountain, B. S. Ogorzalek, R. J. Cox, D. J. Strickland, and J. S. Evans

"NEAR Laser Rangefinder," **T. D. Cole**

"Universal Particle Detector Experiment," **R. P. Cain**, O. M. Uy, J. C. Lesho, J. P. Oliver, C. G. Simon, and J. E. McKisson

"Monolithic Millimeterwave Integrated Circuits," **C. R. Moore** and J. E. Penn

"Pulsed Laser Heating of Contaminant Films on Metal Substrates," **A. N. Jette** and R. C. Benson

"MSX Attitude System," **T. E. Strikwerda** and J. C. Ray

"Focal Plane Units; Intensified CCD Detectors for UVISI," **S. E. Hawkins, III,** and E. H. Darlington

"A General Purpose MIL-STD-1750A Spacecraft Computer," **L. J. Frank**, C. B. Hersman, S. P. Williams, and R. F. Conde

"A Low Power, Radiation Tolerant Spacecraft Attitude Processor," **S. P. Williams**, L. R. Kennedy, L. J. Frank, and R. T. N. Pham

"A High Speed Real Time Space Qualified Time Division Multiplexed Data Formatter," **P. D. Schwartz**

"Design of a High Reliability X-Band Power GaAs FET Amplifier for the Midcourse Space Experiment (MSX)," **J. H. Sinsky**

"RF Interconnect Reliability in Spaceborne Applications," **E. Nhan**, P. M. Lafferty, R. K. Stilwell, and K. Chao

"Optical Scatter of Contaminate Films at Low Temperatures," **O. M. Uy**, B. E. Wood, and J. C. Lesho

"Design and Implementation of a Data Analysis Center in Support of a Scientific Satellite Experiment," **A. A. Nicholas** and P. Mulhall

"Estimating On-Orbit Communications Link Performance for the MSX Spacecraft," **C. C. DeBoy**

"Outgassing Analyses Performed During Vacuum Bakeout of MSX Components Painted with Chemglaze Z306/9922," **T. E. Phillips**, R. C. Benson, J. S. Dyer, and J. J. Guregian

"A Real Time Cryogenic Film Sensor for the MSX Spirit III IR Telescope," **J. C. Lesho**, O. M. Uy, and B. E. Wood

## Session C: Advances in Electrical, Optical, and Structural Materials (N. A. Blum, Chair)

## *Oral Presentations*

"Multichip Module Performance—Cost Analysis," **H. K. Charles, Jr.**

"Relaxing with Thin Films of Indium Nitride," **T. J. Kistenmacher**, W. A. Bryden, S. A. Ecelberger, and M. E. Hawley

"Scanning Near-Field Optical Microscopy," **R. Fainchtein**

"Electromagnetic Interference (EMI) Shielding of Thin Graphite/Epoxy Composite Plates," **P. D. Wienhold**, J. C. Roberts, and D. L. Kirkbridge

"Electromagnetic Interference (EMI) Shielding of a Thin Nickel Plated Graphite/Epoxy Composite Aperture with Different Gasket Materials," **J. C. Roberts**, P. D. Wienhold, and D. L Kirkbridge

## *Poster Presentations*

"Low Dimensional Organic Conductors and Superconductors," **D. O. Cowan** and R. Fainchtein

"The Growth and Characterization of Silicon Doped GaN," **D. K. Wickenden** and W. A. Bryden

"ECR Plasma Assisted Reactive Magnetron Sputtering," **S. A. Ecelberger**, T. J. Kistenmacher, and W. A. Bryden

"Magnetic Resonance Imaging Investigations of Solid Materials," **B. Collins**, W. Bryden, and T. Poehler

"Pulsed Laser Deposition Processing of Small Single Crystals of $BaTiO_3$ for Photorefractive Applications," **P. R. Schuster**

"Modeling of Vanadium Dioxide Thin Films as High Contrast Optical Modulators in the Infrared," **M. J. Elko**, D. W. Blodgett, H. F. Karimy, and A. Razavi

"Electronics Reliability Assessment," **S. D. Wajer**, K. J. Mach, and B. M. Romenesko

"Failure Analysis of Missile Electronic Components," **P. H. Cohen** and B. M. Romenesko

"Locally Increasing the Through-Thickness Thermal Conductivity in Graphite/Epoxy Laminates," **M. H. Luesse** and J. C. Roberts

"The Effect of Annealing on GaN Nucleation Layers on (0001)-Oriented Sapphire," **A. Estes Wickenden**, D. K. Wickenden, and T. J. Kistenmacher

"Solder Fatigue of Surface Mounted Components," **M. G. Bevan** and H. K. Charles, Jr.

"Characterization of Water Formation Mechanisms on Hydrophobic Radome Materials," **A. A. Nicholas**, J. C. Roberts, P. D. Wienhold, and P. N. Garner

"High Density Storage Combining Charge Transfer Complexes with Scanning Probe Microscopy," **C. A. Valenzuela**, S. Yamaguchi, and R. S. Potember

## Wednesday, November 3, 1993

### Opening Remarks (V. L. Pisacane)

### Session D: Environmental Research (C. H. Sinex, Chair)

*Oral Presentations*

"Oceanographic Mini-Profiling System," **D. G. Ondercin**, J. T. Belky, C. C. Sarabun, and L. J. Frizzell-Makowski
"Radar Scatter from the Ocean Surface: A New Surface Wave-Vector Spectrum," **J. R. Apel**
"Environmental Databases at the Applied Physics Laboratory," **C. J. Myles-Tochko** and L. M. Peco
"Advanced Dedicated Natural Gas Vehicle Development," **J. J. Wozniak**

*Poster Presentations*

"Trace Element Sources and Sinks in the Chesapeake Bay: Concentration in the Water, Organisms and Sediments," **D. W. Edsall**, J. R. Rottier, F. D. Correll, and D. M. Moore
"Synthetic Aperture Radar and Optical Data Fusion Studies of the Chesapeake Region," **D. G. Tilley**
"LIDAR Measurements of Duct Heights in the Sea Surface Boundary Layer," **A. H. Zysnarski** and R. M. Sova
"A Disposable Ship Launched Free-Floating Air/Water Interface Probe," **J. H. Meyer**
"Possible Measurement of Ocean Warming Using Telecommunications Cable," **A. P. Rosenberg**
"UV/Visible Radiation Field Modeling for Photodissociation Rate Evaluation, UV-B Flux Measurements and Analysis, and Nadir Remote Sensing of Ozone and Aerosols," **D. E. Anderson, Jr.**, S. A. Lloyd, J. H. Yee, L. J. Paxton, and R. DeMajistre
"How Would Polar Ozone Depletion Be Affected by a Doubling of Atmospheric Chlorine?" **S. A. Lloyd**
"Environmental Monitoring of Waste Management Dumps by Magnetometer Assisted Current Tomography," **P. Gopalan**, R. Srinivasan, and J. C. Murphy
"Observation from Recent Howard County, MD Earthquakes," **G. S. Gealy**
"Hydrodynamic Green's Functions," **D. P. Vasholz**
"Numerical Solution of Flow Past Arbitrary Complex Geometries by the Mask Method," **H. C. Ku**

### Session E: Information Science and Applications (J. C. Spall, Chair)

*Oral Presentations*

"Imaging System Inspection Software," **J. A Becker**, F. B. Weiskopf, and H. Y. Chiu
"Intelligent Systems for Machinery Diagnosis," **F. B. Weiskopf** and B. Coury
"Automation With Data Uncertainties: The Value of Fuzzy Theory," **T. F. Quaranta**
"Effects of Controls and Displays on the Use of Rule-Based Supervisory Control Systems," **J. R. Gersh** and B. W. Hamill

*Poster Presentations*

"Information Sciences and Technology," **L. W. Hunter**
"Model-Based Fault Detection and Isolation in Complex Systems," **J. L. Maryak**
"A Summary of the Techniques Planned for the Reduction and Management of Data from a High Data Volume Atmospheric Research Mission," **R. DeMajistre, Jr.**
"Semantic Data Modeling for Reverse Engineering to a Conceptual Schema," **R. D. Semmel**
"A Simple Cousin of Genetic Algorithms for Optimizing Likelihood Functions," **J. B. Nelson**
"Model-Free Control of General Discrete-Time Systems," **J. C. Spall** and J. A. Cristion
"Fractal Decompression in Analog VLSI," **F. J. Pineda** and A. Andreou

### Session F: Mathematical and Physical Sciences (M. E. Thomas, Chair)

*Oral Presentations*

"Order and Disorder in Electrochemical Deposits of Copper," **R. Srinivasan** and P. Gopalan
"Qualitatively Nondeterministic Physical Systems," **J. C. Sommerer** and E. Ott

### Opening Remarks (D. J. Williams)

"Variational Trial Fields: Importance of Creeping Waves," **B. J. Stoyanov** and R. A. Farrell
"Advanced Warfare Analysis Techniques," **R. F. Spiegel**

*Poster Presentations*

"Quantum Kinetic Equations Incorporating the Fano Collision Operator: Rarefied Gas Techniques," **L. Monchick**
"Circular High-Power Overmoded Waveguide for Shipboard Use," **W. A. Huting**, J. W. Warren, P. N. Garner, Jr., and J. A. Krill

"Transmission Properties of Window Regions of the $\nu_4$ Band of Methane," **M. E. Thomas** and G. Birnbaum
"Spectroscopic Database for $H_2O$ and $CO_2$ for the 2 micron Region," **R. M. Sova**, M. E. Thomas, L. L. Strow, and D. Tobin
"Electrical Conductivity in Condensed Phases of Ammonia, Water, and Carbon Dioxide," **C. B. Bargeron**, T. E. Phillips, and R. C. Benson
"Ray Path Modeling in a Refractive Atmosphere," **R. I. Joseph** and M. E. Thomas
"Estimation Without High Rate, Highly Accurate Data," **A. E. Love, Jr.**, and B. C. Jacobs
"Amplitude Control for Failed Array Element Compensation," **F. Everly**

## Session G: Advanced Computing and Information Visualization (R. E. Gingras, Chair)

### *Oral Presentations*

"Sensory Engineering: Science and Technology for New and Innovative Uses of Computing," **J. Sadowsky**
"Amalthea: An Architecture for Responsive Computer Systems in Reactive Applications," **L. Zitzman**
"Real-Time 3D Graphics Display of Command and Control," **M. T. Dennehy** and J. F. Ritter
"Distributed Object-Oriented Rendering System," **D. W. Nesbitt** and S. M. Jones

### *Poster Presentations*

"Battle Group Simulation," **W. V. Perez**
"A 32-Bit Microprocessor for Embedded Systems," **M. E. Fraeman**, J. R. Hayes, R. I. Williams, and R. M. Henshaw
"A High Performance Linearized Analog Divider," **D. S. Shelton** and K. E. Thompson
"Blood Flow Simulation and Scientific Visualization," **R. Raul** and W. J. Geckle
"Scientific Visualization on the IBM Personal Computer," **P. E. Biegel** and R. J. Baker
"Making Dynamic Spacecraft Imagery Accessible," **K. J. Heeres**
"The Shape Characterization Abilities of Some Nonlinear Image Filters," **F. Everly**
"Development Tool for a General-Purpose MIL-STD-1750A Flight Computer," **C. B. Hersman** and L. J. Frank
"A Transportable Advanced Computing Facility for Processing and Analyzing Aircraft Instrumentation and Radar Data," **E. B. Alvarez** and M. H. Luesse
"GSOES: A Reusable Ground Support System," **A. Hestermeyer**, L. Linstrom, B. Alvarez, and S. Jaskulek

## Session H: Biomedical Research (J. J. Wozniak, Chair)

### *Oral Presentations*

"Non-Invasive Fetal Heart Monitoring and Waveform Extraction," **J. Cristion**, W. Sternberger, and R. Greenberg
"Instrument of Balance and Grace," **G. Wright**, W. Schneider, C. Curtiss, E. Pirali, and C. Mandra
"The Design of Mechanically Compatible Fasteners for Human Mandible Reconstruction," **J. A. Ecker**, J. C. Roberts, and P. J. Biermann
"Dive Monitoring System Derivation," **W. I. Sternberger** and S. A. Goemmer

### *Poster Presentations*

"Successful User Interfaces," **K. R. Fowler**
"The Establishment of Network Structure by Central Neurons in Culture," **M. Matsuzawa** and R. S. Potember
"A Fiber-Optic Ranging System for Endoscopes," **V. Bhatnagar**, J. C. Poret, J. J. Suter, J. A. Giannini, and W. J. Ravich
"What Light Scattering Can Tell About Ordering of the Collagen Fibrils in Corneal Stroma," **D. E. Freund**, R. L. McCally, and R. A. Farrell
"Noradrenergic Excitation of Cutaneous Nociceptors After Ligation of Spinal Nerve $L_7$ in Monkey," **R. A. Meyer**, D. K. Selig, and J. N. Campbell
"Haze Measurements in Excimer Laser Ablated Corneas," **R. L. McCally**, B. F. Hochheimer, P. J. Connolly, W. Chamon, and D. T. Azar
"Temperature Profiles in Weakly Absorbing, Biological (or Other) Materials During Irradiation," **L. C. Aamodt**
"Developments in Polygraph at APL," **D. E. Olsen**, J. Harris, M. Capps, and G. J. Johnson
"Laser Interferometry for Ear Ossicular Motion Detection," J. L. Suter, J. C. Poret, and D. E. Mattox

## Session I: Transportation (R. S. Potember, Chair)

### *Poster Presentations*

"Development of an Ammonia-Fueled Engine," **H. E. Gilreath**, J. E. Hopkins, and D. E. Clemons
"Detection In-Vehicle of Impaired Driving (DIVID)," **G. Silberman**, D. Olsen, S. Young, and B. Coury
"Adaptive Collision Avoidance for Automated Highway Systems," **T. J. Urban**, A. J. Pine, and H. Y. Chiu
"Automated Crash Notification System," **R. L. Yuan** and R. W. Newman