reasonably expected from the wingless, tail-controlled missile. A stepwise development was planned, therefore, so as to have in the production stage at any given time a missile capable of countering the potential threat for that period.

On the basis of this review, BuOrd early in 1955 redirected the Terrier II program along the lines summarized above, assigning technical direction to APL. Although the program of developing an improved-performance Terrier took on a somewhat different hue as a result of this redirection during early 1955, the test results obtained up to that time in three STV–4 firings contributed substantially to the STV–5 program. Much useful data were obtained. The third STV–4 test confirmed studies that a wingless missile would be both feasible and practical, thereby contributing in large measure to the decision to eliminate wings on all improved-performance Terriers.

Planning started at once on the Advanced Terrier program. A homing-guidance Terrier, to be designated HT–3, was made the ultimate objective of the program, but since development of homing guidance had not progressed as far as that of beam-riding guidance, some doubt existed that missiles employing a homer would be ready for production as early as 1960. It was decided, therefore, to develop the necessary aerodynamics, dynamics, control, and propulsion systems in a beam-rider (BT–3) that could be available by 1960, and then to utilize these developments in a homing missile design when a suitable system of this type was developed. By so doing, maximum use could be made of Terrier BW–1 developments in the areas of guidance, warheads, and fuzes, as well as of the STV–5 series of missiles. The firing of two launching test vehicles and four control test vehicles in this series contributed data that were to prove useful in the advanced program.

### First Guided Missile Heavy Cruiser

The ultimate aim of the years of effort in Terrier development was brought a long step closer to realization on November 1, 1955, when the USS *Boston,* having successfully completed the required preliminary acceptance trials, was recommissioned at the U.S. Naval Base, Philadelphia. Its name was unchanged but it bore a new Navy classification, CAG–1, signifying the first of a new class of ship in the U.S. Navy (and in world history)—"guided missile heavy cruiser."

On January 30, 1956, after several weeks devoted to familiarization with the new weapon system, the *Boston* sailed for Guantanamo to undergo shakedown training. There, early in February, the prescribed training began, which, because of the revolutionary weapon system installed in the ship, was extended beyond the usual six weeks. Several important groups of visitors witnessed the missile firings, spanning a period in which 10 Terriers, in the jargon of Navy torpedomen, flew "hot, straight, and normal" to successful achievement of all objectives.

As of July 1, 1956, the development phase of Terrier I was considered to be complete. Terrier had gone to sea.

# PUBLICATIONS

**The following list is a compilation of recently published books and technical articles written by APL staff members.**

J. O. Artman and J. C. Murphy (APL) and S. Foner (M.I.T.), "Magnetic Anisotropy in Antiferromagnetic $\alpha - (Cr_{1-f}Al_f)_2O_3$," *J. Appl. Phys.,* **36**, Mar. 1965, 986–987.

J. G. Parker and R. W. Swope, "Vibrational Relaxation Times of Oxygen in the Temperature Range 100° – 200°C," *J. Acoust. Soc. Am.,* **37**, Apr. 1965, 718–723.

T. O. Poehler and D. Abraham, "Aluminum—Doped CdSe Thin Film Triodes," *Appl. Phys. Ltrs.,* **6**, April 1, 1965, 125–126.

L. Monchick (APL), A.N.G. Pereira (St. Xavier's College, Goa, India), and E. A. Mason (University of Maryland), "Heat Conductivity of Polyatomic and Polar Gases and Gas Mixtures," *J. Chem. Phys.,* **42**, May 1, 1965, 3241–3246.

V. Uzunoglu, "Feedback: Perils and Potentials in Designing Integrated Circuits," *Electronics,* May 31, 1965, 67–71.

S. D. Bruck, "Thermal Degradation of an Aromatic Polypyromellitimide in Air and Vacuum—III—Pyrolytic Conversion into a Semiconductor," *Polymer* (London), **6**, July 1965, 319–332.

R. P. Rich and A. G. Stone, "Method for Hyphenating at the End of a Printed Line," *Communications of the ACM,* **8**, July 1965, 444–445.

D. J. Williams (APL) and G. D. Mead (NASA), "A Nightside Magnetosphere Configuration as Obtained from Trapped Electrons at 1100 Kilometers," *J. Geophy. Res.,* **70**, July 1, 1965, 3017–3030.

W. G. Berl, "A Brief Review on the Combustion of Boron Hydrides," *Progress in Astronautics and Aeronautics,* **13**, Academic Press, New York, 1964, 311–325.

R. R. Newton, "Orbital Elements from the Doppler Tracking of Four Satellites," *J. Spacecraft and Rockets,* **2**, July-Aug. 1965, 634–636.

D. Abraham and T. O. Poehler, "Heat Flow as a Limiting Factor in Thin-Film Devices," *J. Appl. Phys.,* **36**, June 1965, 2013–2020.

The following five papers were published in *Tenth Symposium (International) on Combustion,* The Combustion Institute, Pittsburgh, Pa., 1965:

W. G. Berl (APL), P. Breisacher (Aerospace Corp.), D. Dembrow (NASA), F. Falk, T. O'Donovan, J. Rice, and V. Sigillito (APL),

## PUBLICATIONS

*(continued)*

"Combustion Characteristics of Monopropylpentaborane Flames";

R. W. Hart and F. T. McClure, "Theory of Acoustic Instability in Solid-Propellant Rocket Combustion";

F. S. Billig, "Supersonic Combustion of Storable Liquid Fuels in Mach 3.0 to 5.0 Air Streams";

A. A. Westenberg and R. M. Fristrom, "H and O Atom Profiles Measured by ESR in $C_2$ Hydrocarbon-$0_2$ Flames";

W. E. Wilson, Jr., "Structure, Kinetics, and Mechanism of a Methane-Oxygen Flame Inhibited with Methyl Bromide."

### BOOKS

R. M. Fristrom and A. A. Westenberg, *Flame Structure* (McGraw-Hill Series in Advanced Chemistry), McGraw-Hill Book Company, New York, 1965.

## ADDRESSES

The listing below comprises the principal recent addresses made by APL staff members to groups and organizations outside the Laboratory.

W. Liben and G. J. Veth, Lecture Series on Microelectronics, *U.S. Naval Postgraduate School,* Monterey, Calif., Mar. 29–Apr. 2, 1965.

P. F. Oberheim, "A Working PERT/Time System," *U.S. Naval Reserve,* College Park, Md., Apr. 1, 1965.

The three papers listed below were presented at the *Third Navy Microelectronics Program Conference,* Monterey, Calif., Apr. 5–7, 1965:

W. Liben, "Progress Report on Application and Development of Thin Films to Surface Launched Missiles";

G. J. Veth, "Microelectronics in Space";

R. A. Freiberg, "Nuclear Transient Effects on Thin Films."

D. Abraham and T. O. Poehler, "The Introduction of Impurity Levels into CdSe Thin Films," *American Physical Society,* Washington, D.C., April 19–22, 1965.

W. H. Guier, "Satellite Navigation Using Integral Doppler Data—The AN/SRN-9 Equipment," *American Geophysical Union,* Washington, D.C., Apr. 19–22, 1965.

F. F. Hiltz, "A Between Pulses Time-Interval Correlator," *Third International Biomedical Sciences Symposium,* Dallas, Apr. 20, 1965.

V. W. Pidgeon, "Bistatic Cross Section of the Sea," *International Scientific Radio Union Spring Meeting,* Washington, D.C., Apr. 20–23, 1965.

G. L. Dugger and R. E. Walker, "A Survey of Current Air-Augmented Rocket Research," *Air Force Office of Scientific Research, Fourth Symposium on Advanced Propulsion,* Palo Alto, Calif., Apr. 26–28, 1965.

R. B. Kershner, "The GEOS Satellite and Its Use in Geodesy," *International Association of Geodesy, Symposium on the Use of Artificial Satellites for Geodesy,* Athens, Greece, Apr. 27–May 1, 1965.

W. Liben, V. Uzunoglu, and G. J. Veth, Lecture Series on Design, Application, and Fabrication of Thin Film and Semiconductor Microelectronic Circuits (8 lectures), *Naval Ordnance Laboratory,* Silver Spring, Md., Apr. 27–May 20, 1965.

E. P. Gray, "Progress Towards Controlled Thermonuclear Fusion," *U.S. Naval Reserve,* Baltimore, Apr. 29, 1965.

G. L. Dugger, "Hypersonic Air-breathing Propulsion," *Princeton University,* Department of Aerospace and Mechanical Sciences, May 6, 1965.

R. E. Fischell and F. F. Mobley, "Orbital Results from Gravity Gradient Stabilized Satellites," *NASA Symposium on Passive Gravity Gradient Stabilization,* Moffett Field, Calif., May 10–11, 1965.

F. W. Schenkel, "Rare Earth Oxide Dielectrics," *I.E.E.E., Fourth Annual Microelectronics Symposium,* St. Louis, May 24–25, 1965.

D. D. Zimmerman, "Evaporated Single Element Metal Film Resistors," *I.E.E.E., Fourth Annual Microelectronics Symposium,* St. Louis, May 24–25, 1965.

F. S. Billig, "Analysis of Supersonic Combustion Experiments with Gaseous Hydrogen Fuel," *Eighteenth Air Force Office of Scientific Research Contractors Meeting,* Cocoa Beach, Fla., June 1–4, 1965.

C. F. Noyes, "Ministick Method for Packaging Integrated Circuit Flat Packs," *National Electronic Packaging and Production Conference,* Long Beach, Calif., June 6, 1965.

Frances Akridge, "Scaling Matrices Prior to Certain Operations," *Association for Computing Machinery,* Baltimore, June 16, 1965.

J. E. Peebles and R. P. Rich, "Manipulator Program," *Association for Computing Machinery,* Baltimore, June 16, 1965.

L. Wilson, "Sublimation Components for Use with or in Place of Electro Explosive Devices," *I.E.E.E., Aerospace Conference,* Houston, June 20–21, 1965.

F. T. McClure, "Combustion Instability of Rockets," *Air Force Office of Scientific Research, Summer Scientific Seminar,* Cloudcroft, N.M., June 23, 1965.

F. F. Hiltz, "Computer Recognition and Analysis of Intracellularly Recorded Events," *N.I.H., National Institutes of Neurological Diseases and Blindness,* Bethesda, Md., June 25, 1965.

L. Monchick, "Sound Dispersion in Diatomic Gases at High Frequencies," *British Chemical Society, Symposium on Molecular Relaxation Processes,* University College of Wales, Aberystwyth, Wales, July 7, 1965.

## ADDRESSES *(continued)*

F. F. Mobley, "Attitude Control System for the Atmosphere Explorer–B Satellite," *A.I.A.A., Second Annual Conference,* San Francisco, July 26–29, 1965.

B. E. Tossman, "Eddy Current Ball-in-Ball Damper," *A.I.A.A., Second Annual Conference,* San Francisco, July 26–29, 1965

D. J. Williams, "Outer Zone Electrons," *Advanced Study Institute, "Radiation Trapped in the Earth's Magnetic Field,"* Bergen, Norway, Aug. 16–Sept. 3, 1965.

## PATENTS

T. Wyatt — *System for Extending the Range of a Search Radar*, Patent No. 3,176,288.

F. H. Swaim — *Intermittently-Lapped Extendable Boom*, Patent No. 3,177,987.

J. V. Smith and G. W. Luke — *Microwave System Having Diodes Situated in the Waveguide Channels to Control Coupling Between Common and Branch Channels*, Patent No. 3,178,659.

J. H. Kuck — *Opto-Electronic Panel Data Processor*, Patent No. 3,178,708.

R. T. Ellis — *High Energy Damping Spring*, Patent No. 3,179,399.

J. F. Gulick, T. D. Jacot, H. H. Knapp, and H. H. Nall — *Interferometer Homing System*, Patent No. 3,181,813.

E. A. Bunt and H. L. Olsen — *Arc Plasma Generator*, Patent No. 3,182,176.

J. P. Randolph, H. B. Riblet, and J. W. Hamblen — *Missile In Flight Indicator*, Patent No. 3,182,930.

S. N. Samburoff— *Impact Switch for Missile Warhead,* Patent No. 3,188,960.

W. H. Guier—*Method of Navigation,* Patent No. 3,191,176.

## HONORS AND APPOINTMENTS

*W. H. Avery,* Supervisor of the Aeronautics Division, has been appointed to the Scramjet Panel, National Academy of Sciences, which is an Advisory Committee for the U.S. Air Force Systems Command.

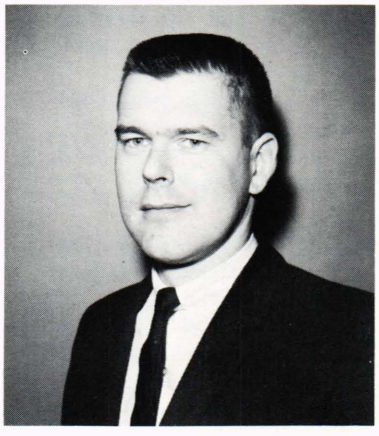
*F. T. McClure,* Chairman of the Research Center, has been named to receive a John Scott Award for 1965. This award, given annually to "ingenious men and women who make inventions," will be presented to Dr. McClure for his invention of the satellite doppler navigation system.

*V. M. Root,* Supervisor of the Technical Reports Group, has recently been named a Fellow in the National Association of Technical Editors and Publishers.

## WITH THE AUTHORS

*W. H. Avery,* author of "Status and Future Trends in High Speed Chemical Propulsion," was a co-author of "Thermal Insulation for Hypersonic Vehicles" in the July-Aug. 1962 *Digest*. Dr. Avery received his Ph.D. degree in physical chemistry from Harvard University in 1937 and came to APL in 1947 as a Group Supervisor in the field of guided missile launching rocket development. He was later named Supervisor of the Launching and Propulsion Group and served in that capacity until being appointed in 1961 as Supervisor of the Aeronautics Division. Dr. Avery is a member of the Applied Physics Laboratory's Executive Committee and Technical Policy Board, and has been Chairman of the Bumblebee Propulsion Panel since 1951. He has served on numerous special panels and advisory committees of the Department of Defense, the National Academy of Sciences, and the National Aeronautics and Space Administration. He is a member of the American Chemical Society and the American Physical Society, is a Fellow of the American Institute of Aeronautics and Astronautics, and is a Director of The Combustion Institute.

*D. J. Williams,* author of "Studies of the Earth's Outer Radiation Zone," was the author of "The Earth's Albedo Neutron Flux" in the



Mar.–Apr. 1964 *Digest*. Dr. Williams, who received his Ph.D. degree in physics from Yale University in 1961, is a member of the staff of the Physics Project of the Space Physics and Instrumentation Group in the Space Development Division. He is serving on the Editorial Board of the *APL Technical Digest* and is a member of the American Physics Society and the American Geophysical Union.