

## GUEST EDITORS' INTRODUCTIONS

ANNIVERSARIES: 50, 30, 10

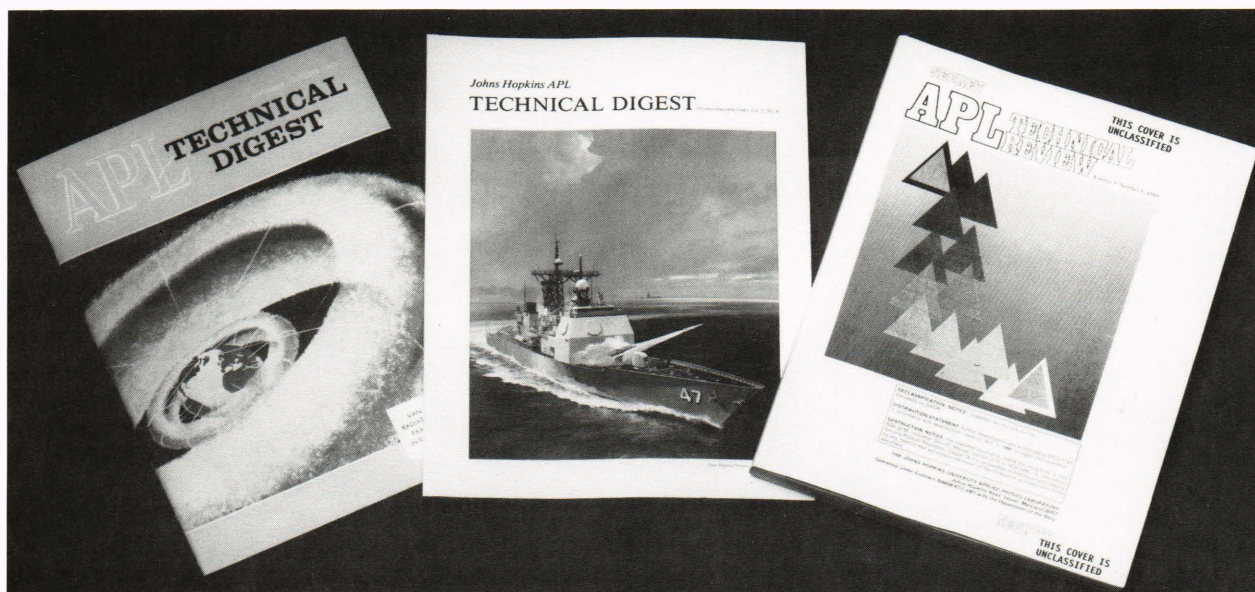
The Applied Physics Laboratory will soon observe the fiftieth anniversary of its founding in 1942. Actually, two years earlier, even before Pearl Harbor plunged the United States into World War II, Merle A. Tuve and a small group of collaborators put aside their scientific research careers in favor of the development of the proximity fuze. Placed in action after three years of intensive effort, this device played an important role in the outcome of the war. It was the first of many APL contributions to the defense of ships from air attacks and to other security-related problems. It left a legacy that is visible even today.

Thirty years ago, Ralph E. Gibson proposed<sup>1</sup> that the documentation of these contributions could be improved by establishing an "in-house" publication that would serve both as corporate memory and as an archival record of novel ideas, new devices and systems, and research results. Despite restrictions imposed by security considerations (now overcome by a new classified journal, the *APL Technical Review*), the "old" *APL Technical Digest* and, during the past ten years, the enlarged "new" *Johns Hopkins APL Technical Digest* have published a wide variety of articles on many subjects.

Most of the topics were supported by the Department of Defense, by civilian agencies such as NASA, or by APL Independent Research and Development funds. Some of the work was done in collaboration with colleagues at The Johns Hopkins University School of Medicine and the Homewood campus, and with hundreds of collaborators around the globe.

This issue of the "new" *Technical Digest* is designated as the Tenth Anniversary Issue, as it looks back at the more than 500 articles written since 1980 by nearly 600 authors. Twenty-six topics, representing a broad diversity of subject matter and disciplines, were selected for updating, giving a bird's-eye view of the research and development effort currently under way at APL. Several of the contributions are on the cutting edge of research. Others deal with large-scale system development or component designs.

The articles are grouped loosely into seven sections. Readers interested in more details about the scope of the APL effort should scan the bibliographies following each section. They give a glimpse of topics either not mentioned at all or treated only sparsely in this issue. The cited articles deal with a multitude of APL satellite programs, spaceborne instruments, and experiments; document oceanographic explorations on scales varying from centimeters to thousands of kilometers in most of the Earth's oceans; and deal with supersonic and hypersonic missiles, ramjet and rocket power plants, and the structures and materials from which they are fashioned. They also cover the propagation of electromagnetic and acoustic signals in the atmosphere and under water; explore the magnetospheres of the Earth and other planets; discuss novel energy resources and topics in hazard mitigation; review an array of biomedical and biophysical devices; report on a multitude of physical and chemical investigations; and, last but not least, review the influence of twenty-two of the most widely cited APL journal publications.





Most of the articles have a technical slant, although some deal with management issues,<sup>2</sup> personal and historical recollections, and reflections on technical creativity,<sup>3</sup> or with the relationship of APL with The Johns Hopkins University,<sup>4</sup> in which it is embedded, and with the country that it serves. Taken together, they provide a view of continuity and change that began with the development of a novel fuze triggering a small explosive warhead and that has led to many startling developments and discoveries on, below, and above the Earth's surface.

## REFERENCES

- <sup>1</sup> . . . The diversity of the Laboratory's activities and of the vehicles for their publication requires a synthesizing agent to preserve the overall pattern of its activities, not only for the benefit of its own staff, but also for the benefit of scientific and engineering colleagues throughout the world. It is the purpose of the *Technical Digest* to accomplish this synthesis by presenting in one periodical results from many fields, expressed in terms that excite the interest of those who are not specialists in the particular field and at the same time invite the critical examination of those who are . . . (*APL Technical Digest* 1, 1 [1961])
- <sup>2</sup> Gibson, R. E., "Some Thoughts on Planning—The Handmaid of Direction," *Johns Hopkins APL Technical Digest* 4, 45-55 (1983).
- <sup>3</sup> Kershner, R. B., "The Cost/Benefit Monster," *Johns Hopkins APL Technical Digest* 2, 207-208 (1981).
- <sup>4</sup> Muller, S., "Research Universities and Industrial Innovation in America," *Johns Hopkins APL Technical Digest* 5, 370-380 (1984).

WALTER G. BERL

## INTO THE NEW DECADE

Forty issues of the *Johns Hopkins APL Technical Digest*, published over the past ten years, have reported on various APL programs conducted for the U.S. Navy, other defense components, civilian agencies such as NASA, and academic institutions. These activities have often resulted in technical innovation leading, in turn, to new program areas to support both the original and new sponsors. For example, decades of work on naval surface to air missiles and on general missile guidance principles were the basis for the conception and implementation of the Delta 180 program for the Strategic Defense Initiative Organization. Collaborative efforts between APL and The Johns Hopkins School of Medicine and other institutions have resulted in breakthroughs in science and medical technology. It is noteworthy that the Laboratory's Independent Research and Development (IR&D) program, which focuses on areas in both basic and applied research, has been a primary source of new technologies to support the missions of the Laboratory and its sponsors.

The primary function of the *Digest* is to serve as a vehicle for communicating new ideas, basic research, and the application of research to the program sponsors and technical community. The *Digest* also functions as an archival journal, preserving APL's accomplishments as well as "good tries" that did not go all the way because funds or technical facilities were limited. An Anniversary Issue commemorating ten years of publication appeared to be an excellent way to update work previously reported in the *Digest*, thereby providing some items of

relatively recent APL history to our newer employees, program sponsors, and general readership, and to document work not yet otherwise reported. The twenty-six articles in this issue were selected to represent a few of the programs currently active at APL. They have been grouped loosely into seven readily identifiable areas of activity: fleet defense, oceanography, space science and technology, computer design and applications, microelectronics, basic science, and biomedical research. The separations between the areas of activity that the articles describe are not always clearly defined, so an article may represent more than one technological area.

## Fleet Defense

A long-time major program area for APL, fleet defense has been covered throughout the previous decade in a variety of articles published as "Special Topics," as "R & D Updates," and in "Theme" issues. George Emch's overview of fleet air defense discusses Aegis and the New Threat Upgrade weapon systems, advanced displays, and missile guidance. James Miller and co-workers update the status of battle group gridlock, a system allowing two or more ships at sea to share a common coordinate frame to merge and use data from their individual sensors. Robert Thurber reports on data fusion, the merging of the output data of multiple sensors for range control. Bradley Boone and associates report on two IR&D-funded projects in which they are performing state-of-the-art research on missile guidance and navigation.

## Oceanography

A wide variety of oceanography papers have been published during the past ten years in the *Digest*; the theme of the preceding issue (Vol. 10, No. 4) was "APL Ocean Sciences." A survey of past and present APL projects by Jack Calman describes the methods used and observations obtained of the surface of the ocean and its interior. An excellent example of APL's success with *in situ* instrumentation is found in Charles Sarabun and Daniel Dubbel's summary of high-resolution data collection in the Chesapeake Bay; their work is supported almost entirely by APL's IR&D program. An area of considerable interest for naval application is remote sensing of the ocean surface. Robert Beal describes the measurement of ocean waves by using a synthetic aperture radar (SAR); he also discusses the SAR processor that APL is building for the shuttle flight (1993) of the Spaceborne Imaging Radar, as part of NASA's program in Earth science and application.

## Space Science and Technology

The five articles in this section portray some of the Laboratory's contributions to space research and technology, including the development of instrumentation as well as mission support to major sponsors such as the Navy and NASA. Documented for the first time in the *Digest* is APL's involvement in the strategic defense initiative, a major program that began in the 1980s via the Delta 180 program. Barry Mauk and associates discuss the Voyager Program at APL, emphasizing the most



recent results achieved during Voyager's pass over Neptune. Edmond Roelof and Donald Williams discuss a new modeling technique for measuring neutral particles; their experiment may be flown on the NASA Earth Orbiting System at the end of the decade. David Rust and associates approach space physics from the ground in their article on solar research. The initial findings of the experiment they describe resulted in DoD program sponsorship in the form of a three-year University research initiative grant. An overview of the Delta program by John Dassoulas and Michael Griffin describes APL's contributions to the strategic defense initiative, from program inception to the present. Lastly, Robert Danchick and L. Lee Pryor describe APL's contributions to past and continuing technical support of the Navy Navigation Satellite System (Transit).

### Computer Design and Application

The *Digest* recently devoted a theme issue (Vol. 10, No. 3) to advanced computing at APL. Representing computing in this Anniversary Issue are three specific efforts that span the spectrum of computer design and applications from systems to research. Hugh South discusses the detection of signals with passive (listening) sonar and the development of high-speed sonar-processing hardware in APL's Strategic Systems Department. Bruce Blum updates the use of clinical information systems at Johns Hopkins Hospital; he provides an example of the application of software to the care of patients and the management of hospital operations. Michael Roth journeys to the frontiers of research in his article on neural network technology and its application to automatic target recognition.

### Microelectronics

The articles on microelectronics sample one of the many areas of engineering at APL. During the past ten years, the Microelectronics Group has made major advances in organizing and upgrading Laboratory facilities in response to the rapidly changing technological requirements of APL programs and projects. These adaptations allow APL to offer strong, modern support resources for digital, analog, and microwave electronic systems. Harry Charles and associates give an overview of microelectronics, beginning with the formation of the Microelectronics Group, and discuss the effort APL plans to devote to microelectronics in the 1990s. A second article, by Harry Charles and co-workers, updates the development, characterization, and application of new materials used in microelectronic components and also discusses the thermal management of high-power dissipation in integrated circuits. In yet another article, Harry Charles and Guy Clatterbaugh discuss the complex technical considerations involved in electronic packaging technology. Joseph Abita reviews APL's activity in microwave electronics technology, work initially funded by the IR&D program.

### Basic Science

Recognizing the importance of identifying, developing, and applying advanced materials technology to sup-

port a variety of endeavors (e.g., the National Aerospace Plane and advanced missiles) has resulted in several areas of material research and development. This section reviews the development and characterization of advanced materials in areas of research supported wholly or in part by the IR&D program. Kishin Moorjani and associates, discussing high-temperature superconductors, highlight the progress achieved to date in developing processing and measurement techniques and the results of measurements of thin and thick high-temperature superconducting films. Lawrence Hunter provides a background for high-temperature materials chemistry, updates the progress made in composite applications, and introduces one of APL's newest thrust areas, advanced materials technology insertion. Jane Maclachlan Spicer, Leonard Aamodt, and John Murphy update their research on time-resolved infrared radiometry techniques for the nondestructive analysis of protective coatings. Brent Bergeron, Norman Jette, and Berry Nall review low-energy electron scattering, a technique used to study crystal structure.

### Biomedical Research

The biomedical articles represent only a small portion of the ongoing projects performed in collaboration with the Johns Hopkins Medical Institutions. It is interesting to note one commonality: the use of electromagnetic radiation is a factor in each project. John Parker describes the use of a laser to excite dye molecules, which subsequently transfer the energy to oxygen. This process creates the singlet oxygen state, which is believed to be the active agent in treating certain types of cancer. Richard Farrell, David Freund, and Russell McCally, in their article on corneal structure, briefly review a general theory developed to predict light scattering on the basis of observations of fibrillar structure by electron microscopy; they then present experimental verification that those fibrils are the primary scattering elements. Robert Flower uses electromagnetic excitation of injected fluorescent dye to monitor blood flow in his updated study of how the choroid vasculature provides oxygen nourishment to the retina.

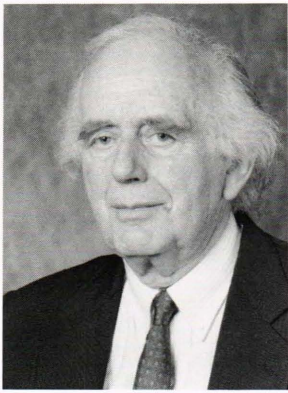
### To the Future

As we enter an exciting new decade, the last before the twenty-first century, it is reasonable to speculate that some programs of the past decade not currently active, such as power-plant siting, renewable energy sources, transportation, and environmental protection, may become of renewed interest to APL. Political changes in Eastern Europe and the Soviet Union affecting relations between the East and West could also change the scope and nature of the defense-related work of APL, creating new, but no less exciting, challenges in science and technology. This new decade may bring about some changes in the technical direction of articles published in the *Digest*, but the need to communicate and record will remain.

TERRY L. PFENNING



## THE AUTHORS



WALTER G. BERL joined APL in 1945 and is a member of the Principal Professional Staff. In 1937, he received a B.S. degree in chemical engineering from the Carnegie Institute of Technology, followed by an M.S. from Harvard in 1939 and a Ph.D. from Carnegie in 1941 in physical chemistry. After a distinguished career in combustion and fire research and their applications to practice, he was Editor of the *Johns Hopkins APL Technical Digest* (1980-87) and the *APL Technical Review* (1988-89). A member of numerous professional societies and advisory boards, he is the author of

more than 40 technical papers. He is currently a William F. Parsons Professor at the Paul H. Nitze School of Advanced International Studies of The Johns Hopkins University, where he is involved with the introduction of an expanded curriculum in science and technology in international affairs.



TERRY L. PFENNING joined APL in 1986 as a member of the support staff in the Director's Office. A Senior Secretary supporting the Editor-in-Chief of the *APL Technical Review*, she has been (for the past 24 months) a "cadet-in-training" as an Assistant to the Editor. She initiated undergraduate work at Cochise College in Sierra Vista, Arizona, and is currently attending Howard Community College in Columbia, Maryland, with the goal of obtaining a bachelor's degree in journalism. Active in civil affairs, Terry helped establish the Cochise County Adoption Support Group in

Arizona. She is a former elected member of the Board of Directors and a former appointed officer of The Cedar Acres Homeowner Association. Currently, Terry is Secretary of the Maryland Microscopical Society and a member of The Johns Hopkins University Women's Forum. In addition to the above, Ms. Pfenning has a full-time job raising a family and maintaining a household.