

TITLE INDEX WITH ABSTRACTS of PAPERS (1961–1971)

A

Airbreathing Mach 7 Transport, *G. J. Pietrangeli*, 1, 2, November–December 1961, pp. 2–9.

Design of a Mach 7 transport for flights between far-distant cities requires the solution of many major interrelated problems in aerodynamics, propulsion, operational limitations, and performance. One dual-propulsion system studied makes use of turbojets and ramjets.

Albedo Neutron Conference Report, *D. J. Williams*, 3, 2, November–December 1963, pp. 25–26.

Amorphous Semiconductors, *Charles Feldman and Kishin Moorjani*, 7, 3, January–February 1968, pp. 2–9.

This article discusses the optical and electrical properties of amorphous semiconductors and their possible applications in electronic devices.

APL and The VT Fuze, *Staff*, 2, 1, September–October 1962, pp. 18–22.

The inevitable movement of the United States toward entry into World War II gave great urgency to the search for new weapons to combat massive enemy air threats. The proximity fuze, a mechanism for detonating an explosive shell within kill range of an aircraft, had been long envisioned as such a weapon but had also been considered impossible to attain. Nevertheless, the project was successfully launched in mid-August 1940 to investigate three possible mechanisms for this type of fuze: photoelectric, acoustic, and radio. After a period of research and development, quantity production was started in the fall of 1942 on a radio-type fuze that proved to be a major scientific achievement that contributed greatly toward winning the war.

APL Propulsion Research Laboratory, *H. L. Olsen and H. F. Kirk, Jr.*, 1, 1, September–October 1961, pp. 13–15.

The new Propulsion Research Laboratory, constructed to provide experimental testing capabilities for advanced airbreathing propulsion systems, including hypersonic ramjets, is described. Flexibility and versatility for current and future propulsion research programs are built-in features of the PRL.

APL Resistance Welder and its Role in Satellite Reliability, *R. C. Evans*, 5, 1, September–October 1965, pp. 2–7.

The requirements of reliability prompted a study of the relationship between the metallurgy of a weld and the characteristics of the electrical pulse that produced it. This resulted in the development of a

resistance welder of superior reproducibility, optimum pulse shape (current versus time) for each pair of materials welded, and the discovery of characteristic resistance-versus-time patterns that can be used to verify that the welds are of high quality.

Application of Digital Filtering, *R. P. Rich and H. Shaw, Jr.*, 4, 3, January–February 1965, pp. 13–18.

An optimal adaptive digital filter based on an exact relationship between homogeneous differential and difference equations locates and then tracks the "instantaneous frequency" of a signal in noise. An example of the performance of a programmed model of this filter is given.

Applications of a Sensitive Television System, *R. C. Beal*, 7, 5, May–June 1968, pp. 14–19.

Photoemissive image devices are very useful for low-light applications because of their inherent high quantum efficiency. This paper describes some of the characteristics of a sensitive television camera utilizing the recently developed Secondary Electron Conduction tube. The camera is being considered for a variety of low-light applications, including night-time meteorology and precise attitude measurement from earth satellites.

Applications of ESR to the Chemical Kinetics of Gases, *A. A. Westenberg*, 6, 1, September–October 1966, pp. 9–15.

Great advances are being made in the experimental study of gas phase kinetics, and the exploitation of electron spin resonance (ESR) spectroscopy in this field has proved fruitful. These advances are the result of solutions to several problems that have hindered the classical methods of studying kinetics. This article briefly reviews some of the shortcomings of the classical methods in studying kinetics, and describes some of the results of the ESR experimental technique and considers some of its future applications.

Appreciation, *R. E. Gibson*, 5, 5, May–June 1966, p. 2.

The Director of the Applied Physics Laboratory pays tribute to Mr. P. Stewart Macaulay upon his retirement from The Johns Hopkins University for his outstanding services and contributions to the university.

Artificial Radiation Belt, *G. F. Pieper*, 2, 2, November–December 1962, pp. 3–7.

The high-altitude nuclear explosion over the Pacific on July 9, 1962, created an artificial radiation belt of considerable intensity. The characteristics of this belt,

as determined by particle detectors on several satellites, are presented.

“ . . . As My Eye is Part of Me,” *G. H. Mowbray and J. F. Bird*, 9, 2, November–December 1969, pp. 9–16.

The ability of the eye to resolve time-varying inputs has been a fruitful area of research in the past. Analysis of some recent experiments on a visual transient response demonstrates continued usefulness of the approach both from the standpoint of theory and applications in the clinic.

Attitude Control and Determination Systems of the SAS-A Satellite, *F. F. Mobley, B. E. Tossman, G. H. Fountain*, 10, 4/5, March–June 1971, pp. 24–34.

A high-speed wheel inside the satellite provides the basic attitude stability for SAS-A. An ultrasensitive nutation damper that uses a copper vane pendulum on a taut-band suspension dissipates energy by eddy currents. The spin axis can be oriented in any position in space as required for the X-ray experiment by ground command. Magnetic torquing is also used to maintain the satellite spin rate at 1/12 rpm.

Auroral Oval, *A. J. Zmuda*, 6, 2, November–December 1966, pp. 2–8.

Magnetic data obtained with the Navy-APL satellite 1963 38C are contributing basic information on some of the auroral oval properties. It is anticipated that these data, for 1100 km altitude, will play an important role in connecting visible auroras and their related ionosphere disturbances with phenomena occurring at altitudes considerably above 1100 km.

Author Index (Vols. 1 through 6), *Staff*, 6, 6, July–August 1967, pp. 3–6.

Author Index (Vols. 1 through 8), *Staff*, 8, 6, July–August 1969, pp. 11–15.

Author Index (Vols. 1 through 9), *Staff*, 9, 6, July–August 1970, pp. 11–16.

Author Index (Vols. 1 through 10), *Staff*, 10, 6, July–August 1971, pp. 18–23.

Availability Model for Shipboard Equipment, *R. J. Hunt*, 2, 5, May–June 1963, pp. 9–16.

Quantitative evaluation of the usefulness and effectiveness of fleet shipboard guided-missile defense systems is essential for assessment of present and future fleet defense capability. The measure discussed, called equipment availability, is the average probability that an equipment will perform in a specified manner at some random point in time. Such variable parameters as equipment failure, repair time, practical operating conditions, and logistics are taken into account.

B

Beam-Plasma Interactions, *J. R. Apel, E. P. Gray, and A. M. Stone*, 3, 5, May–June 1964, pp. 2–11.

Experiments are being carried out to explore the interactions between a plasma and an electron beam.

The plasma can be excited into several modes of oscillation, some of which grow in amplitude at the expense of the beam energy. The theory is developed in terms of the dispersion relationship, the dependence of wavelength on frequency. Calculations elucidate the coupling between the various simple modes. Such studies are helpful in understanding similar processes occurring in nature and in man-made devices.

C

Camera for Recording the Dynamic Blood Circulation of the Eye, *B. F. Hochheimer*, 9, 2, November–December 1969, pp. 17–23.

A camera has been designed for recording the rapid changes that occur in the blood vessels of the retina in fluorescence angiography. The initial investigations, the design considerations, and a prototype camera are discussed.

Chemical Milling of Space Flight Hardware, *R. E. Hicks*, 6, 4, March–April 1967, pp. 11–16.

As more advanced equipment is developed and more knowledge gained, chemical milling is becoming a specialized metalworking process. With the increasing demands for special hardware in satellites and other space applications, designers have found chemical milling a satisfactory aid in meeting these demands.

Combustion Instability in Solid Rockets, *R. W. Hart*, 1, 6, July–August 1962, pp. 8–18.

Rocket motors sometimes break into acoustic oscillations of such amplitude that devastating consequences to the performance and integrity of the motor result. Theoretical studies of the mechanics by which the energy of burning propellants is converted to high-amplitude sound have been made. Analytical criteria for stability have been determined that impose certain restrictions on the properties of propellant and motor configuration.

Computer-Aided Layout of Ministick Artwork, *R. C. Moore*, 6, 3, January–February 1967, pp. 9–16.

A computer program developed to aid in the preparation of artwork for ministick multilayer printed circuit boards is described. It shortens the time previously required for manual layout of artwork and makes practical multiple versions of the same circuit layout in order to compare different packaging designs.

Computer Pantomimes, *W. H. Huggins*, 5, 5, May–June 1966, pp. 11–17.

This article examines many facets of computerized film making, and discusses a technique for conveying abstract ideas without using traditional words and mathematical symbols. Several interesting experiments are also discussed.

Constant-K Lenses, *T. C. Cheston, E. J. Luoma*, 2, 4, March–April 1963, pp. 8–11.

The Constant-K lens is a microwave lens antenna formed of a homogeneous dielectric sphere and capable of generating beams in any direction. Its theory of operation, its limitations, and some manufacturing problems are discussed.

Cornucopia in Space, *C. J. Swet*, 3, 1, September–October 1963, pp. 13–18.

Cornucopia, a unique concept developed at APL for extending the utility of storable rocket bipropellants to include life support and other essential services in the space environment, is described in this paper.

Correlator of Time Intervals between Pulses, *Staff*, 5, 1, September–October 1965, pp. 14–16.

A small, special-purpose device designed and built at APL, and known as a correlator, will supply the user with a time-interval histogram, time interval autocorrelation, and time interval crosscorrelation for analysis of neuronal data.

Coupling that Went into Space, *Staff*, 5, 3, January–February 1966, pp. 16–17.

A coupling that permits unrestricted flow with high reliability is described. Developed at APL, it was first used on the Gemini-4 flight.

Criteria for Conically-Scanned Tracking Antennas, *T. C. Cheston*, 1, 5, May–June 1962, pp. 12–18.

Criteria for radiation patterns, cross-over gain, and modulation sensitivity are analyzed for conical-scan-type tracking antennas using amplitude or phase-comparison methods. It is shown that the radiation patterns of interest are their RF vector sum and difference, and a method of measuring these patterns is suggested.

Cyclotron Resonance in Solid-State Plasma, *T. O. Poehler and J. R. Apel*, 9, 5 May–June 1970, pp. 2–12.

Electrons and holes in a semiconductor form a solid-state plasma having many unusual features. When cooled to low temperatures and placed in a large magnetic field, such a plasma interacts with far-infrared laser radiation and with ionized impurities in a distinctly quantum-mechanical fashion.

D

Damping Spring for Gravity-Stabilized Satellites, *Staff*, 2, 2, November–December 1962, pp. 20–21.

Many experimental and practical applications of satellites are best achieved if these bodies can be vertically stabilized. A method called gravity attitude stabilization was developed at APL and is discussed here. Basically, it incorporates a boom, attached to the satellite, and a damping spring extending from it with a weight attached to its outer extremity.

Decennial Index (Vols. 1 through 10), *Staff*, 10, 6, July–August 1971, pp. 3–36.

This issue comprises a title index with abstracts of papers, an author index, and a subject index.

Design and Performance of Hypersonic Gun Tunnels, *R. A. Makofski and R. W. Henderson*, 6, 3, January–February 1967, pp. 2–8.

The performance of a hypersonic gun tunnel designed to operate at driving gas pressures up to 1000 atm is presented. An evacuated acceleration tube is shown to increase significantly the enthalpy of the gas. Mach 10 flight at 87,000 feet can also be simulated in the tunnel. With a contoured nozzle designed for Mach 10 flow attached to a gun tunnel operating at a pressure of 1600 atm and a temperature of 3400°K, the flow in the test region is found to be vibrationally frozen.

Design and Performance of the DODGE Cameras, *R. C. Beal*, 6, 5, May–June 1967, pp. 9–14.

The characteristics of the Vidicon cameras used in the DODGE satellite and the electronic system for information processing are presented. Considerations that affect the electronic and mechanical design philosophy are emphasized. A discussion of results obtained on a test monitor facility is given.

Design and Use of a Digital Rallye Computer, *R. C. Rand*, 8, 2, November–December 1968, pp. 11–17.

A simple and inexpensive computer that is suitable for use in "rallye" contests has been designed, constructed, and tested.

Design Method for Optimizing Insulated Structures for Hypersonic Vehicles, *R. M. Rivello*, 4, 5, May–June 1965, pp. 11–16.

A preliminary design procedure for optimizing insulated structures of hypersonic flight vehicles is described. It is useful for selecting and sizing both insulating and structural materials to minimize weight or volume.

Design of an Ultrastable Oscillator for Satellites, *J. B. Oakes, W. J. Billerbeck, K. F. Read*, 2, 1, September–October 1962, pp. 10–14.

A normal by-product of scientific investigation is the continual refinement of the measuring instruments involved. The Navy's navigational satellite system under development at APL is a fairly important case in point. The accuracy of a position location is highly dependent on the frequency stability that the oscillator in the satellite exhibits.

Development of a Myoelectrically-Controlled Prosthesis, *Staff*, 8, 1, September–October 1968, pp. 17–18.

An electrically powered artificial hand and closed-loop control system has been designed and fabricated at APL. The system comprises a servo-operated hand, signal acquisition electrodes, signal amplifiers, a servo amplifier, power control circuits, and a battery pack power supply.

Development of Infrared Spectrometer for Rocket Gas Analysis, *H. J. Unger*, 1, 4, March–April 1962, pp. 15–18.

Carefully documented research of exhaust gases of rockets is being done at APL by infrared spectroscopic analysis of the composition and temperature of gases flowing from a solid-propellant rocket. A specially modified spectrometer and recording equipment, ruggedly constructed and mounted to maintain the requisite optical alignment, are used for testing under severe environmental conditions.

Digital Pulse Compression Radar Receiver, *S. A. Taylor and J. L. MacArthur*, 6, 4, March–April 1967, pp. 2–10.

A method of pulse compression using binary 0°–180° phase modulation waveforms with pseudo-random character has features which the advent of high-speed, low-cost microcircuits has made possible. Some general properties of the modulating waveform and results from a hardware implementation are discussed in this article.

Distinguished Public Service Medal Citation, *Staff*, 8, 6, July–August 1969, p. 3.

This note publishes a facsimile of the citation accompanying the gold medal award made to Dr. Gibson by Dr. Frosch, Assistant Secretary of the Navy for Research and Development, on July 9, 1969. Other outstanding awards received by Dr. Gibson are also listed.

DODGE Television System, *T. Thompson*, 6, 5, May–June 1967, pp. 2–8.

The DODGE television system was designed to evaluate the performance of the gravity-gradient stabilization system on the DODGE satellite. The system geometry and measurement requirements leading to its design are discussed, limits of measurement are presented, and the system operation is described.

Domain of Polymeric Materials, *S. D. Bruck*, 3, 2, November–December 1963, pp. 2–12.

Some important areas of polymer research are reviewed, and the study of the thermal stability of a new, experimental dielectric material at APL is described. By means of thermogravimetry, thermal degradation profiles in air and vacuum were obtained, and from these, reaction rates and activation energies were calculated.

Dr. R. E. Gibson Retires, *Staff*, 8, 6, July–August 1969, p. 2.

This note announces the retirement of Dr. R. E. Gibson as Director of the Applied Physics Laboratory on July 1, 1969. A brief biographical sketch and photograph of Dr. Gibson are included.

Dynamic Phase-Difference Measurement System, *E. E. Westerfield*, 3, 2, November–December 1963, pp. 13–16.

A system developed at APL uses an artificial satellite to provide determination of the azimuth of a line from north. A single-axis interferometer system is used in conjunction with a specially designed receiver

that employs some unusual techniques to make the required radio-frequency measurements. The receiver in particular is described.

E

Earth's Albedo Neutron Flux, *D. J. Williams and C. O. Bostrom*, 3, 4, March–April 1964, pp. 14–21.

A neutron detector designed and constructed at APL and placed aboard the TRAAC satellite to measure the flux of leakage neutrons is described. Summaries of data telemetered from the neutron detector are compared with findings of other researchers.

Effect of the Artificial Radiation Belt on Solar Power Systems, *R. E. Fischell*, 2, 2, November–December 1962, pp. 8–13.

The artificial radiation belt created by the July 9, 1962, nuclear event caused serious degradation of the power-generating solar cells in some U.S. satellites. The significant factors relating to this degradation and the effect of high-energy electron radiation on two types of solar cells are discussed.

Eggs and Other Deformed Spheroids in Stokes Flow, *V. O'Brien*, 4, 4, March–April 1965, pp. 11–16.

A program written for the IBM computer yields viscous flow fields for various nonspherical bodies. Results compare well with previous analytic theory where it exists, but for most bodies the results are new.

Electromechanical Time-Code Generator, *Staff*, 3, 2, November–December 1963, pp. 24–25.

The time-code generator developed at APL was adapted to generate the Atlantic Missile Range (AMR) 13-bit, 1-pulse/sec code; it is equally adaptable to many other codes, including 100-pulse/sec codes.

Elements of Modern Culture. Science in the New Humanism, *R. E. Gibson*, 7, 4, March–April 1968, pp. 2–10.

This paper is based on an address delivered by Dr. Gibson on March 29, 1968, to the Joint General Session, Association for the Education of Teachers in Science, and National Science Supervisors Association, at the National Science Teachers Association Sixteenth Annual Convention, Washington, D.C.

Engineer as an Individual, *W. J. Wright*, 7, 6, July–August 1968, pp. 10–15.

This article outlines the evolution of an engineer from recent graduate to senior scientist or top-level supervisor, describes the problems he encounters at various stages of his career, and gives some guidelines to growth opportunities. In learning how to help his employees, a supervisor grows and improves his own abilities.

Error Detection and Correction Codes, *P. T. Komiske*, 5, 2, November–December 1965, pp. 10–18.

Fire codes, which provide protection against errors

in bursts, are specifically described in this paper. Emphasis is placed on generating fire codes using a computer program, selecting a code to satisfy a given system requirement, and implementing codes using existing techniques and hardware.

Evolution of Microelectronic Packaging, *D. D. Zimmerman*, 7, 2, November–December 1967, pp. 10–14.

This article reviews the evolution of microelectronic packaging, showing the development of today's packaging concepts. The influence of new capabilities on electronic designs now emerging in the packaging field is also discussed.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1960–June 30, 1961, *R. E. Gibson*, 1, 3, January–February 1962, pp. 25–26.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1961–June 30, 1962, *R. E. Gibson*, 2, 3, January–February 1963, pp. 24–26.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1962–June 30, 1963, *R. E. Gibson*, 3, 3, January–February 1964, pp. 19–22.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1963–June 30, 1964, *R. E. Gibson*, 4, 3, January–February 1965, pp. 18–22.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1964–June 30, 1965, *R. E. Gibson*, 5, 3, January–February 1966, pp. 18–22.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1965–June 30, 1966, *R. E. Gibson*, 6, 3, January–February 1967, pp. 16–22.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1966–June 30, 1967, *R. E. Gibson*, 7, 3, January–February 1968, pp. 14–18.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1967–June 30, 1968, *R. E. Gibson*, 8, 3, January–February 1969, pp. 12–19.

Excerpts from the Report of the Director of the Applied Physics Laboratory, July 1, 1968–June 30, 1969, *R. E. Gibson*, 9, 3, January–February 1970, pp. 16–20.

Experimental 3-D Radar Display, *A. C. Schultheis*, 2, 1, September–October 1962, pp. 2–9.

Control and tracking of high-speed aircraft, guided missiles, and giant vehicles of the space age require visual display systems of greater flexibility than are now available. Development of an experimental integrated data display system having two- and three-dimensional capabilities and a controllable memory using coherent fiber optics is a major advance in this

field. Used in conjunction with advanced data-gathering systems, it will reduce the chance of errors in operator judgment and accelerate decision-making.

Explosive Lens Flashblindness Protection System, *D. D. Scott and L. M. Snider*, 5, 6, July–August 1966, pp. 11–16.

Nuclear detonations emit thermal energy in the ultraviolet, visible, and near infrared spectrums, which if not protected against, may produce permanent chorioretinal damage to the eyes or a temporary loss of vision referred to as "flashblindness." Since the loss of vision, even for a few seconds, may be disastrous to a high-performance aircraft pilot, he must be provided eye protection. This article discusses the development of an explosively actuated protective system designed to minimize the effects of flashblindness and to prevent permanent thermal injury to the eyes.

External Burning in Supersonic Streams, *F. S. Billig and G. L. Dugger*, 8, 2, November–December 1968, pp. 2–10.

Net thrust can be obtained by external burning near rearward facing surfaces on a body flying at supersonic speeds. Both experimental and analytical results show that "external burning ramjets" could be used for hypersonic cruise and steering control systems. Fuel specific impulses may be four to ten times those achievable with simple jet reaction systems.

F

Feedback Technique Improves Efficiency of Hydraulic Servos, *W. Seamone*, 4, 2, November–December 1964, pp. 12–16.

A system concept which attempts to match the required input power to the servo as a function of actual load demand is reported. The system has improved power efficiency potential, and tests on an experimental model have shown encouraging results.

Fixed-Rate Rechargeable Cardiac Pacemaker, *P. W. Barnhart, R. E. Fischell, K. B. Lewis, and W. E. Radford*, 9, 3, January–February 1970, pp. 2–9.

APL, in conjunction with the Johns Hopkins Medical Institutions, is developing a pacemaker containing a nickel-cadmium cell that can be recharged by magnetic induction through the intact skin. This device has approximately one-fourth the volume of presently used pacemakers and should have a lifetime of at least ten years.

FLEXICON: Medical Display Unit for Digital Data, *L. G. Knowles and W. A. Yates*, 7, 3, January–February 1968, pp. 10–13.

With the adoption of digital computer techniques for the presentation of radioisotope scanning data, an accompanying display system was required to present the results in pictorial form. The system discussed uses low-cost internal storage to minimize computer loading while preserving a flicker-free, medium resolution, continuous contrast picture.

Fluidic Angular Rate Sensor—A Replacement for Rate Gyroscopes? *T. M. Rankin, A. G. Moore, and W. C. Schuemann*, 8, 4, March–April 1969, pp. 17–22.

A very simple fluidic angular rate sensor is described wherein angular rate information is obtained by sensing the deflection of a laminar jet flowing from a nozzle. The prime advantages of this type sensor when compared with the conventional rate gyroscopes are its over-range capabilities, inherent long life, freedom from rotating parts, and extreme ruggedness.

Four-Channel Video Integrator, *Staff*, 2, 4, March–April 1963, pp. 20–21.

The inherent disadvantage of current closed-circuit television monitoring is that one cathode-ray tube can display only one video signal (picture) at a time unless very expensive and complex commercial special-effects equipment is used. This led to the development at APL of a simple, inexpensive, and compact system for combining electronically four separate video signals and displaying them simultaneously on a single cathode-ray tube.

Fourier Transform Spectroscopy, *B. F. Hochheimer*, 7, 2, November–December 1967, pp. 2–9.

A Michelson interferometer spectrometer is used to process radiant energy into a Fourier transform of the spectrum which is then inverted by a digital computer. Because of the high light-gathering power of the interferometer and the efficient use of this energy, many problems are now being done that previously were considered possible only in theory.

Frequency Agility for Radar Target Detection and Tracking, *F. E. Nathanson and J. Patrick Reilly*, 9, 6, July–August 1970, pp. 2–8.

The use of frequency agility in radar systems can reduce nulls in the radar cross section of complex targets and can also reduce angle and range glint. How wide the frequencies must be separated and how much can be gained in terms of improved detection and tracking capability are surveyed in this paper.

Frequency Monitoring and Nuclear Burst Detection: Some Aspects of VLF, *C. R. Haave and B. W. Shaw*, 4, 4, March–April 1965, pp. 2–10.

Very-low-frequency radio waves are now used in a number of special applications. Two recent developments—long-range comparison of frequencies and the investigation of the lower ionosphere by VLF phase measurements—are discussed. Some examples of the phase perturbations linked with the Soviet high-altitude nuclear bursts of October 1962 are given.

Frequency Monitoring of VLF Transmissions, *B. W. Shaw and C. R. Haave*, 1, 5, May–June 1962, pp. 7–11.

The APL Time and Frequency Standards Laboratory provides standards of time and frequency accurately referenced to national and world standards. Precise frequency comparison is accomplished by monitoring transmissions from frequency-stabilized VLF transmitters located throughout the world. The

facility also includes instrumentation to provide versatile VLF propagation research.

Frog and the Radar Display, *A. J. Cote, Jr.*, 1, 4, March–April 1962, pp. 8–14.

The possibility of designing radar subsystems that simulate the frog's highly developed mechanism for distinguishing moving objects from stationary backgrounds was prompted by studies of the frog's eye and nerve network. One aspect of a design is discussed that used phosphor particles on the light-sensitive surfaces of television cameras to simulate the frog's nerve fibers.

Fully Redundant Command System for the SAS-A Satellite, *E. J. Hoffman, A. L. Lew*, 10, 4/5, March–June 1971, pp. 19–23.

With satellites so dependent on commands from the ground, stringent demands are placed on command system reliability. This article outlines the special design techniques used in the SAS-A command system, including the use of a heavily cross-connected redundant topology. Many of the design principles have other applications.

Fundamental Processes and Laminar Flame Structure, *R. M. Fristrom and A. A. Westenberg*, 1, 3, January–February 1962, pp. 10–15.

Flames are gas-phase reactions that can propagate through space and are characterized by strong interactions among convection, molecular transport processes, and chemical reactions. Individual flame processes are well understood; flame theory has been formulated in general but the study of specific flames is largely experimental. Flame theory provides the model for quantitative interpretation of experimental studies. Structures of several flames have been examined, and information on the physical processes and chemical kinetics derived.

G

George W. Gardiner and New Mexico State University, *W. H. Goss*, 1, 2, November–December 1961, pp. 20–21.

The contributions of Dr. Gardiner to New Mexico State University and particularly to its Physical Science Laboratory, which he founded, are reviewed on the occasion of his retirement.

Graphical Automatic Programming, *A. Kossiakoff*, 9, 1, September–October 1969, pp. 2–22.

By means of the method described, an entire complex computer program can be designed, documented, and managed by direct interaction between the systems engineer and the graphics terminal. The four principal features of the method are: (a) the use of Data Flow Circuit Language, (b) the application of Computer Graphics, (c) the Transformation of Graphical into Logical Form, and (d) Integration and Testing of Complex Programs. It is hoped that this technique will be capable of producing system software at a fraction of the time and cost achievable by current methods.

Gravity Gradient Stabilization of Earth Satellites, *R. E. Fischell*, 3, 5, May–June 1964, pp. 12–21.

This paper discusses the theory of gravity gradient attitude stabilization, procedures for putting it to practical use, and application of the principles in specific satellites designed at APL.

H

Helium Hypersonic Wind Tunnel, *R. A. Makofski*, 2, 5, May–June 1963, pp. 2–8.

The helium hypersonic tunnel at APL is described, and the need for such research equipment is discussed. Results of the interaction between an incident shock wave and a laminar boundary layer indicate that the fluid model developed from lower Mach number studies is essentially valid at supersonic speeds.

High Sensitivity Mass Spectrometry of Transient Species, *S. N. Foner*, 10, 1, September–October 1970, pp. 2–15.

The detection of low concentration transient chemical species presents several formidable problems not encountered in ordinary analysis. This paper discusses the various factors involved in high sensitivity mass spectrometry of transient species and describes a mass spectrometer that incorporates design features based on these considerations. The successful integration of the mass spectrometer with a crossed molecular beam system has permitted the study of important elementary gas phase reaction mechanisms.

High-Temperature Gas Transport Measurements by the Source-in-Flow Method, *A. A. Westenberg and N. de Haas*, 1, 4, March–April 1962, pp. 2–7.

Difficulties in conventional methods of measuring coefficients of diffusion and thermal conductivity in gases at even moderately high temperatures have led to the development of novel techniques. A steady point source of one gas in a laminar flow of a second gas is used for measuring diffusion, while for thermal conductivity a steady line source of heat is necessary.

How High Does the Whistling Swan Fly? *W. A. Good and J. W. Hamblen*, 10, 2, November–December 1970, pp. 2–10.

As a participant in The Johns Hopkins University Whistling Swan migration studies, APL developed a radio transmitter that could be attached to the swans and that would send location signals for 50 miles, measure altitude, perform for three months, survive a salt water environment, and still weigh less than three ounces. An improved tower receiving antenna system was also devised.

I

Improved Data for the Classical Determination of Radar Detection Range, *L. F. Fehlner*, 3, 2, November–December 1963, pp. 17–23.

In an effort to extend the scope of existing data on radar detection probability, a way was found to ex-

press the pertinent relationships in such a manner that accurate, extensive data could be computed on a high-speed digital computer. The physical significance of the data, new mathematical solutions, and some representative graphs of the new data are given.

Improved Detection of PCM Waveforms, *R. B. McDowell*, 5, 4, March–April 1966, pp. 12–18.

Filtering, frequency modulation, pulse code modulation, and the development of information theory have all contributed to solving the problem of reliably demodulating or decoding noisy signals in the field of communications engineering. Recently, the digital computer has been used as a signal-decoding device, and a method for using it to decode a digitized or sampled PCM waveform is described. A comparative analysis is made of the computer method and more conventional real-time methods, and their respective advantages and disadvantages are noted.

Improving the Chance of Hitting the Target, *Staff*, 5, 1, September–October 1965, pp. 17–18.

The optimum way to shift fire to take account of successive observed misses in aimed fire against a target is given. The rewards of using the optimum aim shifting procedure may be very great.

Information Retrieval with a Small Computer, *Staff*, 2, 4, March–April 1963, pp. 17–19.

The information retrieval system at APL, using the IBM 1401 computer, with its major characteristics of direct storage and low cost, is described. Direct storage is defined as that in which information relating to a single document is stored on one continuous segment of tape.

Injun, A Radiation Research Satellite, *G. F. Pieper*, 1, 1, September–October 1961, pp. 3–7.

On June 29, 1961, three satellites, Transit 4A, Injun, and Greb, were launched simultaneously. The Injun satellite is described, especially the low-energy proton detectors developed for it at APL, and some preliminary conclusions are drawn from the data received.

Intermittent Thermometer for High-Temperature Measurement, *Staff*, 1, 4, March–April 1962, p. 19.

The intermittent thermometer technique is one by which the range of a thermometer may be extended above its own melting point for high temperature measurements. It has high spatial resolution, compared with optical techniques, and point-to-point temperature traverses can be taken through hot gas in tunnels. Temperatures up to 3500°K have been measured with good accuracy. Further studies are indicated.

Intraocular Pressure Control System, *J. G. Chubbuck and H. R. Bittner*, 7, 5, May–June 1968, pp. 2–6.

A closed-loop servo system has been developed for studying the pressure-flow characteristics of the eye. The system greatly increases the resolution with which one can control the rate of adding fluid to or remov-

ing it from the interior of the eye. It may also be used to slave the eye to a prescribed intraocular pressure and to measure, with high resolution, the rate of fluid flow into the eye required to sustain that pressure.

L

Laser Modes, *B. F. Hochheimer and J. T. Massey*, 3, 3, January–February 1964, pp. 2–8.

When an ordinary neon gas discharge tube is placed in a high-Q resonant cavity, certain properties of the light from the discharge are changed. Some properties of this new type of light source, called a laser, are discussed, and the results of experiments to determine other properties are given.

Low-Angle Beam Riding over the Ocean, *W. S. Thompson*, 1, 2, November–December 1961, pp. 10–15.

Radar ocean surface reflection and its effect on beam-riding missile guidance is reviewed. A vector model of the radar signal is developed and studied by real-time analog simulation, permitting evaluation of missile performance for any prescribed sea state and target position.

M

Mass Spectrometry of Free Radicals and Metastable Molecules, *S. N. Foner and R. L. Hudson*, 5, 4, March–April 1966, pp. 2–11.

Short-lived, highly reactive chemical species are being studied by a special mass spectrometer that uses a collision-free molecular beam-sampling system. The information obtained has led to critical insights on the nature of elementary chemical reactions. Recently, the scope of investigation has been extended to include electronically and vibrationally excited components. This article describes the principles and techniques involved in the research, and presents experimental results obtained in studies of exceptional interest.

Mass Spectrometry of Very Fast Chemical Reactions, *S. N. Foner and R. L. Hudson*, 7, 6, July–August 1968, pp. 2–9.

Studies of very fast bimolecular reactions have been carried out with a mass spectrometer incorporating a high intensity crossed molecular beam system. At the low pressures involved, the products observed are the result of single molecular collisions. Free radicals formed in a variety of elementary reactions have been directly observed, and an unusual reaction has been discovered in which an oxygen atom, in a single step, removes two hydrogen atoms from opposite ends of a molecule.

Mass Transient and Plasma Arc Instability, *S. D. Raezer*, 4, 1, September–October 1964, pp. 7–9.

The problem of the adverse effect on the arc of the starting-pressure transient caused by the initial excess

of gas in the chamber, as well as the incorporation in the APL arc of a vent valve to overcome it, is discussed.

Materials for Structural Use Above 3000°F, *M. L. Hill*, 3, 4, March–April 1964, pp. 2–13.

The behavior of metallic alloys under stress at temperatures above 3000°F is discussed. The usable strength at a given temperature may vary by a factor of ten because of the way in which strength depends on the rate at which the materials are deformed. Estimates of the design allowables are given for currently available alloys, along with predictions of developments for the next decade.

Method of Analysis for Clamped-Free Cylindrical Shells, *R. M. Rivello and T. M. Rankin*, 3, 1, September–October 1963, pp. 19–23.

A method of deflection analysis is discussed for a clamped-free cylinder when loads and temperatures are symmetrically distributed about planes passing through the axis of the cylinder for shell thickness variations along its axis.

Method of Radome Compensation with Broadband Capability, *R. H. Hallendorff*, 4, 1, September–October 1964, pp. 10–16.

Boresight-error measurements on tapered solid-wall radomes have provided an experimental boresight bandwidth of 3.6%. Boresight bandwidth is defined as the frequency band over which boresight-error slopes are less than 0.01 degree/degree in any 20° gimbal rotation. Theoretical bandwidths extrapolated from experimental data indicate that bandwidths as high as 5% are obtainable with ceramic radomes having a relative dielectric constant of 5.5.

Microelectronics at the Applied Physics Laboratory, *W. Liben*, 3, 1, September–October 1963, pp. 2–12.

Advances in the sophistication and complexity of electronic systems have required development of new methods for producing the necessary circuitry. Thin-film and semiconductor electronics are two such methods that solve problems in conventional circuitry. These and the APL microelectronic laboratory facilities are described.

Miniaturized Satellite Tracking Receiver, *Staff*, 5, 4, March–April 1966, pp. 19–20.

The Miniceiver, developed at APL, can provide time synchronization with a satellite to within a fraction of a second. With auxiliary equipment, and the known slant-range of a satellite, it can provide synchronization within a fraction of a millisecond. It could provide accurate time information for navigational and other purposes, especially for ships operating far from radio stations.

Ministick Packaging, a Further Aid to Satellite Reliability, *C. F. Noyes*, 5, 3, January–February 1966, pp. 2–10.

Ministick, a method developed at APL for maintaining the reliability inherent in integrated circuits, is discussed in some detail. It promises a significant

reduction in efforts required to build and test electronic hardware.

Missile-Wing Flutter Simulation, *J. P. Kearns*, 2, 4, March–April 1963, pp. 12–16.

A ground-test technique for simulating the aerodynamic forces that act on missile wings in flight has been investigated. The hardware required to demonstrate the interaction of the simulation forces with a cantilever plate analogous to a wing is discussed. Self-excited vibrations similar to those in flight flutter are produced in the plate for certain critical test conditions.

Mobile Automaton, *Staff*, 2, 1, September–October 1962, pp. 15–16.

A primitive automaton has been constructed that can operate independently for relatively long periods in an unmodified environment. It has the ability to replenish its energy supply and to cope with obstacles in its path. Plans have been made to give a new model greater operational capability.

Modular Externally-Powered System for Limb Prostheses, *W. Seamone, C. H. Hoshall, G. Schmeisser*, 10, 3, January–February 1971, pp. 14–23.

In an effort to help severely handicapped upper limb amputees and others who cannot use standard prostheses, APL has developed a prosthetic system that is powered by rechargeable batteries. The amputee need only supply a control signal. The concept is being evaluated with the aid of eight amputee subjects; some of the results are presented.

Moving Bubbles, Drops, and Other Fluid Blobs, *V. O'Brien*, 1, 5, May–June 1962, pp. 1–6.

In the array of motions possible for a single drop or bubble moving through another fluid, it is interesting to examine the slow, steady motion of small fluid bodies. Some experimental data are discussed in terms of a theoretical drag relation previously derived for low Reynolds number flows. Further research on the role of interfacial forces is indicated.

N

New Coaxial Cable Design, *Staff*, 2, 6, July–August 1963, pp. 18–19.

A new coaxial cable was developed to meet the rigid standards required by the AN/SPG-59 radar designed at APL. It is reliable, has low losses, is pliable, and is comparatively inexpensive to manufacture.

New Digital Data Processor, *T. G. Calhoun*, 7, 4, March–April 1968, pp. 15–20.

The new digital data processor (DIDAP) described is a highly versatile one. It handles both digital and analog data simultaneously and accepts various types of parallel or serial data. The new processor shapes and conditions the data it receives, translates them into digital form, correlates the data with an accuracy better than one millisecond, and writes the data on digital tape in IBM 7094 computer format. Critical information is monitored on visual displays, and high-

speed time-history plots of more than 80 selected functions can be produced simultaneously.

New Trends in Telemetry, *J. P. Randolph, Jr.*, 1, 1, September–October 1961, pp. 8–12.

Marked improvement in speed, accuracy, and reliability of telemetry systems, along with reduction in size, weight, and cost are indicated for the future by combining existing systems with new hybrids.

Nonlinear Friction in Servomechanisms, *Staff*, 9, 5, May–June 1970, pp. 13–15.

The conventional nonlinear friction model was extended to include elastic deformation effects in the bearings and other friction-producing elements of the mount. This resulted in a high-performance tracking loop that gave smoother and more predictable tracking than the conventional method.

O

Ocean Wave Measurements, *I. Katz*, 4, 1, September–October 1964, pp. 2–6.

This is a review of the methods used to measure wave structure. It describes a stereophotogrammetric technique recently developed to measure even the smallest ripple in the sea.

Old Faithful: World Endurance Record Radioplane, *M. L. Hill*, 4, 5, May–June 1965, pp. 17–22.

Old Faithful, a radioplane, is described in detail. It won the endurance record on September 18, 1964, with a flight of 8 hours, 52 minutes, 25 seconds.

Optical Soldering and Microelectronic Interconnections, *G. J. Veth*, 3, 3, January–February 1964, pp. 9–14.

The theory of optical soldering of microelectronic interconnections, and the packaging concept for which the soldering technique was developed, are discussed.

Orchids and Photography, *H. B. Riblet*, 7, 5, May–June 1968, pp. 7–13.

This is a paper that tells of Mr. Riblet's hobby of growing orchids and photographing them in full color. A description and diagram of a photometer-timer that Mr. Riblet designed and built is included.

P

Paving the Plane, *R. B. Kershner*, 8, 6, July–August 1969, pp. 4–10.

The problem of determining all of those shapes for which replications of the given figure can fit together to cover a flat area without gaps or overlapping is an ancient one. The author has recently succeeded in carrying through a complete determination in the special case of convex polygons. This paper contains a few critical proofs and a complete statement of the results.

Performance of the GEOS-II Heat Pipe System, *R. E. Harkness*, 8, 5, May–June 1969, pp. 14–19.

The GEOS-II was the first satellite to be equipped with a heat pipe as an integral part of its thermal design. The heat pipe was used to minimize the temperature differences between transponders located in opposite quadrants of the spacecrafts. Based on a 145-day observation period, transponder maximum and minimum temperatures showed significant improvement over those of GEOS-I.

Photographic Essay of the APL Propulsion Research Laboratory, *Anon.*, 8, 1, September–October 1968, pp. 10–16.

Photometric and Optical Considerations in the DODGE Satellite TV Camera Design, *F. W. Schenkel*, 6, 5, May–June 1967, pp. 15–19.

The photometric aspects and some unique problems in camera optics of the DODGE TV cameras are discussed. The photometric analysis is based upon black and white plus color picture transmission; the scheme used for color picture transmission is discussed in detail.

Physicists and Fipple Flutes at APL, *S. A. Elder*, 3, 3, January–February 1964, pp. 15–19.

The recorder, or English fipple flute, is described. It is classified along with the flue organ pipe and transverse flute as a jet-edge resonator. A brief history of recorder development is given; some of the physics involved in its manufacture and tone production are also included.

Plasma Arc Heating for Hypersonic Wind Tunnels, *E. A. Bunt and H. L. Olsen*, 1, 2, November–December 1961, pp. 16–18.

Increasing speed requirements of aircraft and missiles demand development of hypersonic propulsion tunnels for testing simulated flight conditions. Splitting, water-cooled arc heaters have been developed to provide temperatures required in propulsion research in the Mach 7 to 10 range for use in these tunnels.

Polaris Fluid Magnetic Spring, *Staff*, 2, 1, September–October 1962, pp. 16–17.

A fluid magnetic spring that provides suspension characteristics and acts as a variable damping and lockout device has been developed at APL for the Polaris missile and tube launching combination on Polaris submarines. The concept is based on varying the viscosity of the working fluid by electrical control.

Present State of Navigation by Doppler Measurement from Near Earth Satellites, *R. B. Kershner*, 5, 2, November–December 1965, pp. 2–9.

The initial stages in the development of a world-wide navigation system have been successfully completed, and the system has been used extensively for over a year. The operation is based on the measurements of the doppler shift of stable signals transmitted to earth from orbiting artificial satellites. The most significant features of the system as initially implemented, some factors that influence its accuracy, and some of its potential uses are described.

Probing the Clear Atmosphere with Radar, *I. Katz*, 6, 1, September–October 1966, pp. 2–8.

Recent experiments with high-powered radars have shown that electromagnetic radiation is scattered sufficiently by irregularities in the atmospheric refractive index to use radars as a probe. Some of the experiments also included the detection and tracking of birds and insects with radar. This article discusses these experiments and suggests the future use of radar as a valuable aid in the fields of meteorology and entomology.

P. Stewart Macaulay, *Staff*, 5, 5, May–June 1966, pp. 3–4.

This is a biography of Mr. Macaulay, who served as Executive Vice President of The Johns Hopkins University and upon retirement continues to serve in an advisory capacity.

Q

Quantum Effects in Molecular Scattering, *L. Monchick*, 5, 3, January–February 1966, pp. 11–15.

The characteristic interference phenomena of wave mechanics usually can be inferred from experiment only in an indirect manner. Molecular and atomic scattering exhibit this effect directly, because the particle distribution itself is being measured. Some of the qualitative features of the scattering cross section and the influence of quantum effects on the macroscopic transport properties of gases are discussed.

R

Radar Backscatter from Rain, *Staff*, 7, 6, July–August 1968, pp. 16–18.

In experimenting on the characteristics of rain clutter, efforts were concentrated on three aspects: doppler spectrum spread, spatial uniformity, and frequency correlation of precipitation echoes.

Radar Reflectivity of the Earth's Surface, *I. Katz*, 2, 3, January–February 1963, pp. 10–17.

Radar reflectivity of rough surfaces is being studied at APL with a view toward improved radar and missile guidance performance. The present state of our experimental knowledge of the reflectivity of smooth and rough land and water surfaces is reviewed.

Radiation-Produced Sound, *J. G. Parker and R. H. Swope*, 5, 6, July–August 1966, pp. 17–22.

By combining the principles of acoustic resonance and relaxation of internal degrees of freedom of gas molecules, a sensitive converter of radiation to sound has evolved. Radiant energy absorbed in vibrational or rotational modes is very rapidly converted to translational energy. The accompanying pressure rise, augmented by acoustic resonance, generates a sound field easily detected by a condenser microphone. This article discusses the theory of operation; provides a quantitative comparison of theory and experiment; and estimates the increase in sensitivity achievable by future improvements.

Radicals in Flames, *W. E. Wilson, Jr. and R. M. Fristrom*, 2, 6, July–August 1963, pp. 2–8.

Radicals in flames may be studied by direct, molecular-beam, mass spectrometry; optical spectroscopy; scavenger probe techniques; or by derivation from kinetic constants. Radical concentrations greatly exceed equilibrium values, and active species diffuse from the reaction zone back into cool gases. Profiles of hydrogen, oxygen, hydroxyl, and methyl radicals in a methane-oxygen flame are given as examples. Chemical kinetic constants of elementary reactions are the most important information to be derived.

Radome Thermal Design for a Mach 4 Missile, *R. P. Suess and L. B. Weckesser*, 3, 6, July–August 1964, pp. 13–18.

Theoretical and experimental work was done to obtain efficient thermal design of a radome for a Mach 4 missile. Theoretical studies showed that maximum tensile thermal stresses were nearly identical for both pointed and blunted von Karman-shaped radomes, but the pointed radome was favored because of its lower aerodynamic drag. Experimental verification that the pointed radome could withstand the flight stresses was obtained in full-scale free-jet tests.

Reese Bros. Dragster, *W. P. Reese*, 4, 1, September–October 1964, pp. 17–21.

A completely handmade vehicle was evolved from the efforts of these two racing enthusiasts (Phil and “Bub” Reese) after five years of exacting work. The dragster and its operation are fully described in this article.

Reflections of a Telescope Maker, “A Scientist and His Hobby,” *I. H. Schroader*, 2, 6, July–August 1963, pp. 8–14.

A description of telescope making is given, and a discussion of the satisfactions gained from this rewarding hobby is included, which, as Mr. Schroader says, can range from occasional diversion up to several lifetimes of serious activity.

Relaxation Phenomena in the Kinetic Theory of Gases, *L. Monchick and E. A. Mason*, 1, 6, July–August 1962, pp. 19–23.

The gas property most affected by internal degrees of freedom is thermal conductivity, since energy may be transported in the form of both translational and internal energy. Inelastic collisions may be treated as small perturbations, and a linearized theory that contains the relaxation time as a parameter may be obtained. This theory accounts for most of the anomalous behavior of polyatomic molecules. Resonant collisions are most effective in stopping diffusion of internal energy in the case of polar molecules.

Resonance Technique for Measuring Satellite Magnetic Dipole Moment, *B. E. Tossman*, 7, 1, September–October 1967, pp. 10–17.

The theory and application of a resonance technique that is especially designed to measure small dipole moments is presented. The satellite is suspended by torsion wires in a controlled magnetic field. By changing the magnetic field in synchronism with

the natural torsion suspension frequency, the satellite is driven into resonance. The rate of change of amplitude is a direct measure of dipole moment.

Rockets and the Aurora Borealis, *W. G. Fastie*, 5, 5, May–June 1966, pp. 5–10.

The aurora borealis has long been a fascinating subject and many studies have been made to help man appreciate this most unusual phenomenon. The use of rockets in studying the aurora has been a very rewarding method. A series of experimental rocket firings, techniques used in auroral research, and some of the resultant data are discussed.

S

SAS-A Telemetry System, *M. R. Peterson, D. L. Zitterkopf*, 10, 4/5, March–June 1971, pp. 11–18.

SAS-A has a PCM/PM telemetry system operating at 136 MHz. In the record mode multiplex data at 1 kHz are stored on an endless loop magnetic tape recorder for a maximum of one orbit or 96 minutes, and simultaneously transmitted at an output power of 250 mW. In the playback mode, the data recorded during the previous 96 minutes are transmitted at 30 kHz with an output power of 1.5 watts.

Satellite Geodesy, *W. H. Guier*, 4, 3, January–February 1965, pp. 2–12.

Artificial near-earth satellites are prolific sources of geodetic information. A brief review is given of both the types of satellite data that have been used extensively for geodetic determinations and of basic approaches to inferring geodetic parameters from the data. In particular, the use of radio doppler to determine values for the nonzonal coefficients through eighth order and degree are given.

Scaling the Effects of Air Blast on Typical Targets, *H. S. Morton*, 7, 1, September–October 1967, pp. 2–9.

A mathematical analysis is used to relate weights of explosives to the distances at which they can cause lethal damage over the entire range of blasts from a few pounds of conventional high explosive to megatons of nuclear blast. Effects at sea level and at higher altitudes are also examined. A dimensionless scaling parameter relating a shock wave parameter to a target parameter is the key to the scaling relationships derived.

Scientist and His Hobby, *W. A. Good*, 2, 3, January–February 1963, pp. 18–23.

Dr. W. A. Good writes about his hobby, radio-controlled model airplanes. He says that the most fascinating aspect is the technical design of the airplane and radio equipment. Particularly challenging is the fact that from the preliminary planning to test piloting, the hobbyist in this field goes through all stages of model evolution such as systems engineer, engineering group, aerodynamicist, production, test crew, and even flight analysis group in case of failure!

Secondary Gas Injection Thrust Vector Control, *M. Shandor, A. R. Stone, and R. E. Walker*, **2**, 4, March–April 1963, pp. 2–7.

Fluid-injection thrust vector control is rapidly being exploited for attitude control of solid-propellant ballistic missiles. This method of developing control forces removes moving parts completely from a hot-gas environment, leading to a more reliable control system. Interest at APL is centered on the physics of supersonic-flow/side-jet interaction.

Self-Erecting Missile Fin, *Staff*, **4**, 2, November–December 1964, pp. 17–18.

Five engineering models of a self-erecting folding fin have been developed at APL which provide the self-erecting capability necessary for box- or tube-launch installations; tests have been conducted successfully to establish operational characteristics and functional reliability.

Servo-Controlled Pulsatile Heart Pump, *W. Seamone, B. F. Hoffman, L. A. Jacobs, E. H. Klopp, and V. L. Gott*, **9**, 2, November–December 1969, pp. 2–8.

Pulsing a roller pump to achieve the flow pattern of a normal heart while retaining the simple interface, good blood-handling capabilities, and the established background experience associated with the commonly used roller pump offers an immediate improvement over existing cardiac bypass pumps.

Simplified Method of Hybrid Microcircuit Fabrication, *F. R. Muccino*, **9**, 4, March–April 1970, pp. 14–20.

Standard etched circuit board material is used as the substrate to which all elements are attached by means of solder cream, with the soldering accomplished in seconds on a hot plate. The active elements are leadless inverted devices, and resistors and capacitors are in the form of chips. Assemblies have been completed that contain more than 100 elements with a 10:1 size reduction over previous assemblies.

Simplified Passive Spacecraft Separation System, *D. W. Rabenhorst*, **6**, 2, November–December 1966, pp. 9–17.

A unique, simplified separation system required to initiate despin, unfold solar blades, separate spacecraft from the launch vehicle injection state, and yaw the injection rocket after separation to prevent collision with the spacecraft is described. Additional features of this system are light component weight, elimination of batteries, immunity to background disturbances, and operation completely independent of the launch vehicle.

Simulation Studies of Nuclear Medicine Instrumentation, *A. G. Schulz, L. G. Knowles, L. C. Kohlenstein*, **10**, 3, January–February 1971, pp. 2–13.

A digital simulation of the radionuclide scanning process has been developed to aid in the quantitative evaluation of the clinical significance of instrumentation techniques and operational parameters associated with these systems. The impact of equipment design

changes, radiopharmaceutical characteristics, and data processing on the ability of physicians to detect lesions in scan images has been evaluated.

Small Astronomy Satellite Program—An Overview, *H. B. Riblet*, **10**, 4/5, March–June 1971, pp. 2–10.

The Small Astronomy Satellite Program provides for a series of satellites that can be used for various astronomy experiments. The SAS-A mission is to map the X-ray sources in the entire sky and to observe discrete sources for intensity fluctuations in the range 1 to 20 keV. APL was responsible for designing and fabricating the power, telemetry, command, and attitude control systems and for the experiment integration tests and the flight qualification tests. SAS-A was launched December 12, 1970 and has been very successful.

Small-Motion Biological Stimulator, *J. G. Chubbuck*, **5**, 5, May–June 1966, pp. 18–23.

A transducer has been developed for producing micron level indentions in the skin of animals to study the response of the sensory nervous system. The closed-loop system in which this instrument is operated features precise motion control of the stimulating probe and the capability of measuring the force applied to the skin.

Small, Radio-Controlled Aircraft as a Platform for Meteorological Sensors, *T. G. Konrad, M. L. Hill, J. R. Rowland, and J. H. Meyer*, **10**, 2, November–December 1970, pp. 11–19.

The development and performance capability of a small, radio-controlled aircraft as a versatile measurement platform is described, along with the required instrumentation. Several field tests have shown that controlled soundings to 4000 feet are possible with the unaided eye. With simple optical aids, soundings to 10,000 feet are possible.

Solar Proton Monitoring, *J. W. Kohl*, **8**, 1, September–October 1968, pp. 2–9.

Instrumentation has been developed to provide data over long periods of time on the radiation environment near earth and in interplanetary space. This article presents a description of the particle detectors used and a few of the preliminary observations obtained with this instrumentation on-board rockets and the satellite IMP-F.

Solar-Terrestrial Disturbances and Solar Protons in July 1961, *A. J. Zmuda*, **1**, 3, January–February 1962, pp. 16–20.

Many significant solar phenomena were observed by the Injun satellite during July 1961, which provided valuable new data for the geophysicist. Protons emitted by the sun were studied for several active periods within the month, permitting quantitative analysis of the proton flux under both quiet and disturbed magnetic conditions.

Some Human Perceptual Limits, *G. H. Mowbray*, **1**, 3, January–February 1962, pp. 21–24.

Features of a recently proposed model of the human

nervous system are subjected to experimental test. The findings support a limited-channel-capacity concept, but suggest that the perceptual mechanism is more flexible than the model implies.

Spin Control for Earth Satellites, *R. E. Fischell*, 5, 1, September–October 1965, pp. 8–13.

A magnetic torquing system has been developed at APL for controlling satellite spin rate and spin (Z) axis orientation. The spin rate control system consists of two vector magnetometers, whose outputs are amplified and properly phased to provide a constant-amplitude magnetic dipole moment perpendicular to the projection of the earth's magnetic field in the satellite X-Y plane. Spin axis orientation is obtained by commanding on a magnetic dipole moment in the Z direction.

Status and Future Trends in High-Speed Chemical Propulsion, *W. H. Avery*, 4, 6, July–August 1965, pp. 2–9.

Concentrated effort to develop better solid and liquid propellants has resulted in improvements in rocket propellant performance to a level which is now near the maximum attainable. A survey of chemical propulsion indicated that other approaches should be considered for further improvements. Air augmentation may provide greater gains at less cost. Even greater gains in performance with hypersonic air-breathing vehicles are a possibility. Recent research in supersonic combustion supports the feasibility of very-high-speed flight vehicles powered by supersonic combustors.

Strategic Force Deterrence Model, *M. C. Waddell*, 1, 1, September–October 1961, pp. 16–19.

Deterrence as a method of preserving peace is a relatively new subject for scientific analysis. The model of the interaction of opposing strategic forces described provides a useful framework for such analysis.

Strength of High-Temperature Materials, *Staff*, 6, 1, September–October 1966, pp. 16–17.

A machine has been designed to measure creep of refractory metals and to determine the creep strength of special alloys at high strain rates. In addition, a novel extensometer with special techniques for temperature measurements has been developed.

Studies of the Earth's Outer Radiation Zone, *D. J. Williams*, 4, 6, July–August 1965, pp. 10–17.

Studies relating to the outer radiation zone indicate that the behavior of high-energy electrons in this region in magnetically quiet periods is consistent with their movement in a distorted magnetic field under the conservation of adiabatic invariants. It has been possible to obtain a magnetic field configuration that can explain the observed electron movements. The investigations are described in this article.

Subject Index (Vols. 1 through 6), *Staff*, 6, 6, July–August 1967, pp. 7–16.

Subject Index (Vols. 1 through 8), *Staff*, 8, 6, July–August 1969, pp. 16–27.

Subject Index (Vols. 1 through 10), *Staff*, 10, 6, July–August 1971, pp. 24–36.

Summary of APL Satellites, *Staff*, 7, 4, March–April 1968, pp. 11–14.

This article briefly surveys the satellites made at APL over the past decade and enumerates their more noteworthy achievements.

Survival in Metropolitan-Area Nuclear Attacks, *R. J. Vicars*, 2, 5, May–June 1963, pp. 18–26.

The factual data upon which this study is based were derived from U.S. Government and other publications listed at the conclusion of this paper. The statements herein do not constitute a specific set of recommendations, but are an aggregation of facts from which the reader may determine his own course of action in case of nuclear attack.

System for Checking Hazardous Electrical Circuits, *Staff*, 1, 2, November–December 1961, pp. 19–20.

The two basic devices comprising the hazardous circuit checking system discussed are an ohmmeter and a continuity meter, both operating on the principle of isolating the reading circuit from any possible harmful power source.

T

Technology of Wine-Making, *G. H. Mowbray*, 3, 6, July–August 1964, pp. 18–23.

For practical purposes there are only three basic types of wine: fortified, sparkling, and natural. The making of a good natural wine is described, from growing the grapes to putting the finished product on the table.

Terrier, A Capsule History of Missile Development, *M. R. Kelley*, 4, 6, July–August 1965, pp. 18–26.

This is a condensed history of the development of Terrier missiles since their inception in mid-1948 to the installation aboard the USS *Boston* on July 1, 1956.

Theory of Corneal Structure, *R. W. Hart, R. A. Farrell, and M. E. Langham*, 8, 3, January–February 1969, pp. 2–11.

The physical basis of corneal microstructure has been investigated in an attempt to understand important physiological properties of the cornea. The basis for the optical transparency of the cornea and the nature of the intermolecular forces involved have been studied and a theoretical molecular model has been formulated. Analysis of the model leads to a theoretically derived structure approximating that shown by electron microscopy.

Theory of Nervous Regulation of Intraocular Pressure, *R. W. Hart*, 9, 4, March–April 1970, pp. 2–13.

Proper regulation of intraocular pressure is essential to normal eye function. Many experimental studies have shown that the nervous system plays an impor-

tant role in the regulation of intraocular pressure, but the mechanism is not known. A phenomenological theory that mimics a number of features of the living eye has been developed. The theory offers unifying concepts formulated mathematically so that they can be tested by experiment.

Thermal Design of Current Navigational Satellites, *S. E. Willis, Jr.*, 6, 2, November–December 1966, pp. 18–26.

Navy Navigational Satellites had been operating at temperatures some 20° to 30°F higher than were predicted from preflight tests and calculations. An exhaustive analysis of the thermal design was conducted, followed by an extensive thermal vacuum testing program to help correct this situation. The program verified most of the analysis and supplied answers to problems that could not be answered in the analysis. As a result of both the analysis and the testing program, the difference between orbital results and preflight calculations has been reduced to a range of from 2° to 3°F.

Thermal Insulation for Hypersonic Vehicles, *M. L. Hill, J. M. Akridge, and W. H. Avery*, 1, 6, July–August 1962, pp. 2–7.

Aircraft flying at hypersonic speeds encounter such high temperatures and thermal stresses as to create problems of thermal growth, buckling, and oxidation. A new type of surface insulation made of existing materials is being successfully tested to meet these problems. With a configuration like roof shingles, it transmits all aerodynamic forces to the aircraft structure and provides maximum thermal protection during sustained flight.

Theta-Pinch Plasma Gun Studies, *R. Turner*, 8, 5, May–June 1969, pp. 2–13.

A theta-pinch plasma gun has been developed to study the interaction of a high-temperature, high-density plasma with various magnetic fields. The gun produces a doughnut-shaped puff of hydrogen plasma which has been studied using a variety of techniques including a specially-developed fast far-infrared interferometer. A significant amount of the directed plasma energy can be converted into more useful transverse energy by reflecting the plasma from a magnetic barrier.

Three-Dimensional Radiography, *D. G. Grant, J. B. Garrison, and R. J. Johns*, 9, 3, January–February 1970, pp. 10–15.

A set of conventional radiographs of an object is taken, each corresponding to a different viewing angle. The radiographs are photoreduced and placed in an optical system that projects the entire set of images into a display volume where they superimpose. A three-dimensional X-ray image is thus created and can be observed using a movable viewing screen. Results obtained with an experimental model and a description of a clinical prototype are given.

Tilted-Disc Device, *Staff*, 1, 4, March–April 1962, pp. 20–21.

The tilted-disc device described is adaptable to

many surfaces and environments such as probable lunar conditions, hard and soft land, and water. Several rotating spherical discs provide greater maneuverability than do wheels or tracks.

Time Synchronization between Remote Locations, *Staff*, 3, 4, March–April 1964, pp. 22–23.

The Laboratory's interest in time synchronization evolved from its various activities in space research and development. None of the existing methods of time synchronization had the accuracy and flexibility required for tracking operations; therefore, the development of a precision portable clock was proposed, and it is discussed in this paper.

Title Index (Vols. 1 through 10), *Staff*, 10, 6, July–August 1971, pp. 3–17.

TRAAC Satellite, *R. E. Fischell*, 1, 3, January–February 1962, pp. 2–9.

The TRAAC satellite was primarily an experiment to use the earth's gravitational field for controlling the attitude of an orbiting satellite. Although the gravity stabilization experiment was not realized, TRAAC provided significant scientific and engineering data which further insured the success of Transit and other satellites.

TRANET Doppler Tracking System, *C. A. Dunnell*, 6, 4, March–April 1967, pp. 17–23.

TRANET, a satellite-tracking network, acquires and processes doppler frequency shift data from signals of suitably equipped near-earth satellites. These data are used both in dynamical geodesy and in determining location points on the surface of the earth. TRANET provides high-density and high-accuracy data for many satellites in a form ready for the computing process.

Transistorized Pyrometer—With and Without Feedback, *Staff*, 2, 5, May–June 1963, pp. 17–18.

A completely transistorized recording pyrometer developed at APL for measuring brightness temperatures is described. It evolved from requirements by the hypersonic research facility to measure missile and rocket surface temperatures in their operational environment. The pyrometer system consists of the pyrometer, a control box, and connecting cables. Under ordinary laboratory conditions, the accuracy of the system is better than $\pm 10^\circ\text{C}$.

Translocation Backpack Systems, *Staff*, 9, 6, July–August 1970, pp. 9–10.

With the equipment developed and tested, it is possible to obtain the relative positions of two points on the surface of the earth by the use of the Navy Navigation Satellite System. For a single satellite pass the error is less than 12 meters if the two observing stations are within 50 miles of each other.

Translocation by Navigation Satellite, *E. E. Westerfield and G. Worsley*, 5, 6, July–August 1966, pp. 2–10.

This article describes the concept and early experiments to demonstrate translocation—a method of surveying—using relative distance measurements obtained

with the Navy Navigation Satellite System. Portable equipment specially developed to apply the method to various situations and test results are illustrated and discussed.

Trapped Free Radicals, *E. L. Cochran, F. J. Adrian, and V. A. Bowers*, 2, 3, January–February 1963, pp. 2–9.

Recent development of electron spin spectroscopy has greatly increased interest in trapped free radicals and has permitted a more or less complete determination of their structure. This work has also provided reliable guidelines for predicting the structure of more complex radicals. The radicals in the experiments discussed were formed by elementary photochemical processes or by simple addition reactions, providing knowledge of basic chemical processes.

Triode-Diode Function Generator, *C. J. Nisson*, 2, 6, July–August 1963, pp. 15–17.

The triode-diode function generator developed at APL for use in the Laboratory's analog computer facility, and described here, has overcome disadvantages found in other types of function generators used for the approximation of nonlinear functions in analog computers.

Tunnel-Diode Microwave Amplifiers, *G. T. Munsterman*, 4, 5, May–June 1965, pp. 2–10.

The tunnel-diode and its assumed equivalent circuit are discussed. The concept of negative-resistance reflection amplifiers is discussed from the standpoint of stability, gain, and noise performance. Two amplifier configurations are shown, of which the circulator-coupled type is carried further into a design for a C-band amplifier. The result is an amplifier at 6000 mc/s with a 5.5 dB noise figure over 380 mc/s.

U

Unique Bowsprit Assures Greater Control for Sailing Catamaran, *H. S. Morton*, 4, 4, March–April 1965, pp. 17–23.

After more than a decade of experience with a 30-foot sloop-rigged catamaran, the author has designed and built a similar modification of the bowsprit, which has resulted in the improvement of positive control when "coming about," a term used to indicate "heading into the wind."

Unique Microwave Switches, *Staff*, 1, 1, September–October 1961, p. 21.

These switches, with extremely fast speeds and minimum delay time, make possible lower insertion losses and higher isolation than any commercial product available.

Urban Transportation, *W. H. Avery and G. S. McMurray*, 8, 4, March–April 1969, pp. 2–16.

A system that meets the prime requirements for urban transportation systems is described. It employs a grid of high speed lines spaced at 2½ mile intervals, supported by a local network covering the same area with lines spaced at ¼ mile intervals which employs

constantly moving small cars, available for boarding at 1 to 15 second intervals. The combined system would offer efficient, inexpensive, all-weather transportation within easy walking distance throughout the metropolitan area.

V

Varactor Multipliers, *T. Thompson*, 4, 2, November–December 1964, pp. 2–11.

The fundamentals of varactor multipliers, with the analysis primarily concerned with a charge-controlled multiplier using an abrupt junction diode, are discussed. Several multiplier circuits are treated from the designer's point of view, and a practical satellite application is considered in some detail.

VLF Phase Perturbations Associated with High-Altitude Nuclear Bursts, *C. R. Haave, A. J. Zmuda, and B. W. Shaw*, 2, 2, November–December 1962, pp. 14–19.

VLF propagation paths remote from the July 9, 1962 nuclear burst were perturbed by the effect on the lower ionosphere of charged particles geomagnetically deflected into the VLF path. Some of these particles attach to field lines directly accessible from the burst region; others are geomagnetically trapped and drift longitudinally from the burst to the VLF path.

W

Ways and Means of Boat Design, *J. R. Apel*, 5, 2, November–December 1965, pp. 18–23.

This article discusses the design of pleasure boats, the designers, and considerations that enter into different boat designs. Examples of a few designs are shown, with emphasis on speed boats and hydroplanes.

"Welded Cordwood"—Last Step in Conventional Circuits? *Staff*, 1, 1, September–October 1961, p. 20.

The "3-D" technique of welding described uses miniature components stacked together as a pile of cordwood, but with welded interconnectors. This type of assembly yields low-cost packages that are highly reliable and take less space than conventional assemblies.

Z

Zero-Field Maser, *A. W. Nagy and G. E. Friedman*, 3, 6, July–August 1964, pp. 2–12.

Three major requisites for the operation of a conventional solid-state paramagnetic maser are a low-temperature environment, a source of pumping radiation, and a steady, homogeneous magnetic field. For amplification restricted to a number of discrete ranges throughout the spectrum, however, a magnet is not required. Following some background material that explains these requisites, this paper discusses the feasibility of a maser without a magnetic field, using trivalent iron sapphire, and cites some advantages of this mode of operation.