Empirically, it is known that most of the deflection in a collision takes place at the distance of closest approach. A short calculation shows that the average time required for a molecule to rotate 360° is comparable to the time required to complete a head-on collision. We therefore assume that in a given collision, only one relative orientation of the dipoles is effective, and we evaluate the collision integral as if the orientation were fixed at one value throughout the collision. Different collisions correspond to different fixed orientations, but in any one collision the potential is now effectively spherically symmetric. This assumption shifts the emphasis of the problem from the extremely difficult collision dynamics of rotating dipoles back to the kinetic theory and makes the problem a solvable one. We have evaluated the necessary collision integrals for the Stockmayer (12-6-3) potential usually used for polar gases, and compared the results with experiment. The overall agreement is comparable to that obtained for nonpolar gases with the Lennard-Jones (12-6) potential.[2]

Although practically no measurements have been made on mixtures of two polar gases, many measurements are available on mixtures of a polar and a nonpolar gas. Our classical model can be easily extended to mixtures using rather simple combining rules, with results for diffusion coefficients and viscosities which are generally of the order of experimental scatter (5 to 10% for diffusion and 1 to 2% for viscosity). Thermal diffusion results are potentially the most interesting since they are very sensitive to the intermolecular forces; but experimental data are scanty. The results, however, look promising.[3]

In short, the transport properties of polar gases and polar gas mixtures can now be calculated with about the same degree of confidence as has been possible for some years for nonpolar gases and their mixtures.

ADDRESSES

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

W. Liben, "Present Status of Microelectronic Circuitry," *Institute of Radio Engineers*, Washington, D. C. Section, May 17, 1962.

W. A. Good, "Testing of HT-3," *Society of Automotive Engineers*, A-18 Committee Meeting, Minneapolis, May 18, 1962.

W. H. Avery, "Possibilities of Hypersonic Flight," *National Research Centre*, Cairo, Egypt, May 18, 1962.

W. H. Avery, "Engineering Aspects of Hypersonic Flight," *Institute of Engineers*, Cairo, Egypt, May 19, 1962.

W. H. Avery, "Transit System," *National Research Centre*, Cairo, Egypt, May 21, 1962.

F. E. Nathanson, "Coherent Search and Acquisition System," *Eighth Annual Radar Symposium*, University of Michigan, June 6, 1962.

R. W. Cole, "Transit Reliability," *Seventh Military-Industry Missile and Space Reliability Symposium*, San Diego, June 18–21, 1962.

R. E. Davis, "Radioisotope Power System Operation in the Transit Satellite," *American Institute of Electrical Engineers*, Aerospace Transportation Conference, Denver, June 17–22, 1962.

M. L. Hill, J. M. Akridge, and W. H. Avery, "Thermal Insulation for Hypersonic Vehicles," *American Society of Mechanical Engineers*, University of Maryland, June 26, 1962.

T. Wyatt, "The Transit Navigational System," *American Society of Mechanical Engineers*, University of Maryland, June 26, 1962.

W. Liben, "Microelectronics," *Research Society of America*, Ft. Belvoir, Va., June 27, 1962.

J. O. Artman and J. C. Murphy, "Hemihedral Field Effects in the Spectrum of Ruby," *First International Conference on Paramagnetic Resonance*, Hebrew University of Jerusalem, Israel, July 16–20, 1962.

D. W. Fox, "Estimation of Eigenvalues Based on Operation Comparisons," *International Symposium on Local Properties of Perfect Crystals*, Batelle Institute, Carouge-Genève, Switzerland, July 16–24, 1962.

I. Katz, "Radar Reflectivity of the Ocean Surface for Circular Polarization," *International Scientific Radio Union, Institute of Radio Engineers*, Washington, D. C., May 3, 1962.

H. W. McLaughlin, "Bi-Static Reflectivity from the Ocean Surface," *International Scientific Radio Union, Institute of Radio Engineers*, Washington, D. C., May 3, 1962.

JOURNAL PUBLICATIONS

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

M. L. Hill, E. W. Johnson, R. Itoh, and R. L. Readal, "Determination of Composition and Pressures over the Melt in a Vacuum Arc Furnace," *Transactions of the Eighth National Vacuum Symposium*, Vol. II, Pergamon Press, 1961, 749–756.

M. L. Hill, "Automatic Apparatus for Measuring Gas Evolution Rates," *Transactions of the Eighth National Vacuum Symposium*, Vol. II, Pergamon Press, 1961, 813-816.

E. P. Gray and D. E. Kerr (JHU), "The Diffusion Equation with a Quadratic Loss Term Applied to Electron-Ion Volume Recombination in a Plasma," *Annals of Physics*, **17**, Feb. 1962, 276–300.

S. N. Foner and R. L. Hudson, "Ionization and Dissociation of Hydrogen Peroxide by Electron Impact," *J. Chem. Phys.*, **36**, May 15, 1962, 2676–2680.

S. N. Foner and R. L. Hudson, "Mass

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Spectrometry of the HO_2 Free Radical," *J. Chem. Phys.*, **36,** May 15, 1962, 2681–2687.

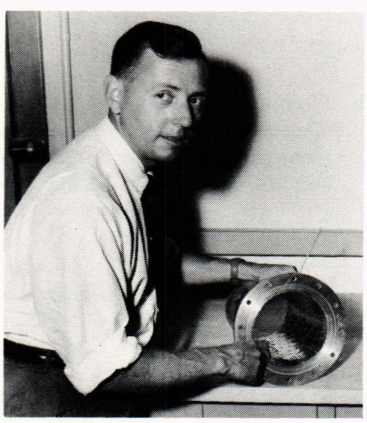
C. K. Jen, V. A. Bowers, E. L. Cochran, and S. N. Foner, "Electron Spin Resonance of Alkali Atoms in Inert-Gas Matrices," *Phys. Rev.*, **126,** June 1, 1962, 1749–1757.

W. Liben, "Some Applications of an Ultrasonic Light Modulator," *J. Acoust. Soc. Am.*, **34,** June 1962, 860–861.

A. I. Mahan, "Astronomical Refraction—Some History and Theories," *Applied Optics*, **1,** July 1962, 497–511.

WITH THE AUTHORS

M. L. Hill, a co-author of "Thermal Insulation for Hypersonic Vehicles," is a native of Lehighton, Pa. He received his B.S. and M.S. degrees in metallurgy from Pennsylvania State University, where he was then employed, from 1950–52, as a research assistant. During his subsequent work at the Central Research Laboratories of the Westinghouse Corp., he specialized in studies of gases in metals and the effect of trace impurities on the mechanical and physical properties of metals and semiconductors. Mr. Hill came to APL in 1960 and is now



Supervisor of the High-Temperature Materials Project in the Flight Research Group. He is a member of the American Society for Metals, the American Institute of Mining and Metallurgical Engineers, and the American Rocket Society.

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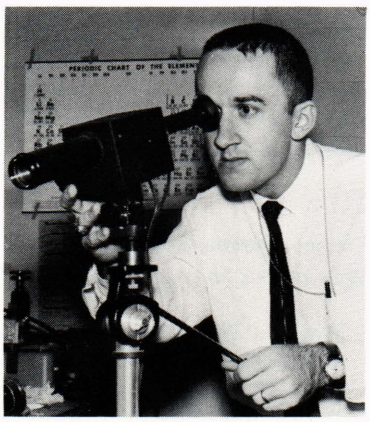

engineering at the University of Maryland. Mr. Akridge came to APL in 1960 as a specialist in stress analysis, mechanical design, and materials evaluation. He is an engineer in the High-Temperature Materials Project of the Bumblebee Flight Research Group.

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Supervisor of the Launching and Propulsion Group, serving in that capacity until his present appointment as Supervisor of the Aeronautics Division. Dr. Avery has served on several APL, National, and Department of Defense committees. He is presently on the APL Technical Policy Board, Department of Defense Technical Panel on Ordnance, Space Exploration Advisory Group, NASA Research Advisory Committee on Chemical Conversion Processes, and the Polaris Ad Hoc Group on Long Range Research and Development.

R. W. Hart, author of "Combustion Instability in Solid Rockets," was born in Yankton, S.D., and received his B.A. and M.S. degrees from the University of Iowa, and his Ph.D. degree in physics from the University of Pittsburgh in 1949. He was a

lecturer and instructor in physics at the University of Pittsburgh and later at the Catholic University of America. Dr. Hart came to APL in 1950 as a physicist in the Research Center Task

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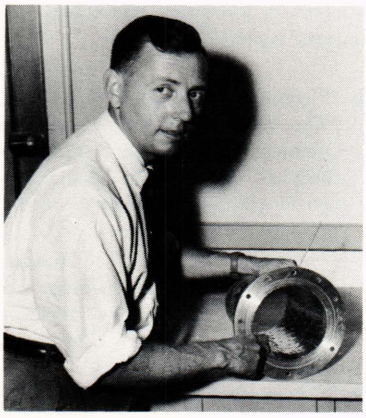

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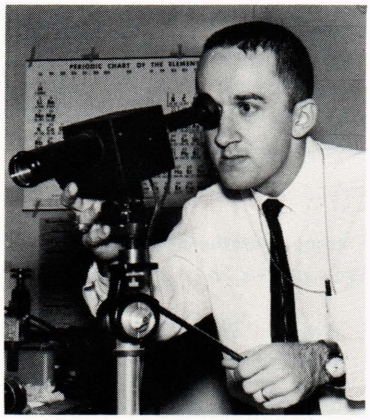

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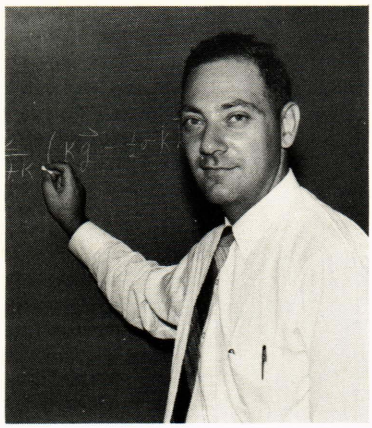
Group and is currently Supervisor of that group. He has contributed to the development of theories of ramjet engine optimum performance, to low-angle beam-rider missile guidance, statistical mechanics, scattering theory, and microwave spectroscopy, and has directed research in other fields related to the APL missile programs. Dr. Hart is a member of the American Physical Society, the Washington Academy of Science, and the Washington Philosophical Society.

L. Monchick, co-author of "Relaxation Phenomena in the Kinetic Theory of Gases," received his A.B., M.A., and Ph.D. degrees in chemistry from Boston University. He is a native of Boston, Mass. Dr. Monchick was employed by the Air Force Cambridge Research Center, the Department of Chemistry of Notre Dame University, and Knolls Atomic Power Laboratory, General Electric Co., before coming to APL in 1957. He is a specialist in liquid ammonia calorimetry, evaporation from liquid surfaces, radiation chemistry, diffusion controlled reactions, and calculations of gas transport properties. Currently, Dr. Monchick is a chemist in the High Temperature Physics and Chemistry Project of the Bumblebee Flight Research Group and is working on gas transport properties. He is a member of the American Chemical Society and the American Physical Society.



E. A. Mason, co-author of "Relaxation Phenomena in the Kinetic Theory of Gases," is a native of Atlantic City, N. J. He received his B.S. degree from the Virginia Polytechnic Institute and his Ph.D. degree in physical chemistry in 1951 from the Massachusetts Institute of Technology. Dr. Mason, now professor of molecular physics at the Institute for Molecular Physics, the University of Maryland, has held fellowships at the Massachusetts Institute of Technology and the University of Wisconsin. He was assistant professor of chemistry at Pennsylvania State University from 1953–1955, and associate professor of molecular physics at the University of Maryland before his present appointment. He is a member of the American Chemical Society, the American Physical Society, the New York Academy of Sciences, and the American Association for the Advancement of Science.