

Dan L. Philen, Ph.D.

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Summary

Recent experience includes eight years teaching general chemistry and physical chemistry laboratory at the university level. Prior experience includes over 26 years in industrial research. Techniques of physical and analytical chemistry were used to evaluate properties of optical fibers for undersea applications. Duties included project management and technical supervision of other scientists and engineers. Accomplishments included numerous publications, patents, book chapters, and awards for excellence in presentations and technical writing.

Education:

06/75 Ph.D. Physical Chemistry, Texas A&M University
06/68 B.S. Chemistry, Auburn University

Experience:

Georgia Gwinnett College

- Professor teaching introductory freshman chemistry and laboratory. **2011 - Present**

Auburn University

- Director, Advanced Chemistry Laboratories, Auburn University. **2009 - 2010**
Responsible for teaching analytical, physical, inorganic, and instrumental analysis laboratories. Duties include maintaining, GC and fluorescence spectrometers, IR and UV-VIS spectrometers, atomic absorption and GC- Mass spectrometers, plus magnetic susceptibility, and differential scanning calorimeters.

Emory University

- Director, Physical Chemistry Laboratories. Responsible for evaluating **2004 -2009**
and maintaining all physical chemistry laboratory experiments. Developed and documented new experiments on the viscosity of gases and Raman spectroscopy. Courses taught: Physical Chemistry lab 331L and 332L, technical writing 332LWR, Quantitative Chemical Analysis 260, and Instrumental Analysis 360.

Georgia Perimeter College

2003-2004

- Professor teaching freshman chemistry lecture and laboratory courses

OFS Fitel (Formerly Lucent Technologies)

2001-2002

Senior Product Manager, Ocean Fiber Products,

- Manager for Optical Fiber for undersea applications. Responsibilities included developing new customers for ocean fiber while maintaining a strong relationship with existing customers for a \$80-\$120M business. Supervised one product manager.

Lucent Technologies, and AT&T Bell Laboratories**1979-2001***Project Manager - Ocean fiber final operations.*

- Worked as project manager responsible for meeting technical requirements of customers. Responsible for translating customer requirements into manufacturing specifications and examining shipping performance to insure specification compliance to reduce defective products and returns. Resulted in keeping a major \$80M customer, and receiving the Network Systems Group Quality Team Excellence Award.
- Saved tens of millions of dollars in defective product by solving a manufacturing problem in finished cable at a customer's cable factory. Received the AT&T Submarine Systems, Ernest Shackleton award for outstanding performance.
- Created statistical analysis tools to generate customer reports and product audit reports using "S" statistical programming language in Unix. Resulted in timely product updates for the customers. Developed fiber selection programs using Basic and Perl .

Technical Manager, Optical Fiber Measurement, 1991-1992

- Developed new measurement techniques and carried out oversight responsibility for factory and production fiber measurements. Supervised 8-10 engineers and technicians.

Product Line Manager for Optical fiber and cable. AT&T Network systems, 1989-1991

- Maintained product responsibility for tactical military fiber and cable, premise cable, specialty fiber, and undersea fiber product lines. Supervised 5 product managers.
- Directed project team responsible for implementing use of "dispersion shifted fiber" (previously a specialty fiber only) into cable for Telmex (Mexico) resulting in Mexico having the first high capacity long distance network using optical fiber cable. Led to AT&T offering that cable as a product in the U.S., and it became one of the most profitable lines.

Member of Technical Staff, Exploratory Fiber Measurements group, 1979-1989

- Responsible for: chirping of solid state lasers, loss coefficient measurements, color center lasers, fiber Raman lasers, material dispersion of fibers, OH diffusion in fibers, single mode fiber OTDR, fiber and cable strain, hydrogen diffusion in fibers, specifications for single mode fibers. Served as the Laboratory Laser Safety Officer.

Experience prior to 1979**1976-1979**

Georgia Tech Engineering Experiment Station, *Staff Scientist*. Lead scientist for project GAMETAG, "Global Atmospheric Measurements Experiment of Tropospheric Aerosols and Gases" using laser spectroscopy. Held "Top Secret" clearance for DARPA. Published paper with 1995 Nobel Laureate, Paul Crutzen.

1976

University of Maryland, *Postdoctoral Fellow*. Worked on spectroscopy and photochemistry of ozone and OH free radicals.

1975

Rice University, *Robert A. Welch Postdoctoral Fellow*. Worked on the molecular physics and spectroscopy of NH₂ free radicals. Published paper with 1996 Nobel Laureate, Robert Curl.

Military**1969-1970**

Instructor, Oxygen and Acetylene Production, U.S. Army, Corps of Engineers, Ft. Belvoir, Va., 56th Engineering. Detachment., HHC 91st, Engr. Battalion.

Computer Skills

Unix system administrator for Silicon Graphics and Sun Workstations, proficient in "S" Statistical programming language, AWK, Perl and Basic, and common PC programs such as Word, Excel, and PowerPoint.

Organizations

American Chemical Society, Optical Society of America, Phi Lambda Upsilon - Chemistry Honorary, Sigma Pi Sigma - Physics Honorary, American Association for the Advancement of Science, Sigma Xi – The Research Society of North America.

Other Activities

Member, Advisory Council, College of Science and Mathematics, Auburn Univ.
 Judge: DeKalb & Rockdale Co. Science Fair, Georgia State Science Fair 2009-2011.
 Intel International Science Fair 2008-2011
 Reviewer: Applied Optics, Optics Letters, Journal of Lightwave Technology

Honors and Awards

- 1992 Distinguished Member of Technical Staff, awarded for long term outstanding scientific and technical accomplishments and value to the organization.
- 1993 AT&T Submarine Systems, Ernest Shackleton Award in recognition of outstanding contribution to International Facilities Management and Submarine Systems.
- 1994 Network Systems Group Quality Team Excellence Award.
- 1996 Best Presentation Award, 44th International Wire and Cable Symposium
- 2001 Commendation for Excellence in Technical Communications, WDM Magazine

Book Chapters

"Optical Fiber Transmission," **Dan L. Philen** and William T. Anderson, in the book: "Optical Fiber Telecommunications II", edited by Stu Miller and Ivan Kaminow, Academic Press, November, 1988.

"Measurement and Characterization of Optical Fibers," **Dan L. Philen**, in the book, "Optoelectronic Technology and Lightwave Communications Systems" edited by, Chinlon Lin, and published by Van Nostrand Reinhold, 1989.

Patents

1. Measurement of Excess Length of Cabled Optical Fibers. Patent Number: 4,555,175 - W. B. Gardner, P. D. Patel, **D. L. Philen**, and M. R. Santana. Granted November 26, 1985.
2. Underwater Optical Fiber Cable. Patent Number: 4,974,926 - J. J. Blee, N. E. Hardwick, III, L. C. Hotchkiss, and **D. L. Philen**. Granted December 4, 1990.
3. High Resolution Zero-Dispersion Wavelength Mapping in Single Mode Fiber. Patent Number 6,118,523 - Igal M. Brener, David J. Thompson, Partha P. Mitra, Daniel D. Lee, and **Dan L. Philen**, Granted Sept. 12, 2000

Publications and Presented Papers

1. "New Dispersion-slope Managed Fiber Pair for Undersea Fiber Optic Transmission Systems," Stig Knudsen, David W. Peckham, Morten Pederson, **Dan L. Philen**, Torben Veng, Louis Pritchett, and Lars Gruner-Nielsen, Sub Optics Conference, paper T4.2.2, Kyoto, Japan, May 2001.
2. "Fiber Pairs Provide Submarine Solution," **Dan L. Philen**, Stig Knudsen, and David W. Peckham, WDM Solutions magazine, April 2001.
3. "Measurement of the Non-Linear Index of Refraction, n_2 ," **D. L. Philen** NBS Symposium on Optical Fiber Measurements, invited paper, pp 39-44, Boulder, Co., September 2000.
4. "Cancellation of the Kerr Non-Linearities in Long Fiber Spans using a LiNbO_3 Phase Conjugator and Raman Amplification," I. Brener, B. Mikkelsen, K. Rottwitt, W. Burkett, G. Raybon, J. B. Stark, K. Parameswaran, M.H. Chow, E. E. Chaban, R. Harel, S. Kosinski, **D. L. Philen**, Bell Labs, with M.M Fejer, Stanford, Univ., Post Deadline paper, Optical Fiber Communications Conference, Baltimore, Md., March, 2000.
5. "Measurement of the Non-Linear Index of Refraction, n_2 , for Various Fiber Types," **Dan L. Philen**, David W. Peckham, and Igal Brener, Optical Fiber Communications Conference, OFC 2000, Baltimore, Md, March 2000.
6. "Efficient wide-band and tunable midspan spectral inverter using cascaded nonlinearities in LiNbO_3 waveguides", Chow MH, Brener I, Lenz G, Scotti R, Chaban EE, Shmulovich J, **Philen D**, Kosinski S, Parameswaran KR, Fejer MM. IEE Photonics Technology Letters 12 (1) 82-84, January 2000.
7. "Old Physics and New Telecommunications: The Internet Undersea," **Dan L. Philen**, Industries of the Mind, Physics and Economic Growth, invited paper, American Physical Society 100th year Symposium, March 16, 1999.
8. "High Resolution Zero-Dispersion Wavelength Mapping in Single-Mode Fiber", I. Brener, P.P. Mitra, D.D. Lee, D.J. Thompson, and **D.L. Philen**, Optics Letters Vol 23., No. 19., October 1, 1998.

9. "A new Technique for Zero-Dispersion Wavelength Mapping in a Single Mode Fiber with High Spatial Resolution," I. Brener, D.D. Lee, P.P. Mitra, **D. L. Philen** and D.J. Thompson, NBS Symposium on Optical Fiber Measurements, pp163-164, September, 1998.
10. "Optical Fiber for Amplified Undersea Systems", **D. L. Philen**, R. B. Kummer, D. Kalish, D. Peckham, J. Darsey, R. Heyda, A. Klein, S. Siddiqui, R. Moore, C. Taylor, A. Meixner, S. Shapiro, L. Marra, R. Tuminaro, D. Applegate, Proceedings of the 44th International Wire and Cable Symposium, Philadelphia, Nov. 13-17, 1995.
11. "The Design and Manufacture of Fiber and Cable for Undersea Optical Amplifier Systems", Robert Franz, Kwang Kim, Louis Marra, **Dan L. Philen**, Marsha Stix, and Ray Tuminaro, 42nd International Wire and Cable Symposium, St. Louis, Mo., November 1994.
12. "Minimization of Transmission Losses in Undersea Optical Fiber Cable", George Decker, Arturo Hale, **Dan Philen**, and Robert Traut, 9th Yield and Reliability Improvement Workshop, AT&T Murray Hill, N.J., April 5-6, 1994.
13. "Optical Amplifiers – A New Challenge in the Design and Manufacture of Undersea Fiber Cable and Joints", Robert Franz, Kwang Kim, Louis Marra, R. K. Samras, Marsha Stix, Ray Tuminaro, and **Dan L. Philen**, Sub-Optic Submarine Conference, Versailles, France, March 1993.
14. "Telecommunications System Solutions for Telefonos de Mexico, S.A. de C.V." **D. L. Philen**, M. Q. Garvin, J. Garcia-Acre, W. Botermans., and E. Gomez-Chibli, AT&T Technical Journal, June 1992.
15. "Trends In Optical Fiber Technology", **Dan L. Philen**, Society of Cable Television Engineers, proceedings of Fiber Optics, Monterey, Ca., March 21-23, 1990.
16. "Defect Formation and Related Radiation and Hydrogen Response in Optical Fiber Manufactured by MCVD," K.T. Nelson, **D.L. Philen**, R.M. Atkins, P.J. Lemare, J. R. Simpson, K.L. Walker, S. Wong, Optical Fiber Communications Conference, San Francisco, Ca., Jan. 1990.
17. "Corrosion Resistant Armor to Prevent H₂ Induced Loss in Underwater (Wire-Armored) Fiber Optic Cable" N.E. Hardwick, L. C. Hotchkiss, J.J. Blee, and **D. L. Philen**. 38th International Wire and Cable Symposium, Atlanta, Ga., Nov., 1989.
18. "Fundamentals of Optical Fiber Communications", **Dan L. Philen** and Robert M. Morais, 11th Ship Technology and Research Symposium, Society of Naval Architects and Marine Engineers, Pittsburgh, Pa., June 1988.
19. "Optical Fiber Communications" **D. L. Philen**, National Research Council, Transportation Research Board, Annual Meeting, January 14, 1987, Wash. D.C.
20. "Laser Safety and Fiber Optics," **D. L. Philen**, Florida Department of Transportation, Orlando Utilities Commission, January 15, 1987, Orlando, Florida.
21. "Laser Safety and Fiber Optics," **D. L. Philen**, National Utility Contractors Association, National Convention, February 5-6, 1987, Orlando, Florida

22. "Lasers and Optical Fiber Technology," **D. L. Philen**, International Right of Way Association, April 14, 1987, Denver, Co.
23. "Dispelling the Myths of Fiber Optics," **D.L. Philen** and J. Edwards, One-Call Systems Annual Symposium, April 24-27, Baniff Springs, Canada.
24. "Fiber Technology – Managing Communications Costs," **D. L. Philen** and J. Edwards, One-Call Systems Annual Symposium, April 24-27, Baniff Springs, Canada.
25. "Fiber Optics in Communications," **D. L. Philen**, AT&T Network Training Organization, AT&T Bedminster, N.J. April 30, 1987
26. "Fiber Optic Technology – A Tutorial " **D. L. Philen**, Dept. of the Interior Telecommunication Conference, May 14, 1987, Albuquerque, N.M.
27. "Taping and Security of Optical Fibers" **D. L. Philen**, Department of State, June 2, 1987, Wash. D.C.
28. "Fiber Optics Technology", **D. L. Philen**, Highway Engineering Exchange Program, June 5, 1987, Nashville, TN.
29. "Local Area Networks and Fiber Optics", **D. L. Philen**, Society of Naval Architects and Marine Engineers, August 27, 1987, Atlanta, Ga.
30. "Safety and Protection in the Outside Plant," **D.L. Philen**, American Public Works Association Annual Meeting, September 26, 1987, Toronto, Canada.
31. "Optical Fiber Technology," **D. L. Philen**, Highway Engineering Exchange Program, 29th International Meeting, October 9, 1987, Des Moines, Iowa.
32. "Safety and Liability Issues in Optical Fiber Communications," **D. L. Philen**, R. C. Petersen, A. Wakefoose, and J. Edwards, Telephony, October, 1986.
33. "Hazards of Lasers Used in Telecommunications," **D. L. Philen**, R. C. Petersen, A. Wakefoose, and J. Edwards, National Utility Contractor, August, 1986.
34. "Safety Issues Concerning Diode Lasers Used in Telecommunications Systems," R. C. Petersen and **D. L. Philen**, IWCS, Reno, November, 1986.
35. "Study of Algorithms Used to Fit Group Delay Data for Single-Mode Optical Fibers," W. A. Reed and **D. L. Philen**, NBS Measurements Symposium, Boulder, September, 1986.
36. "Measurement of Dopants in Optical Fibers by Raman Scattering," **D. L. Philen**, NBS Measurements Symposium, Boulder, September, 1986.
37. "The Effect of Fluorine and Phosphorus on the UV-excited Fluorescence in Germania-Doped Silica Optical Fiber Preforms," H. T. Shang, **D. L. Philen**, and P. F. Glodis, OFC '86, Conference on Optical Fiber Communication, February 24-26, 1986, Atlanta, Ga.

38. "Bandwidth and Cut-Off Wavelength of Single Mode Lightguide - System Considerations", R. W. Tarwater, D. G. Duff, M. J. Maslaney, **D. L. Philen**, and F. T. Stone, 33rd International Wire and Cable Symposium, November, 1984, Reno, Nev.
39. "Prevention of Hydrogen Gas Induced Loss in Optical Fibers by Proper Lightguide Cable Design", **D. L. Philen** and C. H. Gartside, 33rd International Wire and Cable Symposium, November, 1984, Reno, Nev.
40. "Nonionizing Radiation Aspects of Optical Fiber Manufacturing," R. G. Huggins, P. A. Testagrossa, R. C. Peterson, **D. L. Philen**, and J. M. Turnipseed, American Industrial Hygiene Association Journal, 45, 796 (Dec. 1984).
41. "Pressure Dependence of Water Diffusion in Single Mode Fibers" **D.L. Philen**, Optical Fiber Communications, OFC '84, New Orleans, January, 1984
42. "Hydrogen Induced Loss - The Impact of Cable Design," Colloquia on Implementation and Reliability of Optical Fiber Cable Links, **D. L. Philen**, C. H. Gartside III, W. D. Reents Jr., and M. G. Chan. London, June 11-12, 1984.
43. "Hydrogen Susceptibility Studies Pertaining to Optical Fiber Cables," E. W. Mies, **D. L. Philen**, W. D. Reents, and D. A. Meade, Topical Meeting on Optical Fiber Communications, Paper W13, New Orleans, La., January 23-25, 1984.
44. "Thermally Induced Refractive-Index Changes in a Single-Mode Optical-Fiber Preform," W. T. Anderson, P. F. Glodis, **D. L. Philen**, C. L. Bice, and A. A. Schenk, Topical Meeting on Optical Fiber Communications, Paper TUN10, New Orleans, La., January 23-25, 1984.
45. "Chromatic Dispersion Measurements in Single Mode Fibers Using Picosecond Indium Gallium Arsenide Phosphide Injection Lasers In The 1.2 - 1.5 Micron Spectral Region," C. Lin., A. R. Tynes, A. Tomita, P. Liu, and **D. L. Philen**, Bell System Technical Journal, 62 (2), 457-462, Feb. 1983.
46. "Spot Size Measurements In Single-Mode Fibers," W. T. Anderson and **D. L. Philen**, Topical Meeting on Optical Fiber Communications, Paper MK4, New Orleans, La., February 28-March 2, 1983.
47. "Spot Size Measurements For Single-Mode Fibers - A Comparison of Four Techniques," W. T. Anderson and **D. L. Philen**, J. of Lightwave Technology, Vol. LT-1, No. 1, March 1983.
48. "Single Mode Fiber OTDR: Experiment and Theory," **D. L. Philen**, I. A. White, J. F. Kuhl, and S. C. Mettler, IEEE Journal of Quantum Electronics Special Issue on Guided Wave Technology, October 1982.
49. "Experiment and Theory of Very Long Length Single Mode OTDR," **D. L. Philen**, I. A. White, J. F. Kuhl, and S. C. Mettler, 1st International Congress on Applications of Lasers and Electro Optics, Boston, September 1982.
50. "Measurements of Strain In Optical Fiber Cables Using A Commercial Distance Meter," **D. L. Philen** and P. D. Patel, Eighth European Conference on Optical Communication, Cannes, France, September 1982.

51. "Analysis of The Fluorescence Method of Profiling Single Mode Optical Fiber Preforms," **D. L. Philen** and W. T. Anderson, Topical Meeting on Optical Fiber Communication, Phoenix, Arizona, April 1982.
52. "Picosecond Dispersionless Transmission of InGaAsP Injection Laser Pulses at the Minimum Chromatic Dispersion Wavelength in a 27 km long Single Mode Fiber" C. Lin, A. Tomita, A.R. Tynes, P.F. Glodis, **D.L. Philen**, Electronics Letters, Vol. 18, No. 20, pp882-884 (1982)
53. "Pulse Delay Measurements In Single-Mode Fibers Using Picosecond InGaAsP Injection Lasers In The 1.3um Spectral Region," Chinlon Lin, A. R. Tynes, A. Tomita, P. L. Liu, and **D. L. Philen**, Topical Meeting on Optical Fiber Communication, Phoenix, Arizona, April 1982.
54. "Measurements of OH Diffusion In Optical Fiber Cores," **D. L. Philen**, Bell System Technical Journal, Vol. 61, No. 3, March 1982, PP. 283.
55. "Color Center Laser Measurements of OH Diffusion In Optical Fiber Cores," **D. L. Philen**, Third International Conference on Integrated Optics and Optical Fiber Communication, San Francisco, April 1981.
56. "Direct Measurement of Scattering Losses In Single-Mode and Multi-mode Optical Fibers," **D. L. Philen** and F. T. Stone, Advances In Ceramics, Vol.2, Physics of Fiber Optics, The American Ceramics Society, Columbus, Ohio, edited by B. Bendow and S. S. Mitra, 1981.
57. "Optical Time Domain Reflectometry on Single Mode Fibers Using A Q-Switched Nd: YAG Laser," **D. L. Philen**, NBS Symposium on Optical Fiber Measurements, October 28-29, 1980, Boulder, Colorado.
58. "The Use of A Scattering Cube to Characterize the Spectral Loss of Optical Fibers," **D. L. Philen** and F. T. Stone, NBS Conference on The Basic Properties of Optical Materials.
59. "Direct Measurement of Scattering Losses in Single-Mode and Multi-mode Optical Fibers," **D. L. Philen** and F. T. Stone, American Ceramics Society Annual Meeting, Chicago, Illinois, April 28-30, 1980.
60. "Airborne Laser Induced Fluorescence System for Measuring OH and Other Trace Gases in the Parts-Per-Quadrillion to Parts-Per-Trillion Range," D. D. Davis, W. S. Heaps, **D. L. Philen**, M. Rodgers, T. McGee, A. Nelson, and A. J. Moriarty, Rev. Sci. Instrum., 50, 1505 (1979).
61. "Boundary Layer Measurements of the OH Radical in the Vicinity of An Isolated Power Plant Plume: O₂ and NO₂ Chemical Conversion Times," D. D. Davis, W. Heaps, **D. L. Philen**, and T. McGee, Atmospheric Environment, 13, 1197 (1979).
62. "Boundary Layer and Free Tropospheric OH Measurements at Tropical and Sub-Tropical Latitudes in the Northern and Southern Hemispheres," **D. L. Philen**, W. Heaps, and D. D. Davis, Fall 1978 Meeting of the American Geophysical Union, San Francisco.

63. "Remote Tropospheric NO and NO₂ Levels As Estimated From Simple NO_x Photochemistry and In-Situ Measurements of HNO₃ and OH." P. Crutzen, W. Chameides, B. Huebert, A. Lazrus, W. Heaps, **D. L. Philen**, and D. D. Davis, Fall 1978 Meeting of the American Geophysical Union, San Francisco.
64. "Lasers Applied to Chemical Kinetics," **D. L. Philen**, A. R. Ravishankara and F. P. Tully, Invited Paper, Lasers '78, Orlando, Florida, December 1978.
65. "An Advanced Aircraft Compatible Laser Induced Fluorescence System: In Situ Measurements of Atmospheric Trace Gases," D. D. Davis, **D. L. Philen** and M. Rodgers, Lasers '78, Orlando, Florida, December 1978.
66. "An Aircraft Compatible Laser Induced Fluorescence System: In Situ and Remote Measurements of Trace Gases," D. D. Davis and **D. L. Philen**, Fourth Symposium on Meteorological Observations and Instrumentation, Denver, Colorado, April 1978.
67. "High Resolution Absorption Cross Sections for the A₂ - X₂ System of ClO," P. H. Wine, A. R. Ravishankara, **D. L. Philen**, D. D. Davis, and R. T. Watson, Presented at the Spring 1977 Meeting of the American Geophysical Union, Washington, D.C.
68. "High Resolution Absorption Cross Sections for A₂ - X₂ System of ClO," P. H. Wine, A. R. Ravishankara, **D. L. Philen**, D. D. Davis, and R. T. Watson, Chemical Physics Letters, 50, 101 (1977).
69. "A Quantum Yield Determination of O¹D Production from Ozone Via Laser Flash Photolysis," **D. L. Philen**, R. T. Watson, and D. D. Davis, J. Chem. Physics, 67, 3316 (1977).
70. "Direct Measurement of Natural Tropospheric Levels of OH Via An Aircraft Borne Tunable Dye Laser," D. D. Davis, T. McGee, W. Heaps, and **D. L. Philen**, The Non-Urban Tropospheric Composition Symposium, Miami, November 1976.
71. "Saturation Spectroscopy of NH₂ Using a CW Dye Laser," G. W. Hills, **D. L. Philen**, R. F. Curl, and F. K. Tittel, Chemical Physics, 12, 107 (1976).
72. "A Quantum Yield Determination of O¹D Production from Ozone Via Laser Flash Photolysis," **D. L. Philen**, R. T. Watson, D. D. Davis, The 12th Informal Conference on Photochemistry, NBS, Maryland, June 1976.
73. "S₁ and S₂ Fluorescence of Fluoranthene," **D. L. Philen** and R. M. Hedges, Chemical Physics Letters, 43, 358 (1976).
74. "Laser-Excited Time-Resolved Fluorescence of Fluoranthene," **Dan L. Philen** and Richard M. Hedges, Southwest Regional ACS Meeting, December 1974.
75. "Some New Light on Black and White Slides," D. Brooks, **D. L. Philen**, and R. M. Hedges, J. Chem. Ed., 50, 566 (1973).
76. "Vibrational Analyses of Silacyclopentanes," **D. L. Philen**, T. Chao, and J. Laane, J. Mol. Struct., 16, 417 (1973).