

RESOURCE LETTER

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This is one of a series of Resource Letters on different topics intended to guide college physicists, astronomers, and other scientists to some of the literature and other teaching aids that may help improve course contents in specified fields. No Resource Letter is meant to be exhaustive and complete; in time there may be more than one letter on some of the main subjects of interest. Comments on these materials as well as suggestions for future topics will be welcomed. Please send such communications to the AAPT Resource Letters Editor.

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Resource Letter PhD-1: Physics demonstrations

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This Resource Letter has been prepared as a project of the AAPT Committee on Apparatus for Educational Institutions. It represents a response to questions raised at the 1978 winter meeting in San Francisco concerning sources of information on lecture demonstrations. Thus, this letter is aimed more at readers who have recently become interested in lecture demonstrations, rather than those who are already familiar with the literature. While the authors have examined a great deal of material, and have had help from many people, there are always materials which have been overlooked. Therefore, we earnestly request that any reader with suggestions or corrections please communicate with the authors so that they may be included in any future updating. Because of the introductory scope of this Resource Letter, we have not included all of the resources that are available. Most foreign works, books known to be out of print, items having small circulation, and textbooks and earlier editions bearing differing titles have been excluded. The reader may refer to the annotated bibliography by John A. Davis (Sec. I B5) for a more extensive listing of the literature. When possible, the annotations are followed by one or more reviews so that other opinions can be consulted.

I. BASIC LITERATURE FOR LECTURE DEMONSTRATIONS

In this section we will consider those sources which in our judgement are primarily concerned with lecture demonstrations.

A. Monographs

We consider the following four books to be the best basic books on lecture demonstrations and we recommend them as the minimum library for anyone seriously interested in lecture demonstrations.

1. **A Demonstration Handbook for Physics**, G. D. Freier and F. J. Anderson (Freier and Anderson, Minneapolis, Minnesota, 1972). This is probably the second-best single reference for lecture demonstrations presenting a fairly complete sequence of demonstrations

(apart from modern physics) for a high school or college course in general physics. Every physics teacher should possess a copy of this well illustrated work. See the review for special ordering information. Rev.: Phys. Teach. **11**, 252 (1973). This book will shortly be out of print, and, unless it is revised, will no longer be available.

2. **Physics Demonstration Experiments at William Jewell College**, Wallace A. Hilton (The Pillsbury Department of Physics, Liberty, Missouri, 1971). An outstanding lecture demonstration reference. 299 demonstrations with many photographs and journal reprints. Another best buy. Order from the author.
3. **Physics Demonstration Experiments**, 2 Vols., Harry F. Meiners (The Ronald Press Co. for the AAPT, New York, 1970). A monumental work, this is the second "bible" for the lecture demonstrator. It is an excellent source of ideas, information, and construction details, and also contains some excellent reading on the philosophical aspects of lecture demonstrations. Over 1100 experiments, 2200 photographs and line drawings. Rev.: Am. J. Phys. **40**, 641 (1972); Phys. Tod. **24**, 50 (1971); J. Acoust. Soc. Am. **50**, 53 (1971); Phys. Teach. **10**, 482

(1972); *Nature* **233**, 71 (1971).

4. **Demonstration Experiments in Physics**, Richard Manliffe Sutton (McGraw-Hill, New York, 1938). Although somewhat dated, this is probably the best single book on lecture demonstrations for the "beginner." The reader will find many useful ideas, no matter at what level he teaches. It was noted in one of the reviews that probably half of the nearly 1200 demonstrations involve apparatus that is within the range of the average high school. As of January 1979 this book was no longer available; check your library. *Rev.: Am. Phys. Teach.* **3**, 85 (1935); *Am. Phys. Teach.* **6**, 106 (1938); *Elec. J.* **35**, 451 (1938); *Elec. Rev. (London)* **123**, 516 (1938); *Philos. Mag. Ser. 7*, 27 (1939); **7**, 260 (1939); *Rev. Sci. Instrum.* **10**, 111 (1939).

B. Bibliographies and indexes

In this section we list a few of the very specific bibliographies available on the subject of lecture demonstrations. It is also useful to look through the annual indexes of the standard journals listed in Sec. II E.

5. **"Physics Lecture Demonstrations: An Annotated Bibliography, Part I,"** John A. Davis, *Phys. Teach.* **12**, 523 (1974). An alphabetical listing of all kinds of sources which are related in whole or in part to lecture demonstrations. Part II, consisting of an update of Part I, plus the pedagogical aspects, techniques, and tradition of lecture demonstrations, will be published in the near future.
6. **"Ten Year Cumulative Indexes,"** *Am. J. Phys.* (1932-52, 1953-62, 1962-72). The three ten-year cumulative indexes are a must if one wishes to find his way quickly to individual lecture demonstration articles and notes in the journal.

C. Conferences

7. **Proceedings of the Wesleyan University Conference on Lecture Demonstrations**, V. E. Eaton, C. J. Overbeck, and R. P. Winch (AAPT, Middletown, CT, 1959). We wish to list this one-of-a-kind reference even though it had a limited distribution. It contains valuable information on most aspects of lecture demonstrations. It is excellent reading material for the demonstrator if a copy can be located.
8. **"A Summer Course in Demonstrations,"** Vincent Mallette, *Phys. Teach.* **11**, 233 (1973). Describes an extremely successful NSF sponsored short course offered by the U.S. Naval Academy department of physics during 1971-73.

D. Other books

These books are considered to be primarily related to lecture demonstrations and useful additions to anyone's library.

9. **Accessories and Demonstration Manual [Electrostatics]** (Pasco Scientific, San Leandro, CA, 1971). This booklet has two sections: electrostatic accessories and electrostatic demonstrations. It contains good hints on the do's and don't's of electrostatic demonstrations, particularly while using the manufacturer's apparatus.
10. **Apparatus Notes, September 1960-June 1965, Reprinted from the American Journal of Physics**, [Pub. R-185] Center for Educational Apparatus in Physics (AAPT and AIP, New York, 1965). A reprint booklet containing the apparatus notes cited in the title. Although out of print, it is still available from University Microfilms, Ann Arbor, MI, in xerographic copy. This publication is useful to have because the notes were published in the advertising section of the journal which are normally discarded when the volumes are bound.
11. **Apparatus Notes: July 1965-December 1972, Reprinted from the American Journal of Physics**, Committee on Apparatus of the American Association of Physics Teachers (AAPT, Stony Brook, 1974). Second volume of reprints of apparatus notes from the *American Journal of Physics* covering the period July 1965 to December 1972.

12. **Apparatus for Teaching Physics: Reprints of Articles from The Physics Teacher, April 1963-December 1971**, Committee on Apparatus for Educational Institutions (AAPT, Washington, D. C., 1972). The title is self-descriptive. This reprint volume is an excellent resource work. It is a best buy and highly recommended.
13. **Lecture Experiments in Optics**, B. K. Johnson (Arnold, London, 1930). This is a good reference book with excellent diagrams, apparatus lists, and directions for conducting basic optics demonstrations.
14. **Physics Teachers Guide: Effective Classroom Demonstrations and Activities**, David Kutliroff (Parker, West Nyack, NY, 1970). Aimed at high school teachers.
15. **Demonstrations in Physics**, Julius Sumner Miller (Ure Smith, Sydney, Australia, 1969). This out-of-print work describes many simple demonstrations and asks many teaching questions about each demonstration in the hope of "transforming just looking into seeing and just listening into hearing." Answers are not provided.
16. **Electrostatics**, A. D. Moore (Doubleday, New York, 1968). Discusses and describes most of the electrostatic generators and associated demonstrations we perform with them. Includes a good explanation of the Kelvin water generator.
17. **Demonstrations in Modern Physics**, Malcolm C. Nokes (Heinemann, London, 1952). This book of "suitably simplified, fundamental experiments" is one of few works treating modern physics demonstrations. Most of these use materials and equipment that are generally available. *Rev.: Brit. J. Appl. Phys.* **4**, 30 (1953).
18. **Optics: Experiments and Demonstrations**, C. H. Palmer (Johns Hopkins, Baltimore, MD, 1962). An excellent demonstration resource for optics. Each experiment is described with notes on theory, apparatus, procedure, and references. *Rev.: J. Opt. Soc. Am.* **53**, 1116 (1963).
19. **Physics Demonstrations**, edited by Shoma Kutasov (Penn Books, Los Angeles, 1978). A general and fairly complete collection of demonstrations performed with somewhat dated equipment. The written descriptions vary between extremely brief and nonexistent.
20. **Physics Fun and Demonstrations, with Professor Julius Sumner Miller**, edited by R. C. Blasi, F. H. Gunzel, and J. McCarthy (Central Scientific, Chicago, 1974). Second edition of **Physics Fun and Demonstrations**, 1968, with 200 demonstrations and experiments at the basic level using equipment kits from Central Scientific.
21. **Physics Handbook** (Bureau of Secondary Curriculum Development, the State Education Department, The University of the State of New York, Albany, 1970). Contains hundreds of ideas for making apparatus, performing demonstrations, and teaching difficult concepts. Includes safety hints and lists of recommended apparatus and equipment. Another best buy at \$0.50. One of us (B.G.E.) was unsuccessful at obtaining a copy from the above source.
22. **Einführung in die Physik**, 3 Vols., R. W. Pohl, (Springer, Berlin, numerous editions). Probably the best German reference for lecture demonstrations. Two volumes of this classic have been translated into English by Winifred M. Deans and published by Glasgow, Blackie, and Son, London: **Physical Principles of Electricity and Magnetism**, 1930, and **Physical Principles of Mechanics and Acoustics**, 1932 and 1951.
23. **Science Magic**, K. M. Swezey (McGraw-Hill, New York, 1952). Contains many intriguing demonstrations using the simplest of equipment. Good for all ages. *Rev.: Nat. Hist.* **61**, 476 (1952).
24. **Science Shows You How: Exciting Experiments that Demonstrate Basic Principles**, K. M. Swezey (McGraw-Hill, New York, 1964). Written expressly for the young. Some basic demonstrations simply done.
25. **New UNESCO Source Book for Science Teaching**, UNESCO (UNESCO, Paris, 1973). An excellent resource of demonstration ideas using simple apparatus.
26. **The Flying Circus of Physics**, Jearl Walker (Wiley, New York, 1974). A superb collection of ideas, 619 in all, most of which can be used to enrich any physics lecture or laboratory.
27. **The Flying Circus of Physics with Answers**, Jearl Walker (Wiley, New York, 1977). An updated version of the first "Circus" with answers to ease our embarrassment.

E. Journals

There are many articles directly related to lecture demonstrations which appear in many journals. Some of these articles have been listed in the bibliographies mentioned in Sec. II B. Others are listed in the annual indexes of the journals mentioned in this section. For space reasons we do not list all of these articles here but recommend that interested readers refer to the cumulative indexes mentioned in Sec. II B, or the annual indexes of the journals listed below.

28. **American Journal of Physics**, published for the AAPT by AIP. The forerunner of this journal was the *American Physics Teacher*, which was started in 1933 and kept that title for the first seven volumes. Besides the regular articles section, there are a number of different sections, and section titles, some of which have been, and still are, particularly useful for lecture demonstration information. We list some of these sections below.

"Apparatus, Lecture Demonstration, and Laboratory"

This section of the *American Physics Teacher* first appeared in Vol. 1 and continued through the first issue of Vol. 5. This column continued through No. 4 of Vol. 7 under some of the following titles: "Notes on Apparatus, Experiments, and Demonstrations"; "Apparatus and Demonstrations"; and "Notes on Apparatus and Demonstrations."

"Notes and Discussions"

This column replaced "Apparatus, Lecture Demonstration, and Laboratory," and its successors. It began with No. 6 of Vol. 7 (*Am. Phys. Teach.*), and continues through the current issue.

"Apparatus Notes"

This section appeared in the advertising section of most issues from September 1960–May 1968. The notes up to June 1965 were gathered together in a reprint booklet (see listing 10). The title of this section was changed to "Lecture and Demonstration Apparatus" in June 1968. This was a regular section of the Journal with that title until it was changed back to "Apparatus Notes" with the October 1972 issue. This section continues as a regular section under the editorship of Bruce Eaton and appears when suitable material is available. A second volume of reprints has been published (see listing 11).

"Abstracts"

This section of the *American Physics Teacher* started with Vol. 1 and continued through No. 2 of Vol. 2. It contained a subtitle, "Apparatus, Demonstrations, and Laboratory Practice," which alerted the reader to items in other journals.

"Digest of Periodical Literature"

This column replaced "Abstracts." It began with Vol. 2, No. 3 and ran through No. 5 of Vol. 17.

"Practical Aids for Teachers of Physics"

This section was introduced in No. 4 of Vol. 21, and survived the eight issues of Vol. 25. See Thomas H. Osgood, *Am. J. Phys.* **21**, 266 (1953) for an introductory article describing this "new" section.

"Resource Letters"

These appear at intervals in the Journal and are available in reprint volumes. At least ten Resource Letters give references to lecture demonstrations.

29. **The Physics Teacher**, published by the AAPT. This journal was started in 1963 and is published nine times a year. Besides the regular articles, there are two sections listed below which are of particular interest for lecture demonstration ideas.

"Notes"

This section was initiated with the February 1967 issue and sometimes includes information pertinent to demonstrations.

"Apparatus for Teaching Physics"

This has been a regular section of this journal since February 1967 under the editorship of Herbert Gottlieb. It is one of the best sources of current ideas. The predecessor of this column was "Apparatus Lecture Demonstrations and Laboratory, Classroom Techniques." A book of reprints of this section is listed as item 12.

30. **The Science Teacher**. The official journal of the Illinois Association

of Chemistry Teachers, 1934; the American Science Teachers Association, 1942–1944; the National Science Teachers Association, 1944; and other similar organizations. From Vol. 1 to Vol. 3, No. 2 this journal was the *Illinois Chemistry Teacher*.

"**TOPS: Tested Overhead Projection Series in Chemistry**," Hubert N. Alyea, *Sci. Teach.* **29**, 10 (Feb. 1962). This series of 89 demonstrations is designed to be used with an overhead projector that has been converted for vertical orientation. While the subject matter is normally chemistry, many of the demonstrations can be used in physics classes. *The Science Teacher* also made this column available as a reprint (No. 471-14372, 1962).

"**Classroom Ideas**," Michael A. Lipparelli. This section of *Sci. Teach.* is a source of ideas and information, some of which might be useful for physics lectures. Early issues used the section heading "Classroom Ideas and Demonstrations."

"**Idea Bank—A Library of Ideas for Science Teachers**," Irwin Tal-esnick, editor, *Sci. Teach.* **40**, 46 (1973). This continuing column, which began with the January 1973 issue, is a source of some interesting ideas.

31. **Physics Education**. A British journal published by their Institute of Physics. This journal is a cross between our *American Journal of Physics* and *The Physics Teacher*. Besides the regular articles section, the Physics Apparatus and Notes on Experiments section yield ideas and material useful for lecture demonstrations.
32. **Scientific American**. A popular magazine aimed at the educated lay persons concerned with all the sciences. Occasionally articles will appear which are particularly useful for physics lecture demonstrations. Of more frequent use is the section "The Amateur Scientist" which is currently edited by Jearl Walker.

II. DEMONSTRATIONS IN THE HALL AND OTHER SETTINGS

In this section we list articles which are related to demonstrations in settings other than the lecture hall or classroom. The items listed below have been broken up into several categories, but some demonstrations might be suitable for two or more categories with only minor alterations in the setup.

A. Hallway

This area of demonstrations is somewhat neglected in the literature and may be neglected in many schools as well. Apart from the few references listed below, one may obtain useful ideas from many of the science museums located around the country

33. "**Optical Activity Demonstration**," George Freier and B. G. Eaton, *Am. J. Phys.* **43**, 939 (1975). A hall demonstration of optical activity using Karo syrup and a motor driven Polaroid analyzer.
34. "**Corridor Demonstrations**," *Physics Demonstration Experiments*, Everett M. Hafner, edited by Harry F. Meiners, (Ronald, New York, 1970), Vol. II, p. 698.
35. "**The Foucault Pendulum: A Corridor Demonstration**," Wallace A. Hilton, *Am. J. Phys.* **46**, 436 (1978).
36. "**A Short Foucault Pendulum for a Hallway Exhibit**," Haym Kruglak, Larry Oppliger, Rene Pittel, and Stanley Steele, *Am. J. Phys.* **46**, 438 (1978). Both of the above articles describe how to make a driven Foucault pendulum for a hallway demonstrations.
37. "**Physics of a Hall Shelf**," Harald D. Jensen, *Am. J. Phys.* **24**, 592 (1956). Abstract of a paper containing new thought-provoking student operated demonstrations are placed on an open hall shelf each week to stimulate student interest in physics.
38. "**Corridor Displays in Glass Cabinets**," Lee D. Mathews, *Am. J. Phys.* **44**, 602 (1976). Describes modification of existing cabinets and student reaction to putting in a new interactive demonstration every two weeks.

39. "Amperes Ants," R. C. Nicklin, J. G. Lindsay, and T. L. Rokoske, *Am. J. Phys.* **43**, 111 (1975). A simple hallway exhibit of an effort of a moving magnetic field on iron filings.
40. "A Voice Display for Corridor Use," Thomas D. Rossing, *Am. J. Phys.* **43**, 282 (1975). An interesting Lissajous display of one's own voice.

B. Laboratory setting

41. "A 'do-it-yourself' Demonstration Laboratory," Patricia Cryer and J. G. Rider, *Phys. Educ.* **12**, 389 (1977). Describes a hands-on nonsupervised self-paced laboratory built around demonstrations for beginning university students.
42. **The Demonstration Laboratory of Physics at the University of Chicago**, Harvey B. Lemon and Fritz-Hugh Marshall, (University of Chicago, Chicago, 1939). Out of print, but listed due to its uniqueness.
43. "A new addition to the homework assignment: Demonstration Problems," Robert Prigo, *Am. J. Phys.* **45**, 433 (1977). Introductory physics homework problems done in conjunction with student-performed demonstrations in the U.C. Santa Barbara Physics Learning Center are described and evaluated.
44. "Quantitative Demonstration Exhibits and a New Low-Cost Physics Laboratory," Harvey E. White, Hans Weltin, Mauri Gould, and Robert A. Rice, *Am. J. Phys.* **34**, 660 (1966). Describes an approach to introductory labs that utilize self-instruction demonstration exhibits with quantitative capabilities.

C. Take-home

45. "Take-home experiments," Sister Martha Ryder, *Phys. Teach.* **11**, 533 (1973). Discusses a program which has the student perform take-home experiments; including Class I type demonstration experiments.

D. Museumlike location

46. **Exploratorium Cookbook**, Raymond Bruman (The Exploratorium, San Francisco, 1975). This is the best single source of its kind and well worth the expense (\$50.00).
47. "Loudspeakers as Ripple Tank Wave Generators," Richard Green, *Am. J. Phys.* **45**, 683 (1977). Describes use of loudspeakers for generating waves in Exploratorium ripple tanks.
48. "The Exploratorium: A Playful Museum Combines Perception and Art in Science Education," Frank Oppenheimer, *Am. J. Phys.* **40**, 978 (1972). Discusses the working philosophy behind the Exploratorium, a hands-on museum in San Francisco featuring science, perception, and art.
49. "The Physics Activities Center—A mini-Exploratorium," Dean Zollman, *Phys. Teach.* **12**, 213 (1974). Describes a hands-on activities center at Kansas State University and gives a preliminary evaluation of students' reaction to the center.

E. In-house programming

50. "Science demonstrations for elementary schools," Salvatore J. Rodano and James J. D'Amario, *Phys. Teach.* **14**, 441 (1976). Describes a demonstration program for elementary students.
51. "Saturday Science," Cecil G. Shugart, *Phys. Teach.* **14**, 91 (1976). Describes the organization of demonstration-oriented seminars in which the physics of toys, music, sports, and other topics are investigated. Reports that this university-based service has increased high school physics and science fair enrollments.
52. "Physics demonstrations for the public," Jack Willis and Donald F. Kirwan, *Phys. Teach.* **14**, 210 (1976). An extensive listing of topics suitable for large-scale demonstrations and their pedagogical aspects are provided.

F. On the road

53. "The Stephen F. Austin traveling science show," James C. Dennis,

Phys. Teach. **16**, 11 (1978). Describes a traveling demonstration show geared to regional high schools.

54. "Notes of an itinerant demonstrator," R. C. Nicklin, *Phys. Teach.* **12**, 72 (1974). Tells about numerous visits to elementary and secondary schools that were designed to give students a positive attitude about physics and to encourage teachers to use more demonstrations.
55. "The Mobile Demonstration Laboratory of the Pennsylvania Summer EDT Program," Harold K. Schilling, *Am. J. Phys.* **10**, 54 (1942). An abstract of a contributed paper describing a program which used a truck to carry lecture demonstrations and museum-type exhibits of electricity and magnetism to teaching centers.

G. Other locations

56. "Scientists in Space," Joseph P. Allen, *Phys. Educ.* **8**, 444 (1973). Discusses the role of scientists in space programs in the future, and describes a series of demonstrations which need the environment of outer space to work effectively.
57. "Elevator Exhibit," Laurie Eason and Alan J. Friedman, *Phys. Teach.* **13**, 492 (1975). Describes an exhibit placed in an elevator to demonstrate to the public several concepts of Newton's second law.
58. "Spacelab Film Conference," Dean Zollman, *AAPT Announcer* **8**, 15 (Oct., 1978). Describes an AAPT proposal to NASA to develop a film project which would involve planning, executing and filming of pedagogical demonstrations in space.

III. OTHER USEFUL SOURCES

This section lists sources which, while not devoted to demonstrations, do contain some useful material. We have avoided listing many texts and laboratory manuals to make the length manageable. In two areas, upper division modern physics and optics, we have listed laboratory manuals. The first has been included because there is a dearth of good modern physics demonstrations; the second has been included because many optics laboratory exercises make excellent lecture demonstrations or hall demonstrations.

A. Books

59. **Optics of the Electromagnetic Spectrum**, C. L. Andrews (Prentice Hall, Englewood Cliffs, NJ, 1960). An informative text which suggests numerous experimental demonstrations. It is now out of print.
60. **Lecture Demonstrations in General Chemistry**, Paul Arthur (McGraw-Hill, New York, 1939). A collection of 175 demonstrations for use in teaching general chemistry. This book is to chemistry what Sutton's book is to physics.
61. **Introductory Modern Physics Experiments**, Neil Ashby (Ashby, Boulder, 1971). An upper division laboratory manual with 15 experiments in it.
62. **Build-It-Yourself Science Laboratory**, Raymond E. Barrett (Doubleday, Garden City, NY, 1963). An excellent resource work for junior and senior high school students and instructors. Tells how to build approximately 200 pieces of apparatus from inexpensive and readily available materials. Rev.: *Astronautics and Aerospace Eng.* **1**, 131 (Sept. 1963).
63. **Best of General Science From Science Teacher's Workshop** (Parker, West Nyack, NY, 1972). Contains many ideas for activities and demonstrations suitable for physics and physical science classes. Written in a "how-to-do-it" format; and includes other helpful information.
64. **Best of Physics From Science Teacher's Workshop** (Parker, West Nyack, NY, 1972). Written for high school physics teachers, this book presents many demonstrations which are both practical and

- effective, many using simple standard equipment.
65. **Elementary School Science and How to Teach It**, Glenn O. Blough and Julius Schwartz, (Holt, Rinehart, and Winston, New York, 1974). Describes numerous activities that would make good demonstrations for the elementary level.
 66. **Soap Bubbles, Their Colours, and The Forces Which Mold Them**, C. V. Boys (Dover, New York, 1959). This classic of science literature contains many demonstrations, with appropriate hints, on surface tension, etc. The Dover Publication of the second enlarged edition contains several chapters which do not appear in the first edition published by Doubleday, which is out of print. Rev.: *Am. J. Phys.* **28**, 296 (1960); *Science* **130**, 616 (1959); *Soap Chem. Specialties* **35**, 167 (Sept. 1959).
 67. **Science Circus**, Vols. 1, 2, and 3, Bob Brown (Fleet, New York, 1972). These three volumes contain many simple demonstrations using readily available materials. While it was written for young people (up through junior high), some of the demonstrations are suitable for the introductory college level.
 68. **Science Treasures: Let's Repeat the Great Experiments**, Bob Brown (Fleet, New York, 1968). Nineteen of the great experiments in physics described for young people in their historical setting. A good reference and a source of ideas.
 69. **200 Illustrated Science Experiments for Boys and Girls**, Bob Brown, (World, New York, 1973). More simple demonstrations using readily available materials.
 70. **Science Teaching Today: A Series of Practical Teaching Aids**, Guy V. Bruce (The National Science Teachers Association, Washington, D.C., 1950-51). This series is made up of the following titles: Vol. I. Experiments With Water; Vol. II. Experiments with Air; Vol. III. Experiences with Fuels and Fire; Vol. IV. Experiences with Heat; Vol. V. Experiences with Magnetism and Electricity; Vol. VI. Experiences with Sound; and Vol. VII. Experiences with Light and Color. These booklets contain numerous demonstrations that are easily executed with everyday equipment. They are directed towards upper elementary and junior high school grades.
 71. **How Things Work: Practical Guide for Teaching Scientific and Technical Principles**, Eldon A. Byrd (Parker, West Nyack, NY, 1973). A practical teaching aid using an intuitive approach.
 72. **Experiments in Nuclear Science**, 2nd ed., G. D. Chase, S. Rituper, and V. W. Sulcoski (Burgess, Minneapolis, MN, 1971). This well-written laboratory manual presents many experiments that could be used as data-producing demonstrations. Each experiment deals with a single concept of nuclear science. An informative *Teacher's Guide* is available.
 73. **Novel Experiments in Physics: A Selection of Laboratory Notes Now Used in Colleges and Universities** [Pub. R-165], Committee on Apparatus for Educational Institutions (AIP, New York, 1964). This volume of laboratory notes, with differing levels of difficulty and sophistication, may serve as a source of lecture demonstration ideas.
 74. **Novel Experiments in Physics II**, Committee on Apparatus for Educational Institutions (Committee on Apparatus, AAPT, Stony Brook, 1975). A second volume of experiments with 41 additional experiments distributed throughout the basic subject areas of physics.
 75. **Contemporary Experiments for the Undergraduate Physics Laboratory**, edited by Alan M. Peabody (Keithley Instruments, Cleveland, 1966). A 50-page booklet of modern physics experiments performed with Keithley electrometers and instruments.
 76. **Flint Introductory Sequence Teachers Resource Book**, 6 Vols., Donald E. Degraaf (Flint Introductory Physics Sequence Curriculum Project, University of Michigan at Flint, 1971-72). Volumes I-IV offer positive suggestions for demonstrations to be used during the four-semester sequence of physics instruction. They emphasize the continuity of physics and stress physics learning through observation and interpretation of phenomena.
 77. **Demonstration Experiments of Basic Phenomena in Optics** (American Optical, Southbridge, MA, 1968). These optics demonstration experiments were designed primarily for high school and introductory college courses using the manufacturer's laser and accessories.
 78. **Light for Students**, Edwin Edser (Macmillan, London, 1902). Although this little treatise on light went out of print in 1966, it is being listed because it is a classic reference for those interested in the subject.
 79. **University Physics, Experiment and Theory**, G. D. Freier, (Appleton-Century-Crofts, New York, 1965). Freier writes in the preface, "This book was written in the hope that it might serve as a collection of simple demonstrations set into a rigorous theoretical development of the subject matter in physics." The text is demonstration oriented and is a good reference source. Unfortunately, it is out of print.
 80. **Invitation to Experiment**, Ira M. Freeman (Dutton, New York, 1945). This informal, but very informative, book suggests simple experiments that can be done with readily available equipment.
 81. **Fun with Science**, Ira and Mae Freeman (Random House, New York, 1956). Contains 37 good experiments for young people, each with simple directions and explanations. Nearly all the experiments could be presented as demonstrations and many of them would be appropriate for all age groups. Highly recommended.
 82. **Experiments Using a Helium-Neon Laser**, 3rd ed., Herbert H. Gottlieb (Metrologic Instruments, Bellmawr, NJ, 1974). A lab manual of 26 experiments using the manufacturer's apparatus, many of which can be done as demonstrations.
 83. **Mr. Wizard's Science Secrets: New and Revised Edition**, Don Herbert (Hawthorne Books, New York, 1965). This book contains 163 simple elementary experiments utilizing household equipment. Most can be done as demonstrations. It is a good reference source, particularly for those teaching at the elementary or junior high level.
 84. **Experiments in Optical Physics**, 3rd ed., Wallace A. Hilton, (Hilton, Liberty, Missouri, 1974). A manual of some 70 experiments and demonstrations in optics. A brief but inclusive collection of ideas.
 85. **Sourcebook for Chemistry and Physics**, David R. Hittle, Frank D. Stekel, Shirley L. Steckel, and Hans O. Anders (Macmillan, New York, 1973). Part 3 describes some basic demonstrations.
 86. **Introduction to Mechanics, Matter and Waves**, U. Ingard and W. L. Kraushaar (Addison-Wesley, Reading, MA, 1960). Describes some quantitative lecture experiments. Rev.: *Machine Des.* **32**, 320 (Oct. 13, 1960).
 87. **Experiments in Modern Physics**, H. Mark and N. T. Olson (McGraw-Hill, New York, 1966). A text for advanced undergraduate laboratories providing information and ideas for modern physics demonstrations.
 88. **Experiments on an Air Table**, G. Marousek and T. W. Williams III, (Ealing, Cambridge, MA, 1969). An experiment manual which could provide ideas for lecture demonstrations.
 89. **Experiments in Modern Physics**, A. C. Melissinos (Academic, New York, 1966). A text for advanced undergraduate laboratories which might suggest ideas for modern physics demonstrations, Rev.: *Phys. Tod.* **20**, 117 (1967).
 90. **Millergrams I & II** (Doubleday, Garden City, NY, 1966, 1970). This work describes simple demonstrations suitable for elementary courses. See *Phys. Teach.* **10**, 39 (1972) for a note describing the use of Millergrams in a laboratory situation.
 91. ORTEC, Experiments in Nuclear Science [Application Note No. 34] (ORTEC, Inc., Oak Ridge, TN, 1971). Some of the 63 experiments described here might be conducted as demonstrations. Rev.: *Am. J. Phys.* **40**, 1186 (1972).
 92. **Methods and Materials for Teaching General and Physical Science**, John S. Richardson and G. P. Cahoon (McGraw-Hill, New York, 1951). Part II (284 pages) contains many demonstration ideas on the high school and introductory college level.
 93. **Physics for the Inquiring Mind**, E. M. Rogers (Princeton University, Princeton, NJ, 1960). An outstanding text containing numerous demonstration experiments written by one of the "masters" of lecture demonstrations. Rev.: *Am. J. Phys.* **30**, 660 (1962); *J. Franklin Inst.* **271**, 226 (1961).
 94. **Laboratory Experiments with Radioisotopes for High School Science Demonstrations**, Samuel Schenberg, Editor (USAEC, Washington, D.C., 1958). A booklet describing 20 experiments in biology, chemistry, and physics. Catalog No. 43At72R, 11/18 1958.
 95. **Great Experiments in Physics**, M. H. Shamos (Holt, Rinehart and Winston, New York, 1959). Describes some of the crucial experi-

- ments in physics and includes pertinent historical information along with the original accounts of the experiments. Rev.: Am. J. Phys. **28**, 581 (1960); J. Appl. Phys. **31**, 223 (1960).
96. **The Amateur Scientist**, C. L. Strong (Simon and Schuster, New York, 1960). A collection of projects for the amateur scientist from the *Scientific American*. About half of the book has projects which, although somewhat dated, could be related to beginning physics courses.
 97. **Suggested Experiments for Laboratory Courses in Acoustics and Vibrations**, Second edition edited by Vernon M. Albers (Pennsylvania State University, University Park, 16802). A laboratory manual sponsored by the Acoustical Society of America. We have not seen a copy of the second edition. The "First Draft" contains 29 experiments on sound and sound related physics and is well worth obtaining.
 98. **The Lloyd William Taylor Manual of Advanced Undergraduate Laboratory Experiments in Physics**, T. B. Brown, Editor-in-chief (Addison-Wesley, Reading, MA, 1959). A classical laboratory manual that will be a good reference for years to come. Rev.: Am. J. Phys. **28**, 579 (1960); Phys. Teach. **1**, 130 (1963).
 99. **New UNESCO Source Book for Science Training**, UNESCO (UNESCO, Paris, 1973). An excellent resource for demonstration ideas using simple apparatus.
 100. **Experiments on an Air Track**, T. Walley Williams, III (Ealing, Cambridge, MA, 1969). A laboratory manual using the air track as the central piece of apparatus. Might provide some lecture demonstration ideas.

B. Miscellaneous

101. "A Better Way to Teach Physics: Developments and Comments on Teaching Physics," [A continuing series] (Pasco Scientific, San Leandro, CA). Contains new techniques in teaching physics, new experiments and demonstrations, biographical sketches of scientists, interesting problems, and, of course, descriptions of new Pasco equipment. The six issues per year are available free from the publisher if you request your name to be added to their mailing list.
102. **Education News From Metrologic** (Metrologic Instruments, Bellmawr, NJ) [an occasional publication]. This commercial publication is available free from the manufacturer. It usually contains notes on the history of science, various aspects about optics, a teacher quiz, and new-product information.
103. "Some Demonstration Experiments in Optics Using a Gas Laser," Spectra-Physics Laser Technical Bulletin Number Three (Spectra-Physics, Mountain View, CA, 1963). A commercial publication available from the manufacturer. It is a preprint of Am. J. Phys. **32**, 355 (1964).