

PRESERVING THE HERITAGE OF DISCOVERY

In the 40 years since its creation, the Niels Bohr Library has become the world center for preserving the historical record of modern physics and allied fields, and for helping people show this record to the public.

Spencer Weart

Forty years ago, in a ceremony at the headquarters of the American Institute of Physics in New York City, J. Robert Oppenheimer gave one of his characteristically eloquent speeches to a group of eminent physicists. The occasion was the dedication of AIP's Niels Bohr Library (see figure 1). Oppenheimer was ailing and not optimistic about the human condition, but he found cause for hope in the unique institution opening that day.

"The enterprises which are now under way," Oppenheimer said, "and for which this room will serve as hearth, should make it possible, if there are serious students of the human predicament in the future, to know very much more about what has befallen us than we who are acting and living in it." It was always good, he insisted, to know the truth about how people acted and thought. And so much more so for scientists, since "the discoveries in the sciences are among the great epics, and they should be available in our tradition." Oppenheimer saw the discipline of history, like physics, as an objective study based on accurate data. Securing such data was the mission of "the undertakings of which this new library will be the home."¹

A new kind of institution

These undertakings grew out of unhappy experiences that had goaded the small band of physicists who appreciated the history of their field. As Oppenheimer pointed out, "The achievements of physics in this century . . . stand with the high points of the whole history of human knowledge." Yet nobody had taken the trouble to record the recollections of Albert Einstein, Enrico Fermi, and other great figures who had recently died. Would knowledge of the lives and work of pioneers who were still alive likewise be lost to posterity? Would even their lab notebooks and correspondence with one another wind up in some landfill?

A more immediate and galling problem was the way the general public misunderstood the role of physics in their civilization. For example, exhibits planned by the Smithsonian Institution for its new historical museum building included physics only as a subsection of electrical engineering. Yet as Oppenheimer remarked, it was hard to teach people the history of science when "in no real sense is it adequately known."

Discussions with the Smithsonian in 1959 had led AIP's director, Elmer Hutchisson, to create a committee on the history and philosophy of physics. Chaired by the physicist-historian Gerald Holton, the committee recommended a broad program of historical preservation.

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Meanwhile, AIP staff were discussing a library for themselves, to contain not only ordinary reference materials but also biographies and photographs of physicists, and other materials broadly representing the profession. For funding, Hutchisson approached Dannie Heineman, who had recently established the Heineman Prize in Mathematical Physics. An engineer and businessman of Belgian origin, Heineman had wide-ranging humanitarian and intellectual interests (he was, for example, a connoisseur of musical manuscripts). Heineman's response was enthusiastic. With characteristic modesty, rather than name the new library after himself, he asked that it be named after a man he deeply admired: Niels Bohr (see figure 2).

Other history projects were in the works. The recommendations of Holton's committee bore fruit in 1961 with a grant to AIP from NSF for a project to locate, index, and preserve source materials for the history of modern physics. Independently, the noted physicist John Wheeler had joined with physicist-turned-historian Thomas Kuhn and others to devise a project to record the history of the rise of quantum physics in the 1920s and 1930s. They received an NSF grant, which AIP administered for the American Physical Society (APS) and the American Philosophical Society, to tape-record interviews of quantum pioneers and microfilm their correspondence.²

In 1965, as these grant-funded projects were coming to an end, AIP's governing board agreed to continue preservation efforts by founding the Center for History of Physics as a division of AIP. The Niels Bohr Library was integrated into the center, but in many minds it retained an institutional identity of its own. Historians and other scholars, journalists, teachers, and students have continued to turn to the library for information on the history of the sciences covered by AIP's member societies: modern physics, astronomy, geophysics, and allied fields. They find resources ranging from books and "near-print" materials such as mimeographed course notes and catalogs to archival collections of correspondence, tape recordings, photographs, and more. No less important, the library is a center for information about information, helping people to find historical source materials anywhere in the world.

As an arm of the Center for History of Physics, the Niels Bohr Library is unlike any other library. Following the example set by the physics community, staff members work cooperatively and internationally, limiting their activities to things they can do better than any other organization. Rather than concentrate entirely on gathering materials for their own bookstacks and archives, their goal is to make sure that sources documenting the history of modern physics are preserved and made accessible, by whomever and in whatever location. They persuade eminent physicists that essential unpublished materials



FIGURE 1. J. ROBERT OPPENHEIMER speaking at the dedication of the Niels Bohr Library in its new reading room at American Institute of Physics headquarters in New York City, 26 September 1962. He called this “the home and center of a constellation of enterprises in which all of us have deep hope and deep interest.” (Courtesy of AIP Emilio Segrè Visual Archives.)

should be saved. They persuade archivists that these materials have permanent value, and give advice on how to preserve them. And they persuade scholars and others to draw on these resources, by compiling a worldwide catalog of historical materials and advising people how to use them best.

Books at risk

Recently, a young historian of science took an interest in Feynman diagrams. Richard Feynman invented these sketches in 1948 as a tool to organize difficult computations in quantum electrodynamics, but nowadays most physicists first encounter the diagrams as pedagogical devices, bringing a flash of insight into how elementary particles interact. Like many things in physics, the diagrams are simple at first glance but reveal great depths on a closer look. Their meaning has shifted over time, depending on how they have been used. How could the historian investigate this? The path to understanding led through textbooks.

The author of a textbook must figure out exactly what a topic means and explain it as clearly as possible. When did Feynman diagrams first appear in physics textbooks, what were the diagrams said to represent, and how did that change over time? For topics like this, the explanation can vary not just between authors, but even between successive editions of the same textbook. A classic example, studied by many historians, is Arnold Sommerfeld's *Atombau und Spectrallinien* (*Atomic Structure and Spectral Lines*). During the 1920s, the text of each successive edition changed to reflect the rapid shifts in understanding of quantum mechanics.

Textbooks are at risk. Most libraries—even the US Library of Congress—do not keep them systematically. A university library may, at most, keep the latest version and sell the previous one as pulp for a paper mill. The Niels Bohr Library is unique in its mission to preserve all editions of all significant modern physics, astronomy, and geophysics textbooks. The library has, for example, all 8

editions and translations of the Sommerfeld classic, from 1919 to 1944. The library's collection of physics textbooks in various editions has been a boon to the historian of Feynman diagrams and to other scholars.

Textbooks are only a fraction of the materials sought by the library's vigorous book collection program, which is supported entirely by donations from the Friends of the Center for History of Physics (see the box on page 30). Staff members buy the hundred or so significant new scholarly works on history of physics and allied fields that are published each year (the collection of Einstein biographies alone fills three shelves). Meanwhile they peruse bookdealers' catalogs of old scientific books and purchase many more. But the bulk of the collection has come from scientists, donated when they cleaned out their offices or, later, by their heirs. These donations bring in many items printed in small quantities and scarcely preserved elsewhere, ranging from conference proceedings to student laboratory manuals.

While English is the main language in the collection, the library holds a comprehensive set of pre-World War II German-language textbooks. Some came from the collections of emigrés, while others were bought by American students during their studies abroad. The French- and Russian-language collections are also extensive, thanks to donations and purchases from dealers plus trips to bookshops in Paris and Moscow.

There are gaps in the collection. The library only began to collect works in geophysics after the American Geophysical Union joined AIP in 1986, and so far, few personal collections have been donated. But for physics and astronomy through most of the 20th century, the library has nearly every book of any significance. The collection is somewhat less comprehensive for the most recent decades, when a great many specialized books were published. Yet the shelves do hold a variety of recent books that may be hard to find in other libraries. The library does not try to collect comprehensively for the period before 1850. However, gifts have included earlier books of high interest—for

FIGURE 2. THE ORIGINAL READING room of the Niels Bohr Library in New York City with its first full-time librarian, Joan Warnow (now Joan Blewett), in 1971. She began work in 1965 and continues to help part-time since her retirement in 1997. For the programs she instituted, the library in 1985 received the Distinguished Service Award of the Society of American Archivists, which is seldom given to a small and specialized library.



example, Benjamin Franklin on electricity and Otto von Guericke on the vacuum. These rare works are used for exhibits and as sources of fine illustrations.

Equally rare, beautiful, and interesting is the library's collection of pamphlets and instrument catalogs. Very few libraries attempt to collect such "ephemeral" printed materials. An outstanding example is a collection of pamphlets from the 1920s, some trying to explain Einstein's new theory of relativity to the public, others trying to refute it. Even more useful to historians of science are the library's old instrument catalogs. They are handsomely illustrated and often include detailed descriptions of apparatus and techniques (see figure 3). Such items are preserved in very few libraries, and the Niels Bohr Library is by far the most convenient place for a scholar to find and study them.

Old catalogs, pamphlets, manuals, and the like, and many old books as well, are not just hard to find but in actual danger of physical destruction. About two-thirds of the library's collection dates from 1850 to 1950, when many publishers used flimsy bindings and acidic wood-pulp paper. The pages are turning brittle and flaking

away. Library staff have stabilized the most endangered items by placing them in envelopes of acid-free, buffered paper. However, further damage during handling by scholars cannot be prevented. To make the materials both safe and available, the library recently won a grant from the National Endowment for the Humanities to microfilm some 2000 of its most endangered items. The originals will be kept intact, but scholars will be able to use the microfilms either in the library or through loan by mail.

Like any library, the Niels Bohr Library maintains a reference collection and provides reference services. By phone, mail, and e-mail, staff respond to queries about the date an important paper was published, the current address of an astronomer, and so forth. For the more complex inquiries, staff consult the deep resources of the bookstacks, or look in another unique collection: the biographical files. Over the decades, the library has solicited career information from many eminent scientists, including such basic data as curricula vitae and lists of publications, not easily found anywhere else.

In their own words

In 1944, physicist Samuel Goudsmit led the Alsos mission into France and Germany one step behind the invading Allied armies, seeking to discover how far Germany had gotten toward building nuclear weapons. After the war, Goudsmit published a book describing the German project and its complete failure. Werner Heisenberg, a leader of the project, objected to some of Goudsmit's conclusions and wrote his old colleague a letter. After several exchanges, the two could only agree to disagree. Did the German project fail because (as Heisenberg suggested) its leaders lacked enthusiasm, or (as Goudsmit had written) from sheer scientific incompetence, or for some other reason such as lack of resources? These questions still fascinate people. The letters now reside in four folders in a box, one of 75 boxes that make up the Goudsmit Papers collection in the archives of the Niels Bohr Library, where historian after historian comes to peruse them for hints.

This is the fundamental work of the historian—reading other peoples' mail—along with poring over other primary source materials such as minutes of meetings, lab

With a Little Help from Our Friends. . . .

The Niels Bohr Library draws its basic support from the general funds of the American Institute of Physics. Numerous special projects have been funded by grants from government and private foundations. But nothing has been so helpful as support donated by individuals. The Friends of the Niels Bohr Library, later merged into the Friends of the Center for History of Physics, have been extraordinarily generous with annual gifts and bequests. These contributions are the sole source of support for such essential activities as the purchase of books, maintenance of the Emilio Segrè Visual Archives, and a program of grants-in-aid to help impecunious scholars visit the library. The Friends also give in-kind aid by donating books and photographs, providing volunteer assistance, and offering information and advice. For information on joining the Friends, phone (301) 209-3141 or visit the Web site at <http://www.aip.org/history/friends.htm>.

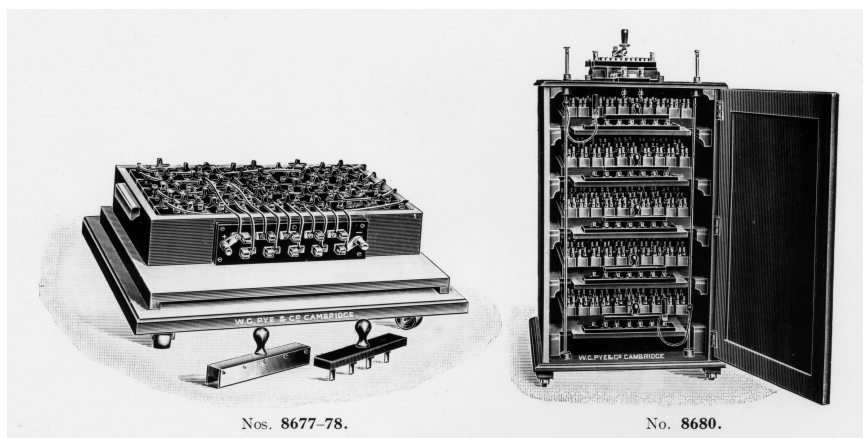


FIGURE 3. A 1000-VOLT BATTERY of 500 cells, illustrated in the W. G. Pye & Co. *Catalogue of Scientific Apparatus* (1926). “The ends of each set of 20 cells,” the text explains, “are connected to suitable spring contacts on ebonite blocks with connectors for charging in parallel from a 50-volt circuit.” This is one of the many rare items in the Niels Bohr Library that document in remarkable detail the history of physics instrumentation. Printed on crumbling paper, this and other endangered books are being microfilmed nondestructively. (Courtesy of AIP Emilio Segrè Visual Archives.)

notebooks, and diaries. The Center for History of Physics has no task more important than making sure that such “raw data” are preserved in appropriate repositories. Staff members offer advice on the one hand to scientists and their families and, on the other hand, to archivists in the university, government laboratory, or other institution where a scientist worked (see figure 4). One major task is to work with research institutions to set up records management systems that will meet the needs of administrators as well as future historians (see *PHYSICS TODAY*, November 2001, page 24). Another task is to stay informed about electronic media in order to give good advice on preserving e-mail and the like. But the chief job is the traditional one of saving paper. Never trying to snatch away valuable collections for itself, the center has built a reputation as an “honest broker” for matching papers with archives. But sometimes the Niels Bohr Library is itself the most appropriate repository, or the only one where a collection can be saved.

One example is the Goudsmit Papers. Goudsmit, having served many years as the renowned editor of the *Physical Review*, was not associated with a university that could take his papers into its archives. Another example is the papers of Lew Kowarski, one of the founders of the French nuclear program and of CERN, whose career path wound through many nonacademic institutions. Government and industrial laboratories often refuse to take in the papers of scientists, leaving the Niels Bohr Library as an archive of last resort. The center has worked ceaselessly to persuade other institutions to build archival programs. Sometimes this succeeded so well that important collections, acquired by the library to save them from destruction, could be donated years later to the appropriate university or corporation after it created its own archives.

For some types of records, AIP will always be the proper repository. AIP itself, and member societies such as the APS and the American Astronomical Society, use the

Niels Bohr Library as the repository for their records. These include dry administrative and financial records preserved mainly for legal purposes, but the persistent scholar can dredge up nuggets of solid historical interest. The character of the scientific community is illuminated by items such as minutes recording arguments over the governance and purpose of a society, officers’ correspondence on how to help postdocs through a time when job prospects collapsed, or debate over a committee report on a national policy issue.

Historians of science still like nothing so much as reading the letters that people wrote one another in the course of their scientific work. What, for example, did Heisenberg

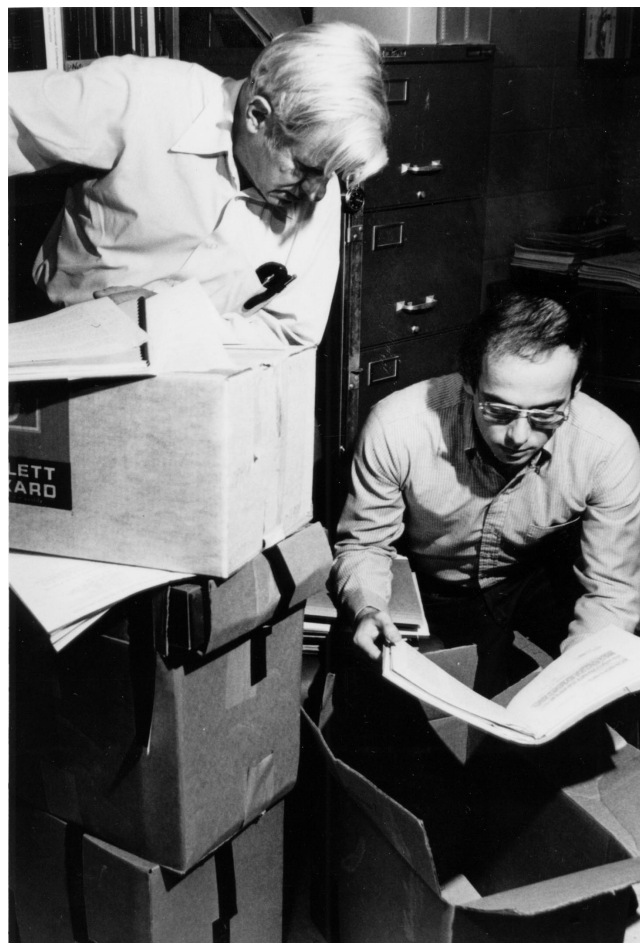


FIGURE 4. HIGH-ENERGY PHYSICIST John Blewett (left), reviewing Brookhaven Laboratory files with historian Allan Needell from the AIP Center for History of Physics. The center’s Niels Bohr Library sometimes takes in collections of correspondence and other unpublished papers and arranges and catalogs them for use by future historians. But AIP greatly prefers to work with scientists, their families, and their institutions to make sure that valuable source materials are preserved in their own institutional archives. (Courtesy of AIP Emilio Segrè Visual Archives.)

and Goudsmit say to each other about quantum physics back in the 1920s when they were still friends? While promoting the deposit of such materials at other repositories, the Niels Bohr Library can collect microfilms of them. Some Heisenberg–Goudsmit letters, for example, were found among Heisenberg’s papers and filmed by the quantum physics project initiated by Wheeler and Kuhn along with thousands of letters by other physicists. In a later Center for History of Physics project, staff microfilmed collections of correspondence between astrophysicists, and the work continues with important correspondence, government records, and research notebooks. Even without visiting the library, scholars can borrow these materials by mail and look over the shoulders of scientists at their work.

Voices and faces of the past

The books, catalogs, and letters and other papers are not what attract the majority of historians who come to the Niels Bohr Library. The majority come to read oral history interviews. A great many things happen that people do not write down in letters or minutes of meetings. If the opportunity was lost to tape-record the recollections of Einstein and Fermi, it was not too late to go to Heisenberg and others of his generation. Some scientists were caught just in time, or almost: Niels Bohr told an interviewer the story of his first discoveries but then died before another interview session could be held to discuss his later work. There are now well over a thousand transcripts in the library covering many aspects of 20th-century physics, astronomy, and geophysics. Alongside these are several hundred autobiographical writings by scientists. Some are only a few pages, written by eminent scientists specifically for the library in response to requests for information. Others are hundreds of pages long, written perhaps for the scientist’s grandchildren, with a copy donated to the library.

Scholars read the oral histories and autobiographies, “with all due caution as to the fallibility of memory” (as Oppenheimer warned), to find insights and clues that otherwise could never come to light. Some of the interviews and other manuscript materials have restricted access, but most are open to anyone with bona fide research interests. Transcripts can even be borrowed through the mail. But the collection is so rich and varied that some scholars visit the library just to make a survey and decide what they will need to borrow. Staff members are used to seeing a researcher arrive with the intention of skimming interview transcripts, get fascinated by a text, plunge into it, and emerge hours later, complaining that there is so much more in the library than expected and too little time to explore it. Typical is a history of science student who

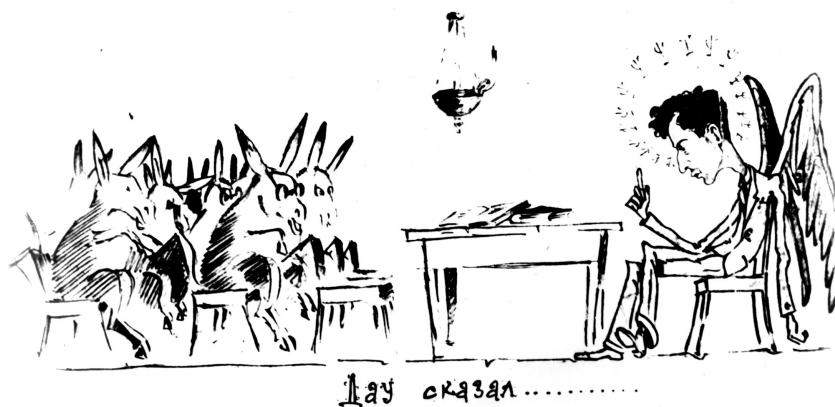


FIGURE 5. “DAU SAYS . . .,” a caricature of the outstanding Russian physicist and teacher Lev Landau. AIP’s Emilio Segrè Visual Archives contains not only tens of thousands of photographs, but also many sketches and cartoons. Such images help journalists and teachers show that scientists are not—as so often portrayed—humorless intellectuals in pursuit of the abstruse, but are entirely human creatures. (Caricature by A. Yusefovich, courtesy of AIP Emilio Segrè Visual Archives, Physics Today Collection.)

wrote, after completing his PhD thesis, “As the footnotes of the manuscript attest, it would be difficult to overestimate the contribution of the library’s collection.” Although no precise statistics have been compiled, it seems likely that, of the hundred or so significant scholarly articles, books, and doctoral theses published each year on the history of modern physics and allied fields, a majority of their authors have made direct or indirect use of the Niels Bohr Library’s oral or manuscript collections.

Tape recordings contain more information than transcripts: the actual voices of the past. Voices are preserved for posterity by the library not only in oral history interviews but also in more than a thousand public talks given at meetings and the like, tape-recorded (often at the library’s request and expense) and deposited in the archives. Thus, an actor who was to portray Fermi in a dramatic movie about Los Alamos was able to study that dry, witty voice. And thus, young people can listen to a clip of Einstein himself saying “ $E = mc^2$ ” and explaining the formula in his high-pitched German accent—one of the most popular of the Web pages in the Center for History of Physics’s set of online exhibits.³

Web exhibits and many other kinds of media productions draw on the library above all for images. If visitors who come to the library in person seek especially oral histories, still more “visitors” come by phone or e-mail or directly to the Web site, seeking especially photographs. These visitors include teachers who want a picture to show a class, students creating projects, journalists and historians who need to illustrate articles, textbook publishers and television documentary producers, and people who just want a portrait of a famous scientist for their wall. All of them find a matchless resource in the Emilio Segrè Visual Archives (<http://www.aip.org/history/esva>), endowed by the widow of the well-known nuclear physicist, historian of science, and amateur photographer. The visual archives preserves some 30 000 photographs.

Such images are indispensable for the educators and science writers who try to reach a public that misunderstands—and often mistrusts—the scientific enterprise. Too often the scientist is seen as a brain without a soul, if not as an actual “mad scientist.” True images of scientists,

A reception commemorating the 40th anniversary of the opening of the Niels Bohr Library will be held on Friday, 5 April 2002, at 5 PM in the American Center for Physics, One Physics Ellipse, College Park, Maryland 20740. If you wish to receive an invitation, please send your name and address to the Niels Bohr Library at that address or to chp@aip.org.



FIGURE 6. THE ARCHIVES, LIBRARY, AND BOOKSTACKS occupy respectively the second, third, and fourth floors of a projecting cube that is a principal architectural feature of the American Center for Physics building in College Park, Maryland (**left**), to which the American Institute of Physics moved in 1993. The archives, bookstacks, and photo collection have separate climate-control systems that maintain the temperature and humidity appropriate to each. The new reading room (**below**) is designed for the modern computer-intensive scholar.



whether formal studio portraits, snapshots of them at work, or family photos, literally show the human face of science (see figure 5). As one young student e-mailed the history center, after viewing its online exhibit about Marie Curie, "The photographs . . . serve as a reminder that world-changing discoveries have been made by rather ordinary-looking people."

Amid so many resources, how can a researcher find the right items? In the library's early decades, people could only leaf through drawers of file cards. From the late 1980s through the 1990s, the library staff was preoccupied with transferring the card files into computer-readable form, meanwhile adding detailed descriptions and thorough subject indexing. These arduous labors were interrupted in 1993 when the library, along with the rest of AIP, moved lock, stock, and bookstacks into the new American Center for Physics building in College Park, Maryland (figure 6). The staff spent most of the following year reorganizing and checking the collections. A benefit from the move was a state-of-the-art climate control system, which ensures the long-term preservation of the books, papers, and photographs by maintaining each collection at its own ideal temperature and humidity. The archives are kept so cold that staff who work there usually bring sweaters.

Despite the interruption, by the century's end the library's chief resources could be easily found through its Web site. Thumbnails of the 3000 most useful pictures in the visual archives are available there, with more scanned every day. The entire book catalog is online. All the library's unpublished archival resources are likewise cataloged online in the *International Catalog of Sources for History of Physics and Allied Fields*. As the name implies, the catalog gives summary descriptions not only of materials in the Niels Bohr Library but also of archival collec-

tions in some 600 other repositories worldwide. A new project of the library is to expand these online resources to include indexed finding aids—detailed folder-by-folder descriptions—for collections both in the library and in other institutions. The library's aim, now as in the beginning, is not just to serve scholars through its own resources. The mission of the Center for History of Physics is "to preserve and make known the history of physics and allied fields," using whatever resources can be found anywhere in the world.

These resources are crucial if scholars and educators, and through them the public and physicists themselves, are to understand our past and our times. That includes "not least," as Oppenheimer concluded, "the historically hardly paralleled dedication and responsibility of physicists to the great, dark, tangled, ununderstood cause of a peaceful world."

For further information, visit <http://www.aip.org/history>, or contact the Niels Bohr Library, American Institute of Physics, One Physics Ellipse, College Park, MD 20740 USA, e-mail nbl@aip.org.

References

1. J. R. Oppenheimer, "Reflections on the Resonances of Physics History," talk at the American Institute of Physics, 26 September 1962. Copies are available from the AIP Center for History of Physics, One Physics Ellipse, College Park, MD 20740.
2. Copies of the interviews and microfilms, collectively known as the Archives for History of Quantum Physics, are deposited in the Niels Bohr Library and 18 other libraries around the world.
3. See the online exhibit at <http://www.aip.org/history/einstein>, with the voice clip at <http://www.aip.org/history/einstein/voice1.htm>. For other exhibits, see <http://www.aip.org/history/exhibit.htm>. ■