

Guide to the Papers of Francis Bitter, 1925-1967

MC.0077

Finding aid prepared by Mary Jane McCavitt

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Summary Information

Repository	Massachusetts Institute of Technology. Institute Archives and Special Collections
Creator	Bitter, Francis, 1902-1967
Title	Francis Bitter papers
Date [inclusive]	1925-1967
Extent	17.3 cubic feet in 17 record cartons and 1 manuscript box
Location	Materials are stored off-site. Advance notice is required for use.
Language	English
Abstract	These papers document the career of Francis Bitter, who helped establish the National Magnet Laboratory at MIT. The bulk of the collection postdates 1934, when Bitter came to MIT. The papers consist primarily of correspondence with colleagues, professional societies, and concerns that hired him as a consultant.

Citation

Francis Bitter papers, MC 77, box X. Massachusetts Institute of Technology Institute Archives and Special Collections, Cambridge, Massachusetts.

Biography

Francis Bitter was born in Weehawken, NJ, on July 22, 1902, to Karl Bitter, the sculptor, and Marie Schevill Bitter. He grew up in Weehawken and New York City.

Starting in 1919, Bitter attended the University of Chicago but, after working on a cattle boat in order to visit Europe in 1922, he transferred to Columbia University. He received his Bachelor of Science degree in 1925 and spent the next year studying in Berlin. He began a lifelong study of magnets when he returned to Columbia for graduate work. Under A. P. Wills's supervision, Bitter wrote his dissertation on the diamagnetic susceptibility of hydrocarbons.

Bitter received his doctoral degree in 1928 and continued his studies under Robert Millikan at the California Institute of Technology with the support of a National Research Fellowship. The same year Bitter married Mrs. Alice Coomara (nee Richardson). Under the stage name of Ratan Devi, his wife was a popular singer.

In 1930 Bitter left academia to accept work in Pittsburgh with the Research Department of Westinghouse Electric and Manufacturing Company. His magnet studies expanded to include ferromagnetism. A symposium on this subject was held in 1931 by the American Physical Society due in part to Bitter's impetus. The same year he discovered the powder pattern method for visualizing magnetic domain structure.

With the help of another fellowship, a Guggenheim, Bitter went to the Cavendish Laboratories at Cambridge University in 1933. There he studied with Peter Kapitza, who was working with powerful pulsed magnetic fields. He returned to Westinghouse in 1934, but only for a few months. In the fall of 1934 Bitter began his long career with MIT while continuing as a consultant for Westinghouse.

At MIT Bitter became an associate professor in the Department of Mining and Metallurgy. He designed a high field magnet through the use of water-cooled copper coil electromagnets. His work was partially funded by grants from the Penrose Fund of the American Philosophical Society and the Joseph Henry Fund of the National Academy of Sciences. By 1938 MIT had a magnet laboratory established largely through Bitter's efforts. His early experiments succeeded in creating a solenoid magnet that produced a constant field of 100,000 gauss. Bitter also collaborated with George Harrison on the use of new magnets for investigations of optical phenomena, the Zeeman effect in particular. Another project involved the study of the connection between magnetism and geology; this work helped to reconstruct the history of the earth's magnetic field.

During World War II Bitter spent five years with the Naval Bureau of Ordnance. He worked in England on methods to demagnetize German mines in the English Channel. Other work included development of detection and target-seeking instruments. Bitter attained the rank of Commander in the Navy and became a reserve officer in 1947.

When he returned to MIT in 1945, Bitter joined the Department of Physics. With one of his students, Jean Brossel, he experimented with double resonance. His magnet laboratory was converted during the war, so Bitter reconstructed the lab after the war to facilitate his experiments.

Bitter maintained an active interest in MIT and in education in general. He became a full professor in 1951 and from 1956 to 1960 he served as associate dean of science. His interest in curriculum studies led to his association with the Physical Science Study Committee of Educational Services, Inc. (ESI). He and his second wife, Katherine Welchman, served as masters of MIT's Graduate House from 1962 to 1965.

In 1960 Bitter became professor of geophysics in the Department of Geology and Geophysics and assumed primary responsibility for the design and completion of the National Magnet Laboratory, which was funded by the US Air Force. The facility's program was to focus on earth and space science, hence Bitter's departmental change. In an October 22, 1963, letter to Bruce Kingsbury of ESI, Bitter explains his association with the National Magnet Laboratory:

I built the original water-cooled magnets and set up a magnet laboratory for their operation in the basement of building 4 during the latter part of the 1930's. After the war Dr. Benjamin Lax of the Lincoln Laboratory became interested in high field work and assembled a group to design and apply for funds to construct a new and larger laboratory. I, subsequently, joined this effort and agreed with Dr. Lax that he would be the director of the laboratory when funds became available and that I would act for the group in taking responsibility for technical aspects of design and construction of the power plant and magnets. These plans were actually carried out when the National Magnet Laboratory came into existence. The final acceptance tests are about to be completed. At this time I propose to officially relinquish all administrative responsibility in the Laboratory and become entirely a consultant to help the Director in any problems in which he thinks my experience would be valuable. In addition, I have been and propose to continue to be a user of the facilities of the Laboratory to further my own work in atomic physics and geophysics.
(Box 6, Physical Science Study Committee)

During Bitter's tenure, the National Magnet Laboratory produced a water-cooled magnet that gave a constant magnet field of 250,000 gauss.

An active consultant, Bitter worked with Arthur D. Little and Sylvania, where he contributed to fluorescent light improvement. His work with Clarence Max Fowler of the Los Alamos laboratories concerned the precise control of high explosives which led to transient magnetic fields of a great intensity, in other words, to megagauss magnets. In 1966 Bitter spent a semester at Chicago's Illinois Institute of Technology serving as advisor in their high field laboratory.

Francis Bitter died on July 26, 1967. In his honor, the National Magnet Laboratory was renamed the Francis Bitter National Magnet Laboratory on November 21, 1967.

Scope and Contents of the Collection

The Francis Bitter papers span the years from 1925 to 1967. Although not exhaustive, the Bitter papers provide a broad overview of the physicist's career. The bulk of the collection postdates 1934 when

Bitter came to MIT. The largest series, his alphabetical subject files (Series 2), consists primarily of correspondence with colleagues, professional societies, and concerns that hired him as a consultant. The collection includes correspondence; reports; minutes; notes; research and patent data; blueprints, sketches, and drawings; course notes; and reprints and other printed material. These papers are from Bitter's office files, and most of his file labels remain intact.

The collection also includes material that does not relate to MIT. His research files (Series 4) contain six student notebooks from his days at Columbia and the University of Berlin. One notebook (in the same volume as a 1952-1962 diary) contains notes on electromagnetic experiments that Bitter conducted in Berlin, prior to his graduate thesis work.

Bitter's time at Westinghouse is documented in the collection. Some of his work was patented and the applications, descriptions, and other technical data are in Series 2A. During his Guggenheim fellowship at the Cavendish Laboratories in Cambridge, England, Bitter wrote to T. D. Yensen and L. W. Chubb of Westinghouse about his investigations. Some of these technical letters concern ferromagnetism and show the evolution of Bitter's book on the subject.

Throughout his career Bitter often served as a consultant and his files document these outside activities. Bitter continued advising Westinghouse and there are minutes from their Magnet Division meetings in Series 2A. The technical letters from this consulting job concern tests Bitter made for Westinghouse at MIT on magnetic alloys, Hipersil development, and grain orientation. There is material from other consulting jobs, including Arthur D. Little and Sylvania (Series 2B). One of Bitter's notebooks (Series 5) is a diary of hours spent on various projects. After he became a reserve officer, Bitter worked with the Navy's Electricity and Magnetism Division and he served on their Ferromagnetic Committee. One of Bitter's most important consulting jobs began in 1963, when he started working at the Los Alamos Laboratories on an Atomic Energy Commission Project. His correspondence with Clarence Max Fowler and other scientists on the project is extensive. His files also include working notes and drawings about their work on megagauss field magnets.

While at Westinghouse, Karl Taylor Compton and Vannevar Bush frequently contacted Bitter in order to arrange his appointment at MIT. This correspondence (Series 2A) includes a discussion of Bitter's plans for magnet research at MIT. Bitter's early correspondence with colleagues includes Nicolas Rashevsky, E. U. Condon, Karl Darrow, Felix Bloch, F. A. Fowler, John D. Cockcroft, and Fritz Zwicky.

When he arrived at MIT, Bitter implemented many of his research plans and formed new ones. He was instrumental in establishing MIT's first magnet laboratory in 1938. The successful and unsuccessful grant requests in the collection (Series 2A) show some of Bitter's ideas about water-cooled magnets. The files contain reports to Compton and Bush on the importance of developing high magnetic fields to study metals. The correspondence also documents the establishment at MIT of a 2300 Volt Electrical Power Station for the first magnet laboratory and the Wright Brothers Wind Tunnel. The engineering firm of Jackson and Moreland helped to design Bitter's water-cooled magnets, and their correspondence includes equipment information, blueprints, and sketches. Bitter's research files (Series 4) contain notes and notebooks dealing with both the laboratory and the development of the lab's early magnets.

After World War II Bitter returned to MIT to continue his work with magnets. He reestablished a magnet laboratory and began work on nuclear magnet resonance. His correspondence, which includes graphs, blueprints, and reports, about the magnet's design is from Arthur D. Little and Allis and Chalmers Manufacturing Company (Series 2B). By 1947 MIT contracted with the firm of Jackson and Moreland

to construct a new magnet laboratory. Some of Bitter's notebooks (Series 4) deal specifically with his magnetic resonance investigations.

Eventually, Bitter's work with electromagnets resulted in an association with the Research Laboratory of Electronics (RLE). The collection contains notebooks (Series 3) and Bitter's progress reports (Series 2) about RLE. In 1958 Bitter proposed that MIT build a High Field Magnet Laboratory. His proposal, budgets, blueprints, and progress records are in Series 2B. Again, Jackson and Moreland served as the engineers.

In 1960 the Air Force provided funds for a National Magnet Laboratory (NML) at MIT. Bitter's close association with the development and progress of the NML is shown through his extensive correspondence about the lab. The records include construction plans; dedication material; and memos, reports, and correspondence after the facility was in operation. The correspondence is from non-MIT colleagues as well as from the NML staff, including the director, Benjamin Lax.

Some of Bitter's manuscripts of articles and books are in Series 6, along with most of his reprints. Series 2B contains correspondence about his talks and the publishing of his books. This section also includes some speech manuscripts. Throughout his career Bitter saved his colleagues' reprints about magnets for reference; this file is in Series 6. Often there is correspondence with the same colleagues (2B); examples are M. Alfred Kastler, P. C. Brot, Dirk de Klerk, and Jean Brossel.

Bitter's interest in MIT students and in pedagogy in general is extensively documented in this collection. Series 3 contains course notes emanating from Bitter's research work. The numerous files from former students (2B) show that Bitter maintained contact with them, especially the graduate students. Unfortunately, there is little material from Bitter's position as assistant dean of science, other than his correspondence about doctoral candidates. From the years Bitter spent as master of MIT's Graduate House, there is correspondence directed to both the administration and the students.

Bitter's concern with education was never limited to MIT. He belonged to the Visiting Scientist program for the American Institute of Physics and for the American Association of Physics Teachers; the Advisory Board of Education for the National Research Council; the Committee on the Role of Science in American Liberal Education; and the Massachusetts Advisory Committee on Science and Mathematics. Ginn and Company used him as a consulting editor for their physics books. There are correspondence, minutes, and reports concerning all of these activities in Series 2B.

Two of Bitter's books are for high school students. *Magnets* and *Mathematical Aspects of Physics* were published by Educational Services Incorporated (ESI) for their Physical Science Study Committee (PSSC) program. There are also reports, agendas, and correspondence from Bitter's attendance at ESI's College Physics Contents Conference.

Arrangement of Collection

The collection is arranged into the following series: Series 1. Biographical Materials; Series 2. Alphabetical Subject Files; Series 3. MIT Course Notes and Student Work; Series 4. Research Files; Series 5. Professional Writings and Reprints; and Series 6. Magnet Reprint Files.

Series 2 is divided into two alphabetical subseries by date span.

Administrative Information

Publication Information

Massachusetts Institute of Technology. Institute Archives and Special Collections 1981

Revision Description

2009

Access note

The collection is open for research. Access to MIT records is governed by Institute record policy.

Intellectual Property Rights

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Controlled Access Headings

Corporate Name(s)

- American Academy of Arts and Sciences
- American Association of Physics Teachers
- American Institute of Physics
- American Philosophical Society
- Arthur D. Little, Inc.

- Bell Telephone Laboratories, inc.
- Jackson & Moreland
- Los Alamos Scientific Laboratory
- Massachusetts Institute of Technology. Dept. of Geology and Geophysics
- Massachusetts Institute of Technology. Dept. of Physics
- Massachusetts Institute of Technology. Research Laboratory of Electronics
- Massachusetts Institute of Technology. Wright Brothers Wind Tunnel
- National Research Council (U.S.)
- Royal Society Mond Laboratory
- United States. Navy. Magnetism Division
- Westinghouse Electronic Corporation. Magnet Systems Division.

Genre(s)

- Diaries.
- Patents.

Personal Name(s)

- Alpert, Nelson Leigh
- Becker, Robert Adolph
- Bergman, Werner, 1945-
- Bitter, Francis, 1902-1967
- Bloch, Felix, 1905-
- Bradbury, Norris Edwin
- Brossel, Jean
- Brot, P. C.
- Bush, Vannevar, 1890-1974
- Chapman, Jamie Crittenden
- Chubb, Lewis Warrington, 1882-1952
- Cockcroft, John, Sir, 1897-1967
- Compton, K. T. (Karl Taylor), 1887-1954
- Condon, Edward Uhler , 1902-1974
- Darrow, Karl K. (Karl Kelchner), 1891-
- de Klerk, Dirk
- Erber, Thomas
- Fiocchi, Giorgio
- Fohl, Timothy
- Fowler, C. M.
- Fowler, R. H. (Ralph Howard), 1889-1944
- Halverson, Ward Dean
- Hide, R. (Raymond), 1929-

- Inglis, David Rittenhouse, 1905-
- Kastler, Alfred
- Kolm, Henry Herbert
- Kurti, Nicholas
- Lax, Benjamin
- McKeehan, Louis Williams
- Moreland, Edward Leyburn
- Rashevsky, Nicolas, 1899-
- Richtmyer, F. K. (Floyd Karker), 1881-1939
- Saslaw, Samuel S.
- Seitz, Frederick, 1911-2008
- Smoluchowski, Roman
- Stevenson, Donald Thomas
- Strandberg, Malcolm Woodrow Pershing, 1919-
- Stroke, H. Henry
- Waymouth, Francis
- Weiner, Robert
- Yensen, Trygve D. (Trygve Dewey), 1884-1950
- Zwicky, F. (Fritz), 1898-

Subject(s)

- Electromagnets--Research.
- Ferromagnetism--Research.
- Massachusetts Institute of Technology--Faculty.

Bibliography

Bitter, Francis. *Magnets: The Education of a Physicist*. Garden City, N.Y.: Doubleday, 1959.

Francis Bitter, Selected Papers and Commentaries, edited by T. Erber and C. M. Fowler. Cambridge, Mass.: M.I.T. Press, 1969.

Biographical Materials

Collection Inventory

Series 1. Biographical Materials

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Biography	1
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Series 2. Alphabetical Subject Files
Subseries 2A. Subject files 1931-1940
Scope and Contents note

Incoming and outgoing correspondence, reports, blueprints, grant applications, memos, and patent records. Files, kept in original order whenever possible, concern Bitter's professional activities.

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An-EI between 1931 and 1940	1
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Subject files

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Jackson and Moreland between 1931 and 1940	1
K-Mar between 1931 and 1940	1
Massachusetts Institute of Technology between 1931 and 1940	1
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Wi-Z between 1931 and 1940	1

Subseries 2B. Subject files 1940-1967**Scope and Contents note**

Correspondence, reports, graphs, plans, blueprints, memos, student information, manuscripts, and printed material.

Box

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Subject files

This folder is restricted for 75 years

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General note

This folder is restricted for 75 years

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General note

This folder is restricted for 75 years

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Magnetism, Harper's Encyclopedia of Science 1960	10
Mathematics - Language of Physics 1960	10
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