THE UNIVERSITY OF CHICAGO

NUCLEONICS:
IMAGINING THE NUCLEAR FUTURE IN CHICAGO

By

Joseph Eilbert

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Faculty Advisor: John Mark Hansen

Preceptor: Deirdre Lyons

Steps away from the University of Chicago's Joseph Regenstein Library, Henry Moore's monumental sculpture *Nuclear Energy* stands on a broad concrete plinth. In 1967, the university dedicated this bronze monolith to mark the site of the world's first controlled, self-sustained nuclear chain reaction on the twenty-fifth anniversary of the event. Two years earlier, Moore had introduced his design, then called *Atom Piece*, to university faculty and leadership in Chicago. The design was well received; the title, with its perceived pun on "atom peace," was not.[1]

In the summer of 1965, the University of Chicago Memorial Planning Committee had ample reason to balk at a title that sounded like "atom peace." Charged with commemorating this crowning achievement of the Metallurgical Laboratory—better known as the "Met Lab," the Manhattan Project atomic weapons research site managed by the university during World War II—the committee likely considered recent world events that reflected the dramatic ongoing political and military impact of nuclear technology. The United States was not yet three years removed from the Cuban Missile Crisis, which had brought the threat of nuclear war closer to home than ever before.[2] The confrontation between the world's foremost nuclear powers

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1. Erin Hogan, "Elemental," *The University of Chicago Magazine* 110, no. 1 (2017): 35. See also the subsection "Titling *Nuclear Energy* and exhibiting *Atom Piece*" from Alice Correia, "Atom Piece (Working Model for Nuclear Energy) 1964–5, Cast 1965 by Henry Moore OM, CH," in *Henry Moore: Sculptural Process and Public Identity* (Tate Research Publication, 2013), https://www.tate.org.uk/art/research-publications/henry-moore/henry-moore-om-ch-atom-piece-working-model-for-nuclear-energy-r1171996. On the context of this commission within Moore's wider corpus, see Catherine Jolivette, "Science, Art and Landscape in the Nuclear Age," *Art History* 35, no. 2 (2012): 264, https://doi.org/10.1111/j.1467-8365.2011.00885.x.

2. David R. Inglis, "Disarmament after Cuba," *Bulletin of the Atomic Scientists* 19, no. 1 (1963): 18–21, https://doi.org/10.1080/00963402.1963.11454445; Roger Hagan and Bart Bernstein, "Military Value of Missiles in Cuba," *Bulletin of the Atomic Scientists* 19, no. 2 (1963): 8–13, https://doi.org/10.1080/00963402.1963.11454455. By 1965, the Bulletin of the Atomic Scientists was considered the premier source of public information, education, and discourse on atomic science; see Alice Kimball Smith, *A Peril and a Hope: The Scientists' Movement in America, 1945-47* (University of Chicago Press, 1965), 294–97. Paul S. Boyer, *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age* (1985; 2nd ed, University of North Carolina Press, 1994), 63–64, 366.

underscored the high stakes of Cold War nuclear diplomacy, projecting disconcerting terms such as "brinkmanship" and "balance of terror" into the public lexicon.[3] Outside of US-Soviet relations, atomic threats to international peace also seemed to be on the rise. China tested its first atomic weapon in late 1964, increasing the total number of nuclear-armed nations to five and stoking anxieties over the ongoing process of nuclear proliferation.[4] Fears surrounding Chinese nuclear capabilities intensified throughout 1965 amidst increasing US involvement in Vietnam, including a surge of US troops into the ground war against Chinese-aligned North Vietnamese forces.[5]

In this context, the university proved reticent to memorialize its contribution to the Manhattan Project with an unsubtle reminder of the international tensions engendered by nuclear weapons. In apparent acknowledgement of the awkward situation, *Nuclear Energy* supplanted *Atom Piece* as the title of Moore's work, a process that has preserved both names for future reflection.[6] What might *Nuclear Energy* memorialize about the Met Lab that the name *Atom*

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3. Eugene Rabinowitch, "After Cuba: Two Lessons," *Bulletin of the Atomic Scientists* 19, no. 2 (1963): 2–8, https://doi.org/10.1080/00963402.1963.11454454; Stephen Hilgartner et al., *Nukespeak: The Selling of Nuclear Technology in America* (Penguin Books, 1983), 209, 212.

4. Bernard T. Feld, "The Nonproliferation of Nuclear Weapons," *Bulletin of the Atomic Scientists* 20, no. 10 (1964): 2–6, https://doi.org/10.1080/00963402.1964.11454726; Howard Margolis, "From Washington: The Bomb in China," *Bulletin of the Atomic Scientists* 20, no. 10 (1964): 36–39, https://doi.org/10.1080/00963402.1964.11454737.

5. Howard Margolis, "From Washington: Some Problems in Vietnam," *Bulletin of the Atomic Scientists* 21, no. 5 (1965): 40–43, https://doi.org/10.1080/00963402.1965.11454813; Hans J. Morgenthau, "The Vietnam Crisis and China," *Bulletin of the Atomic Scientists* 21, no. 6 (1965): 27, https://doi.org/10.1080/00963402.1965.11454822. For contemporaneous discussion of North Vietnam's uneasy dependence on China in the context of the ongoing Sino-Soviet split, see George McT. Kahin and John W. Lewis, "The United States in Vietnam," *Bulletin of the Atomic Scientists* 21, no. 6 (1965): 34, https://doi.org/10.1080/00963402.1965.11454823.

6. A small-scale working model held by the Tate retains the original *Atom Piece* moniker; see Correia, "Atom Piece (Working Model for Nuclear Energy) 1964–5, Cast 1965 by Henry Moore OM, CH."

Piece does not? Looking back on this renaming incident in 1965 affords an opportunity to compare two distinct historical narratives of how the Met Lab shaped postwar entanglements of nuclear science and state power.[7]

Atom Piece, particularly its double meaning "atom peace," invokes the history of the atomic scientists' movement, which advocated international cooperation in nuclear arms control in hopes of securing a peaceful postwar world order. Some historians of the Manhattan Project—notably, those working from the University of Chicago's archives—have emphasized the efforts of atomic scientists, especially those based in Chicago, to bring about world peace along with the dawn of the Atomic Age. The first section of this essay traces how this historical narrative of the atomic scientists' movement emerged, focusing on how the Met Lab came to be seen as uniquely fertile ground for wartime scientists who later emerged as political advocates of nuclear arms control. In this retelling, the Met Lab constituted the nucleus of the atomic scientists' campaign for global "atom peace" after the war's end.[8]

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7. This essay's comparative analysis of historical narratives follows the guidance of Michel-Rolph Trouillot's venerable *Silencing the Past*: "[H]istory reveals itself only through the production of specific narratives. What matters most are the process and conditions of production of such narratives." Michel-Rolph Trouillot, *Silencing the Past: Power and the Production of History* (Beacon Press, 1995), 25. To this end, I discuss not only key archival materials that have been employed for constructing historical narratives of the Met Lab but also the archival practices that have shaped the production processes behind those narratives. For a detailed discussion of the lasting influence of Trouillot's most famous work, see Alyssa Goldstein Sepinwall, "Still Unthinkable? The Haitian Revolution and the Reception of Michel-Rolph Trouillot's 'Silencing the Past,'" *Journal of Haitian Studies* 19, no. 2 (2013): 75–103.

8. Alice Kimball Smith's 1965 *A Peril and a Hope: The Scientists' Movement in America, 1945-47*, one of the earliest and most prominent historical works covering of the atomic scientists' movement, drew heavily from the University of Chicago archives. Smith's book and another early history of Manhattan Project both directly comment on the importance of the university's archives to recounting the emergence of the atomic scientists' movement: Smith, *A Peril and a Hope*, 579–80; Richard G. Hewlett and Oscar E. Anderson, *The New World, 1939/1946*, History of the United States Atomic Energy Commission (1962; Reprint, U.S. Atomic Energy Commission, 1972), 1:659. For later works that testify to the lasting influence of Smith's account and further explore the relationship between the atomic scientists' movement

The dearth of comprehensive world peace even after twenty years of campaigning by the Chicago-based atomic scientists' movement might suffice to explain the rejection of Moore's original *Atom Piece* title in 1965. The question remains, however: what does *Nuclear Energy* mean instead? In historiographic terms, why does the University of Chicago mark a significant moment in the history of atomic science with this particular moniker?

To offer one answer, the second section of this essay reexamines a key archival record produced by the Met Lab—the 1944 "Prospectus on Nucleonics," also known as the Jeffries Report—seeking to expand beyond prior readings that posit it as an early expression of the dreams for "atom peace" that inspired the atomic scientists' movement.[9] I argue that the Jeffries Report lays out more than Met Lab researchers' hopes for a peaceful postwar order undergirded by effective international regulation of atomic weapons; it also describes a nuanced vision for the domestic development of a burgeoning technoscientific discipline centered on researching and exploiting nuclear energy. The authors of the Jeffries Report coined the term "nucleonics" to describe the field of research that would today be recognized as nuclear science and technology in the broadest sense.[10] From their vantage point within the Met Lab in late 1944, nucleonics

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and the Met Lab, see Boyer, *By the Bomb's Early Light*, 49–52; Matt Price, "Roots of Dissent: The Chicago Met Lab and the Origins of the Franck Report," *Isis* 86, no. 2 (1995): 222–24, https://doi.org/10.1086/357154.

9. "Prospectus on Nucleonics," Mimeograph copy, with Enrico Fermi et al., November 18, 1944, Franck, James. Papers, Box 18, Folder 11, Holborn Gray Special Collections Research Center, University of Chicago Library; Smith, *A Peril and a Hope*, 19–24; Price, "Roots of Dissent," 237–39.

10. The earliest reference to "nucleonics" appears in a July 1944 letter to Met Lab director Arthur H. Compton calling for a prospectus on the postwar development of the nuclear field. By analogy to electronics, the field of scientific research and industrial technology defined by the manipulation of electrons, nucleonics is characterized by the utilization of another class of subatomic particles: neutrons and protons, collectively referred to as "nucleons" due to their shared position within the atomic nucleus. The letter also mentions "nuclonics," a shorter alternative that ultimately gained even less traction than did "nucleonics." Zay Jeffries, Mimeograph copy to Arthur H. Compton, July 13, 1944, 1–2, Holborn Gray Special Collections

seemed poised to yield not only devastating new weapons but also a wealth of non-military and dual-use innovations such as nuclear medicine and power reactors. With its current title, Moore's *Nuclear Energy* memorializes their wide-ranging vision for nucleonics—a field that, according to Met Lab scientists, would be organized around the fundamental physical concept of nuclear energy itself.

The third section of this essay explores how wartime imaginations for the future of nucleonics manifested in actual nuclear energy research praxis after the war. Even before the war's end, the University of Chicago began the process of relocating the worksites and reevaluating the priorities of its atomic research program.[11] This process culminated with the transformation of the Met Lab into Argonne National Laboratory (ANL), the "venerable elder statesman" of the US national laboratory system.[12] ANL was the direct scientific and institutional successor to the Met Lab, retaining the Met Lab's specialization in reactor design as well as many of its personnel and its University of Chicago management into the immediate postwar

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Research Center, University of Chicago Library (Franck, James. Papers, Box 18, Folder 5). As Smith notes in 1965, "[t]he term 'nucleonics' [...] did not catch on even among scientists." Smith further observes that "'[a]tomic' energy [...] has never been replaced in popular parlance by the more accurate term 'nuclear.'" Smith, *A Peril and a Hope*, 21. Since Smith's etymological analysis largely holds true today, I use "atomic" and "nuclear" to describe any discipline related to atomic science or nuclear technology (such as weapons development or reactor engineering) while reserving "nucleonics" as a descriptor specifically for the Met Lab's stated vision for the future of the nuclear field. On the origins of the term "nucleonics," see also H. Froula, "Findings of Use of Term 'Nucleon,'" Mimeograph copy, n.d., Franck, James. Papers, Box 18, Folder 9, Holborn Gray Special Collections Research Center, University of Chicago Library, an undated literature review ostensibly undertaken in support of the proposed "nucleonics" moniker.

11. Leonard Greenbaum, *A Special Interest: The Atomic Energy Commission, Argonne National Laboratory, and the Midwestern Universities* (University of Michigan Press, 1971), 6–11.

12. Jack M. Holl, *Argonne National Laboratory, 1946-96*, with Richard G. Hewlett and Ruth Roy Harris (University of Illinois Press, 1997), ix.

years.[13] This genealogy relating the Met Lab to ANL—a lineage traced through the scientific concept of nuclear energy and the administrative legacy that the University of Chicago commemorates with *Nuclear Energy*—provides a fresh historical narrative suitable for a final comparison with the "atom peace" story already told about the Met Lab and its other progeny, the atomic scientists' movement.

***Atom Piece*; or, "Atom Peace"**

After reactor research was safely removed from the university campus to ANL's newly constructed facilities in the southwest suburbs of Chicago, Moore's sculpture and the University of Chicago's Joseph Regenstein Library came to occupy the city block that once hosted Chicago Pile-1, the Met Lab's primitive nuclear reactor that in 1942 sustained the first-ever artificial nuclear chain reaction.[14] Today, within the library's Hanna Holborn Gray Special Collections Research Center, a significant portion of the University Archives preserves material documenting the nuclear history made in the same locale some eighty years ago. Before turning in the next section to a direct analysis of this archival material, this section outlines key historiographic tendencies and structural features of the University Archives itself that underlie interpretations of the Met Lab and its legacy.

The University Archives has long been cherished by nuclear historians not only for its apposite physical location but also for its role as a depository for atomic scientists' self-documentation following World War II.[15] One document in particular, the Franck Report, has

13. Holl, *Argonne National Laboratory, 1946-96*, xix–xx; Greenbaum, *A Special Interest*, 6–7, 15–19.

14. Greenbaum, *A Special Interest*, 6.

15. Smith, *A Peril and a Hope*, 579–80; Hewlett and Anderson, *The New World, 1939/1946*, 1:659.

remained central to the "atom peace" historical narrative in which the Met Lab is characterized as unique due to its deep political connection to the postwar atomic scientists' movement.[16] The output of a late-war committee comprised of leading Met Lab scientists, the Franck Report expressed the atomic scientists' concerns about the impending deployment of the atomic bomb, arguing that "a demonstration of the new weapon might best be made, before the eyes of representatives of the United Nations, on the desert or a barren island" rather than in a surprise attack against Japanese cities.[17] Histories of the atomic scientists' movement have suggested several reasons why the Met Lab was the only Manhattan Project site to lodge such a protest against immediate offensive use of the atomic bomb, but they concur that the Franck Report reflects special qualities of the social and political ferment of the Met Lab that are not observed elsewhere.[18] The practices, content, and format of the University Archives—especially of its faculty papers collections, which contain the Franck Report and other similar records donated by Met Lab scientists—serve to highlight some of these qualities in the Met Lab.

One influential and obvious feature of Met Lab-related collections held by the University Archives is a direct intervention by Alice Kimball Smith. Smith was one of the first historians to write about the Manhattan Project, and she spoke as much from personal experience as from

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16. The University Archives features a complete copy of the report, alongside notes, drafts, and other related documents, within its collection of biophysicist James Franck's personal files: "Memorandum on 'Political and Social Problems' from Members of the 'Metallurgical Laboratory' of the University of Chicago," with James Franck et al., June 12, 1945, Franck, James. Papers, Box 18, Folder 23, Special Collections Research Center, University of Chicago Library; Smith, anticipating the Franck Report's significance to the history of the atomic scientists' movement, reprints the Franck Report in full as an appendix: Smith, *A Peril and a Hope*, 560–72; Boyer, *By the Bomb's Early Light*, 50; Price, "Roots of Dissent."

17. "Memorandum on 'Political and Social Problems' from Members of the 'Metallurgical Laboratory' of the University of Chicago," 10.

18. Smith, *A Peril and a Hope*, 59–60; Boyer, *By the Bomb's Early Light*, 49–50; Price, "Roots of Dissent," 223–24.

archival sources. She joined her husband, a Manhattan Project scientist, at the Los Alamos site in the summer of 1943, where the pair lived before moving to Chicago as her husband took up a postwar position at the University.[19] Short notes left by this founding figure of Manhattan Project history can be found scattered throughout sections of the University Archives related to the atomic scientists' movement, but Smith's notes surrounding the Franck Report in James Franck's faculty papers constitute a representative set. There are a half dozen of Smith's notes in the box containing the Franck Report and related documents; most of them attribute handwritten records to specific Met Lab staff members, and several also include brief commentary from the document's original author.[20] These notes provide an invaluable tangible link between the Franck Report and several documents in the collection that otherwise appear to be little more than loose scraps of scratch paper with inscrutable handwriting. In this capacity, Smith's notes serve the purpose of contextualizing the Franck Report in terms of who contributed to it. Considering that about ninety percent of Met Lab scientists joined the Atomic Scientists of Chicago (ASC) after the war and that Smith herself served as an editor for the ASC's *Bulletin of the Atomic Scientists*, these notes closely resemble one commentator's description of how the atomic scientists' movement "came to tell its own story."[21] In this case, Smith's physical additions to the

19. Alice Kimball Smith, "Alice Kimball Smith's Interview," interview by Martin Sherwin, (Cambridge), April 26, 1982, Voices of the Manhattan Project, https://ahf.nuclearmuseum.org/voices/oral-histories/alice-kimball-smiths-interview/.

20. Alice Kimball Smith, "Notes by Alice K. Smith," August 16, 1958, Franck, James. Papers, Box 18, Folders 14, 15, 17, 18, 21, and 25, Special Collections Research Center, University of Chicago Library.

21. University of Chicago Library, "Guide to the Bulletin of the Atomic Scientists Records," 2006, 1, Bulletin of the Atomic Scientists. Records, Special Collections Research Center, University of Chicago Library, https://www.lib.uchicago.edu/ead/rlg/ICU.SPCL.BULLETIN.pdf; Price, "Roots of Dissent," 223.

collections of the University Archives enriches historical narratives of the atomic scientists' movement by helping future historians utilize materials such as James Franck's papers.

As University Archivist Kathleen Feeney points out, the University Archives considers faculty papers like Franck's to be one of the unique strengths of its collections. Feeney also observes, however, that collected faculty papers, unlike departmental and other organizational records, typically follow "unofficial" trajectories between personal use and archival accession. As opposed to records such as those from the Office of the University President, which are officially "transferred" to the University Archives at the conclusion of a presidents' term, faculty papers are only ever voluntarily "given" to the archives and rarely in a comprehensively sorted and organized state. University of Chicago archivists often work to recover disorganized, derelict, or incomplete sets of personal files, usually upon the death of their owner, from places like home offices, closets, and basements.[22]

For collections such as the James Franck Papers, this ad hoc accessioning process leaves personal and professional content "intermingled;" worse, the documents' original order is also "thoroughly obscured," with the papers later reorganized by archival workers according to date and subject.[23] This intermixing and reordering make it difficult to distinguish professional work products from individual statements of opinion, encouraging readings of documents like the Franck Report in the context of Met Lab scientists' personal identities and beliefs. Such personalist readings lend themselves to interpretations of atomic scientists' activism as stemming from individual moral reckoning or emotional response rather than institutional context or

22. Kathleen Feeney, (Chicago), May 27, 2025, in discussion with the author.

23. University of Chicago Library, "Guide to the James Franck Papers," 2006, 16, 19, Franck, James. Papers, Special Collections Research Center, University of Chicago Library, https://www.lib.uchicago.edu/ead/rlg/ICU.SPCL.FRANCK.pdf.

collective dynamics.[24] In this way, the archival structure itself implicitly supports a narrative in which political advocacy emerging from the Met Lab appears as a product of individual ethics or personality rather than one shaped by organizational or disciplinary forces.[25]

Feeney also explains that the university's archivists gauge interest across the collections through a combination of statistical tracking and personal relationships with archival researchers, allocating their labor to those collections with the highest degree of demonstrated research interest.[26] Signs of research interest have seemingly been sufficient to warrant extensive efforts on behalf of the University Archives to organize, describe, and make available a trove of documentation related to the atomic scientists' movement.[27] This practice of archival prioritization following after active research interest risks generating a recursive cycle in which certain archival materials like the Franck Papers draw researchers' focus, leading to more archival efforts directed towards improving those materials as sources for historical research. Guided by indicators of research interest, archivists may work to organize, describe, and make available certain types of records—Met Lab faculty papers and organizational records relevant to

24. Boyer, *By the Bomb's Early Light*, 49–50, 138; Smith, *A Peril and a Hope*, 528; Price, "Roots of Dissent," 224.

25. I suggest that support for the "atom peace" narrative linking the Met Lab to the atomic scientists' movement arises out of the structure of the University Archives collections themselves; in doing so, I intend to avoid any unjustified implication of a deliberate conspiracy by Met Lab scientists, historians of the atomic scientists' movement, or University of Chicago archivists to bias the University Archives towards a particular historical narrative. Trouillot, *Silencing the Past*, 106.

26. Kathleen Feeney, in discussion with the author, May 27, 2025.

27. In addition to relevant collections of papers from dozens of Met Lab scientists, the University Archives also maintains six collections of records from different organizations comprising the atomic scientists' movement. Nuclear historians have long recognized this abundance of useful primary sources: Smith, *A Peril and a Hope*, 579–80; Hewlett and Anderson, *The New World, 1939/1946*, 1:659.

the atomic scientists' movement, for example—in turn making those sorts of materials even more amenable to continued use by researchers.

This interpretation reveals the University Archives to be a dynamic force deeply implicated in the historiography of the Met Lab. This section has only remarked on some of the historical processes that created a historical narrative emphasizing the Met Lab's role as a forerunner to the atomic scientists' movement. From direct interventions into the collections like Alice Kimball Smith's notes to incidental structural features of the archives such as the reorganization of faculty papers and continuous tracking of research interest, examining the conditions under which this "atom peace" historical narrative has developed sheds light on some possible alternatives for the postwar story of the Met Lab.[28] Sean Johnston has already deftly crafted one such alternate narrative, remarking on the necessity of breaking with "conventional accounts" centering on the Met Lab and the atomic scientists' movement in order to better capture the experiences of the Manhattan Project's often-overlooked nuclear engineering specialists.[29] Recognizing the "atom peace" narrative as a deep-rooted feature of Met Lab historiography, I now turn to another alternative account—one that, unlike Johnston's broader departure, emerges from a modest shift in focus from the Franck Report and the atomic scientists' movement towards "nucleonics" and a lesser-known Met Lab document, the Jeffries Report.

Nucleonics

While the Franck Report has long served as a cornerstone of scholarship on the Met Lab's political legacy, the Jeffries Report offers an alternate perspective oriented away from the

28. Trouillot, *Silencing the Past*, 25, 106.

29. Sean Johnston, *The Neutron's Children: Nuclear Engineers and the Shaping of Identity* (Oxford University Press, 2012), 44.

atomic scientists' movement and inwards towards the Met Lab's imaginings of postwar nuclear research. Prepared in 1944 by a committee of Met Lab scientists and industrial experts, the Jeffries Report outlined not only technical projections for the emerging field of "nucleonics" but also anticipations for how the field should be reorganized, governed, and funded in peacetime.[30] This section explores the contents and context of the Jeffries Report, foregrounding its internal discussion over the roles of academia, government, and private industry in the field of nucleonics.

The first step in this analysis—locating a complete copy of the Jeffries Report—serves as a reminder of the historiographic opportunities previously revealed through reflection on prior archival research undertaken by Alice Kimball Smith. In her 1965 book on the atomic scientists' movement, Smith provides as appendices both the Franck Report and the Jeffries Report; the latter, however, is only reproduced in part. The segment of the Jeffries Report that Smith omits—the first three of the report's seven total sections—cover the scientific history and contemporary state of domestic nuclear science, as perceived within the Met Lab in 1944.[31] Fortunately for this effort to innovate on Smith's perspective, the University Archives, despite implicitly accepting Smith's framing by cataloging it within a subseries titled "Atomic Scientists' Movement, 1944-1953," offers a full copy of the Jeffries Report alongside a number of documents revealing the thinking of the Met Lab committee that contributed to it.[32]

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30. "Prospectus on Nucleonics."

31. Smith, *A Peril and a Hope*, 539.

32. University of Chicago Library, "Guide to the James Franck Papers," 76–77; "Prospectus on Nucleonics"; Froula, "Findings of Use of Term 'Nucleon'"; Jeffries, Mimeograph copy to Arthur H. Compton; M. C. Leverett, "Some Remarks on Nucleonics," Mimeograph copy, August 8, 1944, Franck, James. Papers, Box 18, Folder 6, Holborn Gray Special Collections Research Center, University of Chicago Library; C. M. Cooper, "Future Possibilities on Nucleonics," Mimeograph copy to R. S. Mulliken, August 12, 1944, Holborn Gray Special Collections Research Center, University of Chicago Library (Franck, James. Papers, Box 18, Folder 7); L.

The Jeffries Report, named after its committee chair Zay Jeffries but formally titled "Prospectus on Nucleonics," lays bare in its drafting process and final wording the hopes and concerns of the Jeffries Committee members for the emergent field of nuclear research. Unlike many of his academic colleagues in the Met Lab's senior leadership, Jeffries was a longtime industrial scientist whose specialization in metallurgy incidentally demonstrated that the Met Lab's code name "had turned out to be more appropriate than its sponsors intended."[33] In a letter sent to Met Lab director Arthur H. Compton calling for the formation of a committee to prepare a prospectus on the future uses of atomic energy, Jeffries predicts a postwar boom in the nuclear industry, comparing it favorably to the economic boost that wartime investments had given to the aviation industry.[34]

While in this letter Jeffries emphasizes the economic potential of the future peacetime nucleonics industry, he also anticipates his fellow committee members' belief that "[i]t will be impossible to stop the scientific world from tackling the whole nucleonics scientific field feverishly in the post-war period."[35] The Jeffries Committee agreed that scientists working in industry, in academia, and in new kinds of government-supported research institutions would all take part in upcoming rapid development of nucleonics. They differed somewhat, however, in their opinions on the proper relationship between private industry and universities, particularly as they envisioned specialized publicly-financed nucleonics research institutions.

W. Nordheim, "Remarks on the Future Development of Project and Nucleonics," Mimeograph copy to R. S. Mulliken, September 25, 1944, Holborn Gray Special Collections Research Center, University of Chicago Library (Franck, James. Papers, Box 18, Folder 8).

33. Smith, *A Peril and a Hope*, 15, 19.

34. Jeffries, Mimeograph copy to Arthur H. Compton, 1, 9.

35. Jeffries, Mimeograph copy to Arthur H. Compton, 2.

One committee member, a chemical engineer with prewar experience in the petroleum industry, came closest to matching Jeffries's optimism about the commercial nucleonics industry. Under the header "Some Remarks on Nucleonics," Miles C. Leverett states: "It is inevitable that difference of opinion shall arise over the question of admitting industrial groups to full participation in the development of atomic power and its by-products." Leverett clarifies his own belief "that full development of this field can be assured only by throwing it open" not only to the university physicists who first theorized about harnessing atomic energy but also to the industrial corporations that ultimately supplied the necessary technical expertise to put their theory into practice within the Met Lab's collaborative university-industry research effort.[36] As with electronics and automobiles, in the field of nucleonics Leverett opines that "[r]esearch alone is not enough." Even in peacetime, Leverett believes, domestic industrial capacity ought to be developed in conjunction with university-led programs for fundamental research in order to guarantee future military supremacy.[37]

Unlike Leverett, some Met Lab scientists harbored fears about the involvement of private industry in postwar nucleonics development. They suspected the large industrial corporations participating in the Manhattan Project of seeking monopolies over future developments in

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36. Leverett, "Some Remarks on Nucleonics," 11; Bill Yee, "Miles C. Leverett: From Oil Man to Nuke Man," Oak Ridge National Laboratory, March 27, 2014, https://www.ornl.gov/content/miles-c-leverett-oil-man-nuke-man. Johnston describes the Met Lab as a heterogeneous organization that brought together industrial engineers and academic physicists to leverage the distinct strengths of both groups. While the Met Lab effectively integrated the technical expertise lent by corporate partners, engineering staff—even those like Leverett who held administrative leadership roles within the laboratory's official hierarchy—were routinely treated by some Met Lab academicians as subordinates. Johnston, *The Neutron's Children*, 33–34, 47, 65.

37. Leverett, "Some Remarks on Nucleonics," 12.

nuclear technology.[38] Discussion of the Jeffries Report within the Met Lab provided an outlet for worried staff to air their fears that corporations' participation in the Manhattan Project was actuated by the promise of securing an exploitable monopolistic position within the postwar nucleonics industry.[39] Whereas some figures like Jeffries and Leverett, and even laboratory director Compton, demonstrated real enthusiasm for continued collaboration between academics and industrial researchers, other committee members articulated more cautious approaches to private industrial participation in government-funded nucleonics research after the war.[40]

In his September 1944 "Remarks on the Future Development of Project and Nucleonics," theoretical physicist Lothar W. Nordheim outlines a detailed technocratic plan for differentiating and managing the proper roles of scientists, government, and private industry in nucleonics. From the outset, Nordheim holds non-industry scientists as the most suitable arbiters of postwar decision-making guiding nucleonics development: "After the war there will undoubtedly be pressure from political and commercial interests. The only group with real information and no direct bias will be scientists."[41] Apprehensive about the "danger of private monopoly or profiteering," Nordheim goes on to elaborate a plan for bureaucratic control over nucleonics research by scientific experts. He foresees an inevitable conflict between national security prerogatives and "private research and enterprise" in postwar nucleonics, requiring a solution that involves a nationwide body of scientific advisors who will reject "censorship on basic scientific researches" like "[i]nformation regarding fundamental laws and processes." On the

38. Holl, *Argonne National Laboratory, 1946-96*, 24.

39. Smith, *A Peril and a Hope*, 24.

40. For more on the appreciation showed by Compton and other Met Lab leaders for the laboratory's industrial research partners, see Johnston, *The Neutron's Children*, 33–34.

41. Nordheim, "Remarks on the Future Development of Project and Nucleonics," 1.

other hand, "[d]etails of procedures and plants and of data on performance and production could and should be kept secret, of course, as in ordinary military and industrial practice."[42]

Drawing conclusions from these observations about the proper administration of scientific research, Nordheim recommends starkly different oversight practices for applied nucleonics research efforts—characteristic of the military and private industry—as opposed to basic nucleonics research carried out in the academic tradition. For the former, Nordheim calls for relationships between government and private business to be mediated by disinterested scientific advisors and subject to restrictions on publishing technical data. The latter case of pure research programs, however, merits generous government funding without information compartmentalization rules of the type that the military imposed across the Manhattan Project.[43] By late 1944, some Met Lab scientists like Nordheim who were accustomed to the free flow of scientific information between colleagues in a scholarly environment had spent years chafing under military directives that had fragmented the Manhattan Project into isolated "compartments," limiting communication between its scientific subgroups to prevent espionage.[44] Nordheim's proposal for managing the relationship between government funding, corporate engagement, and scientific convention projects these concerns of the Met Lab's academically-inclined scientific staff surrounding business interests and information sharing into a vision for the future structure of nucleonics research.

Integrating Nordheim's views with those of Jeffries, Leverett, and their fellow committee members, committee secretary R. S. Mulliken drafted the "Prospectus on Nucleonics," which

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42. Nordheim, "Remarks on the Future Development of Project and Nucleonics," 3–4.

43. Nordheim, "Remarks on the Future Development of Project and Nucleonics," 5–6.

44. Holl, *Argonne National Laboratory, 1946-96*, 25–26, 135; Richard Rhodes, *The Making of the Atomic Bomb* (1986; 25th anniversary ed, Simon & Schuster, 2012), 508.

was submitted by the Jeffries Committee to Compton on November 18, 1944.[45] The Jeffries Report—in a section excised from Smith's reprinting of the report—hearkens all the way back to the proto-science of alchemy to describe nucleonics as "the fulfillment of the old dream of transmutation of elements."[46] This historical narrative of nuclear science notes that landmark achievements in theoretical nuclear physics stimulated "a vast enlargement in the possibilities of applied nucleonics," particularly in chemistry, biology, and medicine.[47] This historical pattern also serves as a framing for the report's recounting of the Met Lab's own major contribution to nucleonics—the design and construction of the first nuclear reactors, referred to at the time as piles.[48]

> The construction of the chain-reacting pile is a notable example of how disinterested research in the field of physics apparently far remote from any practical interest can suddenly yield results of tremendous technological value. The potential practical importance of pure research is likely to be shown in this case even more clearly than in the well-known example of the development of the electrical industries from the discovery of electromagnetism by Faraday.

This retelling evinces a dualistic conceptualization that divides "disinterested," "pure research" from research oriented towards "practical interest." The former generates the "tremendous

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45. Smith, *A Peril and a Hope*, 21; "Prospectus on Nucleonics."

46. "Prospectus on Nucleonics," 8. For more on the legacy of alchemical transmutation in the history of European science, see Pamela O. Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance* (Johns Hopkins University Press, 2001), 167, 173; Frances A. Yates, "The Rosicrucian Manifestos," in *The Rosicrucian Enlightenment*, Ark Paperback (1972; Routledge and Keagan Paul, 1986), 242, 250, 258; Pamela H. Smith, *The Business of Alchemy: Science and Culture in the Holy Roman Empire* (Princeton University Press, 1994), 207, 212.

47. "Prospectus on Nucleonics," 11.

48. McAndrew suggests that Chicago Pile-1 creator "Italian immigrant Enrico Fermi, who loved American slang [...] named it pile because it was a big mound of materials." Tara McClellan McAndrew, "Subterfuge In The City: How Illinois Helped Create The Nuclear Age," NPR Illinois, November 27, 2019, https://www.nprillinois.org/illinois/2019-11-27/subterfuge-in-the-city-how-illinois-helped-create-the-nuclear-age.

technological value" that engenders the latter, revealing the same pattern behind the analogous trajectories of "the development of the electrical industries" in the past and the "potential practical importance" of nucleonics in the future.[49] From this perspective looking back on the field of electronics and forward towards the field of nucleonics, the Jeffries Report boldly goes on to predict that this "old story of science and technology mutually assisting and promoting each other is likely to be repeated in nucleonics on a more spectacular scale than ever before."[50]

In its conclusion, the Jeffries Report calls for a careful rebalancing between basic and applied research, between industry and academia, and between secrecy and openness. While expecting the government to remain free-handed with nucleonics research funding even after the war's end, the Jeffries Report foresees a disruption of the close wartime collaboration between university research and private industrial interests.[51] Despite acknowledging that basic, theoretical research in nucleonics "laid the groundwork for the Metallurgical Project and other related projects based on cooperation of universities and industrial concerns," the Jeffries Report envisions a tripartite split in the postwar field between "extensive nuclear research work in universities and specially created nucleonics laboratories," "continued government-sponsored study and development of the problems directly related to military matters," and "an independent nucleonics industry."[52] Reasons given for this anticipated breakdown of university-industrial cooperation include anxieties about patent-chasing, "monopolies contrary to the public interest," and losing a "healthful competition of ideas."[53]

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49. "Prospectus on Nucleonics," 36.
50. "Prospectus on Nucleonics," 36–37.
51. "Prospectus on Nucleonics," 60.
52. "Prospectus on Nucleonics," 61–62.
53. "Prospectus on Nucleonics," 62.

Echoing Leverett, the report states that "[r]esearch alone is not enough, essential though it is."[54] For the time being, the nucleonics industry's role in the US wartime economy seemed comparable with that of "the automotive, the airplane, the metal working, the chemical, and the electronics industries […] in this war."[55] While thus acknowledging the crucial role played by industrial corporation in applied nuclear research during the war, the Jeffries Report ultimately epitomizes the "pure scientific ability and creative talent in nucleonics" of the type utilized for basic research performed in the universities and new government-sponsored nucleonics laboratories.[56] This dualistic conception of basic and applied nucleonics research, as well as the favor shown for the former, reaffirms Nordheim's perspective that corporate and military interests associated with secretive, applied nucleonics ought to be subordinated to the traditional academic priorities of scientific openness and pure, fundamental research in the administration of postwar nucleonics research programs.[57]

The Jeffries Report's vision of a fragmented but interdependent postwar landscape for nucleonics research—divided among academia, government, and industry—did not remain theoretical for long. As the war neared its end, the institutional groundwork for this reorganization began to take shape with the transformation of the Met Lab into Argonne National Laboratory. In the following section, I examine how ANL came to embody the structural and ideological principles laid out in the Jeffries Report, revealing the laboratory as a key site where the Met Lab's technoscientific imaginations for the nuclear future took concrete form.

Nuclear Energy

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54. Leverett, "Some Remarks on Nucleonics," 12; "Prospectus on Nucleonics," 63.

55. "Prospectus on Nucleonics," 62.

56. "Prospectus on Nucleonics," 63.

57. Nordheim, "Remarks on the Future Development of Project and Nucleonics," 3–6.

Previous scholars, adhering to the aforementioned "atom peace" narrative, have demonstrated how the Jeffries Report foreshadowed the political arguments for international nuclear arms control that were later advocated in the Franck Report and by the postwar atomic scientists' movement.[58] This essay instead turns from the Met Lab to Argonne National Lab, treating the Jeffries Report as an intellectual precursor of the postwar order in nuclear energy research.

The managers at ANL, like at other early national centers for atomic energy research, found themselves maintaining an uneasy balance between pure scientific research and applied technological development.[59] As demonstrated in the work of the Jeffries Committee, some academics who later played principal roles in the administration and research at ANL harbored resentments for the intrusion of military or commercial interests into the course of their work. As a result of their beliefs about the nature of scientific progress, many of the Met Lab's university scientists thought of basic research as a paragon and considered applied or developmental research, at best, a necessary evil justified by the ongoing demands of national defense following the war.[60] Fortunately for ANL's university-affiliated leadership, the collections of the University

58. Smith, *A Peril and a Hope*, 31; Price, "Roots of Dissent," 237–39.

59. Greenbaum, *A Special Interest*, xviii.

60. Greenbaum, *A Special Interest*, 27–29, 44. Among the business interests disregarded by university administrators were the protests of hot dog magnate Erwin O. Freund, who complained that ANL's relocation to its current site in DuPage County was unjustly seizing the land from his suburban estate: Erwin O. Freund to Argonne National Laboratory c/o University of Chicago, Contracting Officer, April 1, 1947, Holborn Gray Special Collections Research Center, University of Chicago Library (University of Chicago. Office of the President. Hutchins Administration. Records, Box 18, Folder 12). Intriguingly, a herd of white fallow deer descended from originals imported to Freund's estate still populates the woods around ANL, sparking unfounded local rumors of biological experimentation conducted at the laboratory that changed the coloration of the native brown deer: "Where Do White Deer Graze? At Argonne; Culling 10 Years Ago No Longer Needed," *Chicago Tribune*, July 6, 2003, Chicago Tribune (419955906).

of Chicago Archives attest strongly to the theoretical scientific achievements of the Met Lab and lack much of the likely-classified practical engineering and technical documentation that was co-produced along with the Met Lab's fundamental discoveries in nuclear physics.[61] This alignment coincides with the professional backgrounds of important ANL administrators like the lab's first director, longtime academic physicist Walter Zinn. This favorable archival portrayal could only have served to bolster early hopes at ANL for the success of theory-driven basic research nurtured in a university-like environment.[62]

In an archival boon to the present analysis, the University Archives maintains extensive records from the administration of Robert Maynard Hutchins during his long tenure as president and chancellor of the University of Chicago from 1929 until 1951. Hutchins was an ambitious university administrator who, after being introduced to the idea of a government-sponsored postwar nucleonics laboratory by Compton, staunchly supported the university's stewardship over ANL.[63] While overseeing the university's management of ANL, the Hutchins administration navigated a complex public policy sphere at the intersection of government funding, private industrial interests, university control, and national security imperatives. In doing so, the university found itself facing the balancing act foreseen by the Jeffries Committee in the summer and fall of 1944; one that pitted the basic, fundamental research and open access characteristic of university research environments against the combined forces of commercial exploitation and government censorship.

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61. Price, "Roots of Dissent," 226.

62. Johnston, *The Neutron's Children*, 60. Johnston emphasizes the relative dearth of engineering-oriented research at ANL compared to its peers in the early US national laboratory system.

63. Holl, *Argonne National Laboratory, 1946-96*, 3, 33, 37.

University administrators and outside observers alike were eager to see how ANL struck this equilibrium. Hutchins's office maintained a "Committee on Government Contracts" dedicated to assessing the balance between the university's core "devot[ion] to basic research" in the nuclear field and the "experimental work on reactors and the developmental engineering connected with this effort."[64] A visitor to ANL, unfamiliar with the laboratory's unique administrative arrangement, reported feeling "particularly anxious to get a line on the industrial relations activity which I understand is under the sponsorship of the University."[65] Given ANL's place in the vanguard of the fledgling national laboratory system, the University of Chicago held a real measure of power and influence to realize the Met Lab's dreams for nucleonics.[66]

By 1948, the university could assert a significant degree of control over nuclear energy research. One report on contemporary developments in Washington proudly informs Hutchins's office of the university's strong negotiating position for government research contracts, including but not limited to those associated with ANL:

> [A] critical survey of federal funds in the budgetary department [is] now being utilized by universities. This analysis was made by accountants (government), who stated that the University of Chicago has the best record of any institution reviewed. This statement was based on the method of soliciting funds, total amounts, record of satisfactory expenditures, etc.[67]

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64. "Committee on Government Contracts," June 9, 1949, 1, University of Chicago. Office of the President. Hutchins Administration. Records, Box 95, Folder 1-2, Holborn Gray Special Collections Research Center, University of Chicago Library.

65. A. B. Bonds, Jr. to Wilbur C. Munnecke, May 25, 1948, Holborn Gray Special Collections Research Center, University of Chicago Library (University of Chicago. Office of the President. Hutchins Administration. Records, Box 18, Folder 12).

66. Holl, *Argonne National Laboratory, 1946-96*, ix.

67. L. T. Coggeshall to Central Administration, March 31, 1948, 2, Holborn Gray Special Collections Research Center, University of Chicago Library (University of Chicago. Office of the President. Hutchins Administration. Records, Box 18, Folder 10-11).

This positive general assessment of the university's financial relationship with the government resonates with the specific case of ANL's contracts with the US Navy. University of Chicago and ANL scientists working under Navy nuclear research contracts reportedly "[found] the conditions ideal." These researchers recounted being pleased with relaxed security regulations, flexible reporting requirements, and "complete freedom in the planning and execution of the research." These findings convinced the Hutchins administration "that if all government aid to research and education could be as well handled as the Navy projects have been there should be no fear of the hazards of government control or domination."[68] As the Jeffries Report had anticipated, postwar nuclear scientists perceived their relationship to the government as a tradeoff between their own ideals of research in the academic mode—self-directed, with results shared at the researcher's discretion—and the government's tendency towards top-down planning and strict information management. Aware of researchers' preferences and wielding managerial oversight, University of Chicago administrators focused their own attention on the same issues at ANL. This alignment of priorities between nuclear research workers and their supervisors constitutes an important institutional legacy of the Met Lab, passed down to its heir and still recoverable from archival sources like the Jeffries Report.

Many of ANL's early leaders like Walter Zinn were veterans of the Met Lab who demonstrated a commitment to nuclear energy research structured in accordance with the vision for nucleonics elaborated in the Jeffries Report. Before mid-1949, as ANL researchers and the Hutchins administration alike enthused about naval contracts, Zinn similarly found satisfaction in dictating the terms of ANL naval reactor research contracts to his comparatively powerless Navy

68. "Special Committee on Government Contracts," February 10, 1949, 2, University of Chicago. Office of the President. Hutchins Administration. Records, Box 95, Folder 1-2, Holborn Gray Special Collections Research Center, University of Chicago Library.

counterparts. Finding himself with the upper hand in contract negotiations, Zinn allocated theoretical and fundamental aspects of the naval reactor design process to ANL while outsourcing more practical engineering and technical tasks to an industrial corporation.[69] This peak of Zinn's influence over the direction of nuclear energy research and its attendant spigot of government funding exhibits the significance of the Met Lab's organization philosophy in his thinking. In particular, Zinn's delineation of two types of nuclear energy research aligns with a duality described in the Jeffries Report between fundamental nuclear science research managed by university-affiliated institutions on one hand and applied, technical aspects of nuclear research carried out under the purview of private industry on the other.[70]

Naval nuclear research would begin to lose its charm in the eyes of university researchers at precisely the moment when the locus of managerial control at ANL shifted from the laboratory's university-affiliated leadership towards non-scientist military administration. The first Soviet atomic bomb detonation in the summer of 1949 quickly raised tensions in the Navy-ANL relationship. Before mid-1949, Zinn had gladly inked contracts with the "hard driving and tenacious" father of the nuclear navy, Captain (later Admiral) Hyman G. Rickover.[71] By the end of the year, however, the intense pace of experimental work on naval reactors programs was a simmering source of discontent among ANL scientists. Dwindling institutional support for basic research and a high proportion of classified projects especially galled those like Met Lab alumnus Albert Wattenberg who would been familiar with the intellectual life of the 1944 Jeffries

69. Holl, *Argonne National Laboratory, 1946-96*, 70–71.

70. "Prospectus on Nucleonics," 63.

71. Holl, *Argonne National Laboratory, 1946-96*, 70. For a classic book-length treatment of Rickover's role in the naval reactors program, see Richard G. Hewlett and Francis Duncan, *Nuclear Navy, 1946-1962* (University of Chicago Press, 1974).

Committee, if not the text of the Jeffries Report itself.[72] In an especially disorienting moment for those who subscribed to the conventional dichotomy of basic and applied research, Rickover's power to promote military research priorities saw ANL "involved at times in what seemed like purely engineering activities" while their private industrial partner's efforts "often bordered on fundamental research."[73]

With the start of the Korean War, postwar nuclear research became wartime nuclear research again. The country and the university were back on a war footing by 1951, and the Hutchins administration was busy drafting documents such as "Recommendations for Recruitment of Personnel to Staff Urgent Defense Research Projects Now Being Organized at Institutions of Higher Education." The introductory "General Policy" section spells out the university's overall disposition towards certain types of defense research funding. It highlights among "[t]he long range responsibilities of institutions of higher education" like the University of Chicago "the conduct of fundamental research." The university's policy advocates hesitancy towards "classified research and development projects," suggesting they be carried out at the university "only if the work cannot be performed more effectively elsewhere," presumably at a private industrial research firm or a dedicated military research facility. In due course, "every effort should be made" in this renewed era of militarized nuclear research "to avoid[,] to the fullest extent possible, curtailment of basic research. In fact, it is, under present conditions, clearly in the national interest to devote increased attention and funds to the stimulation of fundamental research."[74] The university's continued commitment to basic, fundamental nuclear

72. Holl, *Argonne National Laboratory, 1946-96*, 87.

73. Holl, *Argonne National Laboratory, 1946-96*, 88–89.

74. "Recommendations for Recruitment of Personnel to Staff Urgent Defense Research Projects Now Being Organized at Institutions of Higher Education," May 19, 1951, 1, University

energy research through the end of World War II and into the start of the Korean War suggests a deep-seated adherence to the opinions expressed by members of the Jeffries Committee for the appropriate relationships between pure and applied research and between academic and corporate actors in government-supported nucleonics.

This apparent commitment to organizational principles that had previously been worked out by the Met Lab does not necessarily imply that administrators like Hutchins and Zinn read the Jeffries Report as a guide for structuring postwar nuclear energy research. More likely, the Jeffries Report expresses attitudes that predate the Manhattan Project, World War II, and the entire field of twentieth century atomic research.[75] In the final section of this essay, I will return to Henry Moore's statue to consider how crafting a new historical narrative of the Met Lab—one that highlights the historical significance of the Jeffries Report without explicitly crediting its dreams for nucleonics with charting the actual course of nuclear energy research at ANL—compares on historiographic terms with earlier portrayals.

What's in a Name?

In navigating the tensions between basic and applied science, university stewardship and industrial collaboration, open inquiry and strategic secrecy, the postwar administration of nuclear energy research did not manifest new dilemmas. Instead, it reproduced long-standing divisions embedded in the scientific philosophy and organizational structure of the Met Lab. The Jeffries Report offered a platform for articulating those divisions, and some early leaders at Argonne National Laboratory strove to embody them in practice. Despite their efforts, nucleonics never came to describe the field of nuclear energy research, either in name or in character. Scholars of

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of Chicago. Office of the President. Hutchins Administration. Records, Box 95, Folder 3, Holborn Gray Special Collections Research Center, University of Chicago Library.

75. Long, *Openness, Secrecy, Authorship*.

nuclear history continue to uncover overlooked accounts and underexplored nuances that further reveal a collective story of nuclear energy research far too rich and variegated to be captured by any one document or archival collection.[76]

This essay has proposed a shift in historiographic perspective from a familiar narrative of "atom peace" towards a new appreciation of "nucleonics" as a historical concept. The term encapsulates hopes and compromises that were forged in the Met Lab, recorded in the Jeffries Report, and recapitulated—at least in part—at Argonne National Laboratory. Henry Moore's sculpture, located just steps from the heart of the University Archives where much of the story of nucleonics is preserved, reverberates with these layered meanings. In renaming it from *Atom Piece* to *Nuclear Energy*, the university sidestepped unfulfilled hopes for "atom peace," choosing instead to commemorate the entire complex scientific field it helped shape. A more precise title might have been *Nucleonics*—a term innate to the Met Lab and a crucial aspect of its lasting historical legacy.

76. A few examples taking innovative approaches to the subject include Johnston, *The Neutron's Children*; James W. Feldman, ed., *Nuclear Reactions: Documenting American Encounters with Nuclear Energy*, Weyerhaeuser Environmental Classics (University of Washington Press, 2017); Gabrielle Hecht, *Being Nuclear: Africans and the Global Uranium Trade* (MIT Press, 2012).

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