Force and Nature

The Department of History and Philosophy of Science at Indiana University, 1960–1998

*By Kevin T. Grau**

The central role of science in modern civilization has evoked an intense and unparalleled interest in its historical development and logical structure. Responding to this, Indiana University has created a new Department of History and Logic of Science, offering an integrated program of studies leading to the A.M. and Ph.D. degrees. The Department will aim to provide graduate students with an opportunity for scholarly historical research into the origins, evolution, and full development of the sciences, while at the same time marking their intellectual, cultural, and social ramifications. Equally significant, and intimately co-ordinated with these historical studies, will be a program of studies examining the logical structure and methodology of the sciences.[1]

The Department of History and Logic of Science at Indiana University was founded in 1960 during a period of unprecedented growth in the life of the discipline and of the university. Almost forty years later, the rare combination of history and philosophy of science within a single department appears as an artifact of a time now past.[2] The academic conditions that made history and philosophy of science a plausible discipline and the local conditions that led to the particular institutional configuration at Indiana University are important facets of the story about how the history of science was established as a discipline in the United States. At Indiana, the disciplinary relations between history of science and philosophy of science after World War II emerged within a local institutional and academic culture that significantly shaped the department's development and its contributions to the history of science.

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[1] Department of History and Logic of Science program announcement, 1960, in departmental files.

[2] The Department of History and Philosophy of Science at the University of Pittsburgh is the only other department-level HPS program in the United States. Five other universities have programs in the history and philosophy of science: University of California at Davis, Notre Dame, Maryland, Boston University, and Montana State. The University of Pennsylvania's Department of the History and Sociology of Science descended from Penn's earlier Department of the History and Philosophy of Science, and the Science and Technology Studies Department at Cornell developed out of the Program in History and Philosophy of Science and Technology.

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The convergence of university aspiration, personal ambition, and disciplinary imperatives bound two disciplines into one department. The logic of this convergence was supported by the historiographical and philosophical questions raised by what was at the same time seen as the central problem of the history of science: the scientific revolution. Long after interdisciplinary interest in the scientific revolution dissolved, this problem remained the organizing framework for the history of science at Indiana. The remarkable stability of the history faculty from the mid-1960s to the mid-1980s produced a stream of significant contributions to the discipline that were related to this fundamental concern. During this period the department steadily produced new historians of science, not experiencing the wide variation in the number of Ph.D.'s that characterized the discipline overall. The evolution of the historiography to which historians at Indiana contributed is testimony to the increasingly contested status of the scientific revolution in the history of science. The intellectual and cultural trends out of which the history of science in the United States developed can be seen by examining the institutional tensions within this hybrid department and how the department itself contributed to shaping the discipline.

THE MAKING OF A DEPARTMENT, 1955–60

After World War II, Indiana University grew rapidly. Its undergraduate enrollment increased from 4,400 in 1940 to 9,554 in 1949; graduate school enrollment grew at an even faster rate, increasing from 727 to 2,142 during the same period. Through the 1950s Indiana University struggled to keep pace with the growth this influx of students demanded. The rapid growth of the undergraduate population was matched by the proliferation of schools, departments, programs, and institutes. At the Bloomington campus, President Herman B Wells had been fighting ceaselessly to consolidate control and modernize the university since his appointment in 1938. By 1955, no problem loomed larger than graduate education as an impediment to improving the university and its national reputation. As early as 1951, Wells had created a nine-member graduate council to gain some influence over a completely decentralized system. He recognized that development of a strong, unified graduate school was essential for the university's long-term success.[3] In July 1958 Wells appointed John W. Ashton to the new position of Vice President and Dean of the Graduate School, consolidating the control of research centers, institutes, and the School of Letters and granting that office sole authority to seek outside grants.[4] Uniting power over policy and purse strings, Wells gave Ashton the tools to fashion a leading graduate school out of the fragments of graduate training on the campus.

Modernizing the Graduate School was only one aspect of the broader ambitions of the Wells administration. As the institutional infrastructure came together, Wells looked toward expansion. Wells's belief that Indiana must develop unusual programs to foster its reputation, cultivating niches for research and teaching excellence, is summed up in one of his many aphorisms: "Provide for the esoteric, exotic, and impractical in the curriculum; the practical and the pedestrian will take care of itself."[5] The development of East European Studies, the Folklore Institute, and Slavic Studies programs inaugurated this trend in the

[3] Thomas D. Clark, *Indiana University: Midwestern Pioneer,* Vol. 3 (Bloomington: Indiana Univ. Press, 1977), pp. 366–369.

[4] *Ibid.,* p. 375.

[5] Herman B Wells, "Remarks before the National Association of State Universities," May 7, 1962, in Wells, *Being Lucky: Reminiscences and Reflections* (Bloomington: Indiana Univ. Press, 1980), p. 145.

1950s. These new niches diversified the university's offerings while drawing attention to its strengths.

Since 1945, historians and philosophers of science had been regular visitors to Indiana, if never permanent residents. During the 1945–46 academic year, a faculty team from across the university, including Herman Muller and Alfred Kinsey, taught a course entitled "Life Views of the Great Men of Science" in the Philosophy Department. "History of" courses occasionally appeared in the science departments. A major boost in the visibility of the history of science came with George Sarton's term at the university as the Patten Foundation Visiting Professor in early 1955, when he presented a series of six lectures on men of science in the Renaissance.[6] During the process of revising the undergraduate curriculum in 1957–58, history and philosophy of science received deliberate and joint consideration from the Curriculum Committee. The proposed history and philosophy of science requirement was finally dropped "because of lack of staff."[7]

Already in 1958, members of the faculty and administration at Indiana viewed the history and philosophy of science as closely related and mutually supportive disciplines. This view represented a broad academic consensus that was reflected in the institutional support for the fields. The creation of the History and Philosophy of Science Program at the National Science Foundation in 1957 was a watershed event in the professionalization of both the history of science and the philosophy of science. The program provided the resources needed to train new scholars and to expand the number of critical editions and translations of important sources.[8] The HPS program reflected the relative value placed at the time on the ways various humanities disciplines approached the sciences. Until the mid-1950s, the history, philosophy, and sociology of science developed in parallel on the margins of the American academy. In February 1955 the NSF funded a conference to study the prospects for a "limited program of support of fundamental research in the history, philosophy, and sociology of science."[9] During the conference and in subsequent discussion, a gap opened between history and philosophy of science, on the one hand, and sociology of science, on the other. The distinction was initially enunciated by Herbert Dingle, a philosopher of science from the University of London and the sole European participant at the conference. He argued that sociology was not merely irrelevant to producing scientific knowledge but that it also facilitated dangerous interpretations: "The validity of any such idea or discovery does not depend in the least on the circumstances—social or any other—of its origin, and therefore the history of pure science can be written apart altogether from the external reasons for its coming into existence. And it not only can, but should, be so written."[10]

The subsequent effects of this exclusion of the sociology of science have been often noted, if rarely analyzed.[11] But the logic that history and philosophy of science were naturally connected grew from deeper roots than the separation of the sociology of science

[6] George Sarton, *Six Wings: Men of Science in the Renaissance* (Bloomington: Indiana Univ. Press, 1957).

[7] Minutes, College of Arts and Sciences faculty meeting, May 15, 1958, Collection no. 8, College of Arts and Sciences, Office of the Dean, Indiana University Archives, Bloomington, Indiana.

[8] Margaret W. Rossiter, "The History and Philosophy of Science Program at the National Science Foundation," *Isis,* 1984, *75*:95–104, on p. 98.

[9] "Conference on the History, Philosophy, and Sociology of Science, Sponsored by the American Philosophical Society and the National Science Foundation in the Hall of the Society, February 10 and 11, 1955," *Proceedings of the American Philosophical Society,* 1955, *99*:327–354, on p. 333.

[10] *Ibid.,* p. 349.

[11] See, e.g., the introduction to the second edition of A. Hunter Dupree, *Science in the Federal Government* (Baltimore: Johns Hopkins Univ. Press, 1986).

from NSF programs. The intellectual and methodological icon for the history of science remained, as it had been since the end of World War II, the figure and work of Alexandre Koyré. The reasons for this elevated stature were manifold, but his impact on the history of science in America was immense. For the generation of scholars leaving graduate school in the late 1940s and early 1950s, Koyré's work energized a quest to understand the modern condition by understanding its most characteristic product, science. For this generation, Koyré revealed the raw power of close textual analysis of conceptual change in the history of science, making the problem of scientific change a problem in the history of ideas. This central concern with conceptual change and the cognitive content of the sciences fostered the growth of a community of scholars who could identify with the program of the philosophy of science to develop an understanding of the fundamental logic of science. The publication of the philosophically sensitive historical work of Koyré's disciples created common ground and methodological coherence for historians and philosophers of science. Moreover, Koyré articulated a central problem that generated a research program of interest to both historians and philosophers. Defining the "scientific revolution" as an "intellectual mutation" and the fundamental problem of the history of science, he provided the intellectual quest that would shape the institutionalization of the history of science. Beginning with the *Études Galiléennes* in 1940, Koyré expressed ideas that would make the scientific revolution uniquely important and compelling for the generation of historians of science in the United States after World War II.[12] He presented a persuasive case for the study of the conceptual history of science. As Koyré described it later in his preface to *From the Closed World to the Infinite Universe:* "As for myself, I have endeavored in my *Galilean Studies* to define the structural patterns of the old and the new world-views and to determine the changes brought forth by the revolution of the seventeenth century. . . . The spiritual change that I describe did not occur, of course, in a sudden mutation. Revolutions, too, need time for their accomplishment; revolutions, too, have a history."[13]

At Indiana University the drive to upgrade and improve the graduate school reinforced the common assumptions articulated by Richard Shryock at the 1955 NSF conference: "There are from ten to twenty times as many persons in this country who teach the history of art or of literature as there are who teach the history of science. Such a contrast might have been appropriate in twelfth-century Europe, but would have been a dubious one by the seventeenth and is nothing short of scandalous in the twentieth. It is time that something was done to overcome this lag in adjusting our educational sights to the realities of the contemporary world."[14] Cultivating the history and philosophy of science within the university would be another step in making Indiana University one of America's leading research universities, filling a new disciplinary niche while modernizing both graduate and undergraduate education.

While the initial recommendation to require history and philosophy of science failed due to lack of staff in 1958, steps were already being taken in the College of Arts and Sciences to rectify the situation. Within a general program of cultivating "philosophical pluralism" among the faculty, the Philosophy Department opened a search for "an honest-to-goodness Analyst" in 1957.[15] At the end of the search the Department hired Norwood

[12] Alexandre Koyré, *Études Galiléennes* (Paris: Hermann, 1940).

[13] Alexandre Koyré, *From the Closed World to the Infinite Universe* (Baltimore: Johns Hopkins Press, 1957), p. viii.

[14] "Conference" (cit. n. 9), p. 331.

[15] Henry Veatch, *Towards a History of the Indiana University Philosophy Department in Bloomington: The Years 1929–65: A Personal Memoir* (Bloomington: Department of Philosophy, Indiana Univ., 1997), p. 103.

Russell Hanson, a thirty-three-year-old philosopher of science from Cambridge. Hanson, a New Jersey native and a decorated Marine Corps fighter pilot in World War II, made use of the G.I. Bill benefits for higher education for returning veterans. He earned a B.A. in philosophy from the University of Chicago in 1946 and B.S. and M.A. degrees in physics from Columbia in 1948 and 1949, respectively, before heading off to Britain to pursue philosophy under a Fulbright scholarship from 1950 to 1952. Settling into Oxbridge life, Hanson completed his Ph.D. at Cambridge in 1956, serving as a lecturer in philosophy of science at both Oxford (1951–52) and Cambridge (1952–57).

When he moved back to the United States to take up his position at Indiana, Hanson was completing his first important book, *Patterns of Discovery,* which displays his complex position in the history of the philosophy of science. While deeply committed to the philosophy of science, he viewed with suspicion the contemporary concern with the "finished systems" of the scientific enterprise, the logic of completed explanations. In challenging the focus of philosophers of science on the context of justification, Hanson enlisted the history of science on behalf of his argument that philosophers of science should also investigate the context of discovery. "Distinctions which at present apply to [classical disciplines] ought to be suspect when transferred to research disciplines: indeed, these distinctions afford an artificial account even of the kinds of activities in which Kepler, Galileo, and Newton themselves were actually engaged."[16] For Hanson the history of science was necessary to the philosophy of science. The process of scientific discovery had to be rescued from those who studied it for the light it shed on individual psychology and historical contingency. It needed to be viewed instead in its focal role of helping us understand what science is and does. "I have not hesitated to refer to events in the history of physics; these will punctuate the other arguments. This comports with my conception of philosophy of science: namely, that profitable philosophical discussion of any science depends on a thorough familiarity with its history and present state."[17]

Hanson injected a cold dose of Anglo-American analytic philosophy into the quiet repose of the Indiana Philosophy Department. He considered the department overly concerned with "metaphysics," to the detriment of rigorous research, graduate training, and undergraduate education. From the time of his arrival, Hanson lobbied the Philosophy Department to expand "within that cluster of disciplines loosely called 'Logic.'"[18] He warned of the persistence of an attitude that treated philosophy "as a merely literary subject," leading to its degeneration into "word-painting." The resulting tension between Hanson and the majority of the philosophers generated constant strain within the Philosophy Department.

Hanson made his presence felt throughout the university. He was the self-appointed vanguard of the philosophy of science in what he perceived as the wilderness of the Indiana Philosophy Department. He played an active role in the new Honors Colloquium series in 1957–58, a first effort formally to integrate the history and philosophy of science into the College of Arts and Sciences. The colloquium, "Darwin and Evolutionary Thought," was

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The department chairman, Newton Stallknecht, hoped to hire Milic Capek for the position. When Adolf Grünbaum visited the campus and recommended Norwood R. Hanson to the department and the deans, Hanson was invited to visit and "stormed on the I.U. campus very like Caesar himself" (p. 107).

[16] Norwood R. Hanson, *Patterns of Discovery: An Inquiry into the Conceptual Foundations of Science* (Cambridge: Cambridge Univ. Press, 1958), p. 1.

[17] *Ibid.,* p. 3.

[18] Norwood R. Hanson, "On the Future of Philosophy at Indiana University," April 1960, Collection no. 8, Indiana University Archives.

taught by Hanson, Muller, Newton P. Stallknecht, and Theodore W. Torrey. Hanson also taught part of the second-semester colloquium on "The Age of Newton."[19] And within the Philosophy Department he introduced a seminar on "Problems of Scientific Method."[20]

History and philosophy of science on the Indiana campus gained momentum the following year when Edward Grant was hired by the History Department. Grant, trained under Marshall Clagett at Wisconsin, emerged as a member of the first full generation of historians of science in the United States. A medievalist by training, he was a strong advocate for Koyré's history of ideas approach, focusing on late medieval natural philosophy and its relationship to the scientific revolution. Grant's early work on Nicole Oresme and his significance for the history of medieval science reflected Clagett's guidance.[21] The routine connection of the history and philosophy of science at Indiana appears in the College of Arts and Sciences 1958–59 Annual Report's section on the new historian hired from an instructor's position at Harvard: "Assistant Professor Edward Grant comes from Harvard University as a specialist in the History of Science to round out the new area of work in Philosophy of Science given by Norwood R. Hanson."[22]

Not long after Grant's arrival in Bloomington, Hanson approached him with an idea. With mischief in his eyes, he told Grant that Indiana needed a program in the History and Philosophy of Science and that they were going to put it together. Grant, Hanson, and Stuart MacClintock developed a prospectus for a Graduate Program in the History and Philosophy of Science. MacClintock, a member of the philosophy faculty, had been a student with Hanson at Columbia in the late 1940s.[23] This initial plan conceived a graduate program with faculty from a variety of departments, including History, Philosophy, Mathematics, Chemistry, Physics, and Psychology. It would develop new scholars for this increasingly important field and foster the integration of HPS into the college curriculum. The underlying rationale reflected the concerns of the time and the perceived "gap" between science and the humanities: "As the 'gap' deepens into a chasm, educators are driving students schizoid by insisting that historians study physics and that mathematicians try some classics. This is a good thing, no doubt. But few educators have realized that in History and Philosophy of Science, pure science and technology as humanistic achievement is stressed, while the more general history of ideas and letters is shown to be permeated with the flow of scientific thought."[24]

The goal was not merely to produce new scholarship, but also to produce new scholars that would reshape the academy for the demands of the Space Age, filling a gap that existed "long before Sputnik." Grant, Hanson, and MacClintock presented a vision of the unity of knowledge that harkened back to the roots of the university in western Europe:

[19] 1957–58 Annual Report, Collection no. 8, Indiana University Archives.

[20] *Ibid.*

[21] On the influence of Clagett's view on the study of Oresme see Edward Grant, "Preface," in *Studies in Medieval Science and Natural Philosophy* (London: Variorum, 1981), pp. i-iv; and Victor L. Hilts, "History of Science at the University of Wisconsin," *Isis,* 1984: *75*:63–94, on p. 83.

[22] 1958–59 Annual Report, Collection no. 8, Indiana University Archives.

[23] Edward Grant, in Oral History Interview, Roger Buck, James Capshew, and Edward Grant, December 30, 1997.

[24] "Prospectus for a Graduate Program in the History and Philosophy of Science," Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives. The gap between the sciences and the humanities was a common theme in Grant's and in Hanson's writings. While they were drawing conclusions in responding to the perceived cultural crisis that were similar to those in the contemporaneous work of C. P. Snow, no one associated with the proposed Indiana program at the time wrote explicitly in terms of Snow's "two cultures" problem or cited Snow's work: C. P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge Univ. Press, 1959).

"Indeed it would not be too much to suppose that this kind of study could become the focus of academic life, to be compared with the Trivium and Quadrivium of the Medieval Schools, at least with respect to its centrality."[25] The compatibility of views between Grant and Hanson about how the field should be taught and studied, combined with their academic concern for the intellectual and cultural fragmentation at the time, made the suturing action offered by the history and philosophy of science compelling. Here, in the close analysis of the conceptual development of the sciences, was the common core curriculum for modern civilization.

This plan for the program was initially presented in a series of meetings in the spring of 1959. Early on, several members of the philosophy faculty attended these meetings, while Grant remained the lone historian participating in the process.[26] With Grant and Hanson pitching the idea, the plan gained adherents in the science departments, as faculty—including H. J. Day and W. J. Moore in Chemistry, R. J. Newton in Physics, Clifford A. Truesdell and Max Zorn in Mathematics, and R. Russell and A. Buchwald in Psychology—threw their support behind the program.[27] Early support from the offices of the deans added momentum to the proposal by the end of the 1958–59 academic year. But the existing tensions between Hanson and some members of the Philosophy Department, not least its chairman, Newton Stallknecht, flared up as Hanson invested more time and effort into lobbying for the program proposal. While Stallknecht saw Hanson trying to slip the bonds of the department to pursue his own professional agenda, Hanson began to worry that the Philosophy Department would gain too much control over the new program. By the end of the struggle, Hanson's antipathy for Stallknecht was clear in his memo to Frank Gucker, Dean of the College of Arts and Sciences: "You made a bad mistake in bringing Stallknecht here."[28] The "metaphysician" and the "logician" stared at each other across an intellectual divide as they struggled for the soul of philosophy at Indiana University.

By the fall of 1959, with intellectual, institutional, and personal conflicts swirling around control of the program, Hanson confided in Grant that he saw an independent department as the preferred solution.[29] Creating a unified location for the pursuit of the common agenda of history of science and philosophy of science emerged as an institutional imperative. Only as a department would the new "Trivium and Quadrivium" be secure from the old regime in the university. In late 1960 Grant and Hanson approached Dean Gucker, John Ashton (vice president for graduate development and dean of the graduate school), Ralph Collins (vice president and dean of the faculties), and President Wells with a revised proposal to create a Department of History and Philosophy of Science. By all accounts, President Wells didn't take much convincing. Here was an opportunity to put Indiana at the forefront of an emerging discipline, an area in which the university could quickly make an impact, reinforcing the growing reputation of its recently unified graduate school. The wheels of the university turned rapidly upon this convergence of interests. The possibility of external support through the Social Science Research Program of the NSF, established in August 1957, and the National Defense Education Act (NDEA), passed in August 1958, provided incentives for establishing the department. It also held the prospect (never far

[25] "Prospectus for a Graduate Program."
[26] Grant, in Oral History.
[27] "Prospectus for a Graduate Program."
[28] Norward R. Hanson to Frank Gucker, March 1960, Collection no. 8, Indiana University Archives.
[29] Grant, in Oral History.

from the administration's considerations) of minimizing the impact of the new department on the budget of the College of Arts and Sciences.

With Wells's approval, Grant and Hanson reworked the proposal, which reflected one last flare-up in Hanson's struggle with Stallknecht. The Philosophy Department insisted that the new department not use the word "philosophy" in its name. Hanson, certain that *he* knew what philosophy was, declared that its name would be the "Department of the History and *Logic* of Science." In the revised material describing the proposed department, its development as a center for research and graduate training was placed in the foreground.

> The Department of History and Logic of Science will be primarily a Graduate School program until 1963, when a fully-implemented undergraduate curriculum will be initiated. It is the intention of the department to explore as *an independent field of study* the conceptual development of scientific ideas, as well as their integral logical structure. The place of scientific thinking within the more comprehensive context of the history of western thought, will be examined via the techniques of historical and logical analysis.[30]

AN INDEPENDENT FIELD OF STUDY, 1960–64

On February 27, 1960, the Board of Trustees of Indiana University, acting on the recommendation of President Wells, approved the creation of the new department. The university approved a plan for six faculty in the history and logic of science: Grant, Hanson, two additional historians, and two additional philosophers. During the fall, Grant and Hanson had begun soliciting possible new faculty members for the program. Before the department was formally approved, Hanson had already received informal authorization to pursue candidates for these new positions. Planning to open the new department in the fall of 1960, Grant and Hanson faced a frighteningly close deadline for securing commitments from new faculty. The March 1 deadline for application for the NDEA Fellowships forced the as-yet-unapproved department to release its first program announcement in late January 1960 with an "Advisory Committee on Curriculum" in place of listing its faculty. This Advisory Committee represented the hopes of Grant and Hanson as to who could be wooed to Indiana on the basis of their conversations during the preceding fall. In addition to Hanson, Adolf Grünbaum at Lehigh University and Roger Buck at Oberlin College would form the logic of science group, while Grant would be joined by A. Rupert Hall and Marie Boas Hall, from UCLA, in history of science. When Grünbaum accepted the Andrew Mellon Professorship of Philosophy at the University of Pittsburgh, Hanson approached Michael Scriven at Swarthmore about joining the new department.[31] The department secured its first grant in May 1960 from the Rockefeller Foundation to provide initial support for Scriven's position as well as to host a curriculum conference in the summer of 1960. The initial planning process for the department culminated with the Conference on Curriculum and Research held June 3–6, 1960. The attendees reflected the heritage of this new "independent field of study": Hilary Putnam (Princeton), Wilfrid Sellars (Yale), Erwin Hiebert (Wisconsin), Marshall Clagett (Wisconsin), and John Murdoch (Harvard), along with Buck, Grant, Grünbaum, A. R. Hall, M. B. Hall, Hanson, and Scriven.[32]

[30] Description of the Department of History and Logic of Science, January 1960, Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives. Italics mine.

[31] Adolf Grünbaum to Dean Ralph A. Collins, March 2, 1960, Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives.

[32] Norwood R. Hanson to Frank Gucker, July 1960, Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives.

Indiana was not alone in cultivating the history of science. Institutional expansion and support reached unprecedented levels in 1960, the "annus mirabilis" for the discipline. In that year, the six graduate programs in the history of science that had been founded since 1941 had three new companions: Princeton, Yale, and Indiana. The strength and promise of Indiana's new department was noted by Alexandre Koyré: "Indiana University has now become the center for studies in the history and logic of science in the world."[33] The reception and interpretation of Koyré's work facilitated this new fusion. While Koyré often leveled scathing attacks upon the influence of narrow positivism on the historiography of science, his recognition of the importance of analyzing the role of philosophy in the history of science provided an additional reason for closer relations between history and philosophy of science.

The department opened its doors with four faculty members in residence. The Halls could not make the move to Bloomington until the following year. But, taken together, the six appointments reflected the biographical and intellectual threads that were woven together in institutionalizing history and philosophy of science at Indiana. With the exception of Ed Grant, a small Oxbridge colony took root in Bloomington. Scriven, Hanson, and Buck had all studied in Britain during the 1950s, and the institutional links through Oxford kept them in touch after returning to the United States. Furthermore, Hanson's first experience with integrating history and philosophy of science in the classroom was in a course that he and Rupert Hall taught together while Hanson was a University Lecturer at Cambridge. Working with Hall, whose canonical survey, *The Scientific Revolution, 1500–1800: The Formation of the Modern Scientific Attitude,* was published in 1954, Hanson was intimately engaged with the problem of the scientific revolution. Hall's understanding of the rational reorientation of human beings to the natural world in the scientific revolution resonated with Hanson's concern for the logical underpinnings of scientific theories. Finding common ground in separating (in Hall's words) "the grain of real knowledge" from "a vast deal of esoteric chaff," the local agendas for history and philosophy of science were quite consistent.[34]

Understanding this great reorientation, the modern scientific attitude, became an interdependent rationale for the history and philosophy of science as configured at Indiana. In June 1960, the summer Alumni Institute at Indiana focused on science in the modern world, showcasing the new Department of History and Logic of Science. In their opening remarks Grant and Hanson made the disciplinary rationale clear: "It is the scientific mind-stretchers we should give our attention to, rather than the technological power achievers. The world is now a different place, not just because we have populated it with a lot of novel objects, but because we think about it differently. This is the feature of science which all too often gets lost in the great noisy spectacular shuffle of technological achievements."[35]

Bringing the Halls to Indiana from UCLA was an ambition on behalf of which neither Grant nor Hanson would compromise. A. Rupert Hall and Marie Boas Hall would provide the historiographical core of the new department, making Indiana an important location for studying the leading problem in the history of science. Grant, working in late medieval

[33] Quoted in letter from Norwood R. Hanson to Dr. Harold Wooster, Chief, Information Sciences, Air Force Office of Scientific Research, April 10, 1961, Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives.

[34] A. R. Hall. *The Scientific Revolution, 1500–1800: The Formation of the Modern Scientific Attitude* (London: Longmans, Green, 1954), p. 307.

[35] "Profs. Hanson and Grant Open Alumni Institute," *Indiana Daily Student,* June 4, 1960.

philosophy, Marie Boas Hall, studying the Renaissance, and A. Rupert Hall, concerned with the seventeenth and eighteenth centuries, created a formidable group for analyzing the scientific revolution. Hanson argued repeatedly to the university administration for the importance of recruiting the Halls. On both sides, there were problems and concerns. After President Wells announced that he would step down in 1962, the Halls were concerned about the change in leadership at the university, while the university had to reckon with the antinepotism rules still in effect at Indiana.[36] A. Rupert Hall's initial appointment would be in the Department of History and Logic of Science but, although Marie Boas Hall would be a full professor with tenure, "in order to circumvent the technicalities connected with nepotistic appointments within the University," she would "very probably have a courtesy appointment with the Department of History and of Chemistry. It is to be understood that Mrs. Hall's center of gravity, vis-à-vis research, teaching, and administration, will be firmly within the new Department of History and Logic of Science."[37] Ironing out the details with Indiana, and their commitments at UCLA, delayed the Halls' arrival until fall 1961.

The four active faculty and nine graduate students opened the first year of the program in the fall of 1960. The Rockefeller Foundation provided support for Scriven's salary, and four of the graduate students were supported by NDEA fellowships, a cadre that would grow to twelve by 1963 through the four fellowships a year the NDEA program provided, three years of support being assured for each fellow. The core curriculum required year-long sequences in both the history and the philosophy of science. In the fall of 1960 nineteen students enrolled in the history survey and seventeen in the philosophy survey.[38] The commitment to HLS as an integrated independent field of study emerged in the classroom immediately. In the core curriculum, all four faculty members attended all classes. The asymmetry produced by the Halls' delayed arrival left Grant as the lone historian in the department during this time. With the arrival of the Halls in 1961, the department completed the development of its upper-level graduate seminars. Each historian would be responsible for two or three seminars. Grant developed "History of Physical Sciences in the Middle Ages" and "Physical Sciences in the Fourteenth Century." Marie Hall focused on "The Mechanical Philosophy" and "Chemical Theory to Berzelius." Rupert Hall would teach "Galileo and the Scientific Revolution," "Newton's Natural Philosophy," and "Concepts of Life."[39] Together these courses provided an extended seminar on the emergence, development, and aftermath of the scientific revolution.

Slow development of an undergraduate program fit well into the disciplinary goals, the university's priorities, and departmental aspirations. The charge to produce "studies that are based on examination of manuscripts and are not limited to previously published materials" echoed throughout the history of science.[40] Indiana University knew what the

[36] A. R. Hall to Norwood R. Hanson, April 21, 1960: "Just one point. Is it true that President Wells is resigning from Indiana University, and if so has his successor been announced? We expect that this rumour is false, but if true it would affect the outlook." Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives.

[37] Norwood R. Hanson to A. R. and M. B. Hall, March 23, 1960, Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives.

[38] Master Roster, Department of the History and Logic of Science, First Semester, 1960, in departmental files. The original nine graduate students were Michael A. Bleyman, Sharon K. Buehler, David L. Hull, Joel H. Lebow, Peter A. Pav, James A. Ruffner, Ovid L. Scott, Clarence E. Wright, and Richard H. Zaffron.

[39] Norwood R. Hanson to Dean Richard B. Curtis, "Plans for Graduate Course Offerings in HLS," October 25, 1961, in departmental files.

[40] I. B. Cohen, book review of *Unpublished Papers of Isaac Newton,* ed. A. R. and M. B. Hall, *Science,* November 16, 1962, *138*:803–804, on p. 803.

department was doing and "didn't worry about or expect big numbers [from enrollment]."[41] Hanson made the departmental research norms obvious to incoming faculty: "It is now quite clear that, within our first three years of existence, a very considerable portion of your time will be free for the prosecution of your own research and research activities. In 1964 we anticipate the development of a fully-articulated undergraduate program under the auspices of the new department. At that time, it may be necessary to reassess the ratio of teaching to research,—but you may be assured in advance that every effort will be made to encourage you in the development of your own independent research."[42]

While the department did not intend to develop its undergraduate program until after 1963, Michael Scriven was permitted to teach an undergraduate honors seminar in "Analytical Philosophy" beginning in 1961. Scriven, at the time the youngest full professor at Indiana, fostered lively discussion about the structure of argument by using controversial issues of the day as case studies. Following a series of negative comments from several members of the Bloomington community and the student government, and under pressure from members of the Board of Trustees, the dean's offices began asking the department for changes—an odd approach, since the department had nothing to do with the course Scriven taught through the honors program.[43] Hanson and Roger Buck, acting chair of the department, resisted outside interference in Scriven's teaching. While the department presented a unified front to the outside, this incident became a focal point for questions of authority and identity within the young department. Scriven's extradepartmental undergraduate teaching and his close relationships with his graduate students were viewed negatively inside the department as encouraging fragmentation and division in the program. Hanson, who "would inevitably get involved with controversies," fought a two-front war: against the threat to academic freedom from outside and against the division of the department inside.[44] The level of Hanson's psychological investment in having created the department only fed his anger in dealing with Scriven: "I am the one who, in more than one year of battling before you ever showed up on the Bloomington scene, determined the general terms controlling the deployment of time and effort of the members of the Department of HLS."[45]

The tensions surrounding the "Analytical Philosophy" class were resolved by internalizing the course, thereby creating the department's first undergraduate offering. Initially its name was "X200—Analytical Philosophy." Buck actively mediated in this resolution, pulling the course into the department, which at once provided protection for Scriven and allowed the department to resist the centrifugal forces bearing in on it.[46] By this time,

[41] Grant, in Oral History.

[42] Norwood R. Hanson to Michael Scriven, March 17, 1960, Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives. Similar language was used in correspondence with Roger Buck and the Halls.

[43] Norwood R. Hanson, Faculty Annual Report, 1961–62, Correspondence and Records of the Department of History and Logic of Science, Collection no. 8, Indiana University Archives. Hanson wrote that "a Trustee became involved and some of our junior deans felt that they had to adopt a posture of one sort or another. So this Department was then asked—for the first time—whether they would pick up the marbles."

[44] The depth of Hanson's support is evident in a telegram to Dean Ralph L. Collins on March 30, 1961: "Suffice it also to say that Professor Scriven does not enter any dispute without first acquainting himself with all the relevant facts. Should this ever become an issue with the legislature I will back Scriven to the hilt." Records of President Herman B Wells, Indiana University Archives.

[45] Norwood R. Hanson to Michael Scriven, June 25, 1962, in departmental files.

[46] Roger Buck to Michael Scriven, May 17, 1962, in departmental files: "Third after your return I shall personally sponsor the idea of an undergraduate offering by this department in the area of inductive logic and experimental design. I would hope that we could come up with a course plan which you, Russ, and I could all approve of and on the basis of which we alternate the teaching of the course."

holding the department together was a recurrent problem. The issues ranged from excessive control of individual graduate students by some faculty to arrangements for collaborative teaching. Repeatedly, however, everyone returned to the table, recognizing that factionalism in a small department would be devastating.[47] Moreover, the larger sense of common mission in the department remained intact as it lobbied for the expansion of the program and sought more support for research. In addition to receiving NSF support in the amount of $12,000 for the Halls' work on *The Correspondence of Henry Oldenburg,* the department sought to expand support for faculty and research assistantships. When the department turned to the Office of Aerospace Research, United States Air Force, its unifying vision remained clear: "Each of us has been concerned with the structure of scientific argument, whether those of late-medieval mathematics or astronomers, or of the giants of the Scientific Revolution, or of the fertile 18th and 19th centuries, or of early-20th-century physics, or contemporary microphysics, mathematics, and the social sciences. It is the ideas, concepts, propositions—the structure of arguments which is our concern."[48]

With seventeen graduate students enrolled in the program, Marie Hall's publication of her *The Scientific Renaissance, 1450–1630,* and the History of Science Society's annual meeting being held in Bloomington in early 1963, Indiana was firmly on the map in the history and philosophy of science. Expansion of the faculty to eight positions, including the recruitment of a historian of biology, was seen as the obvious next step in the department's growth.

CENTRIFUGAL FORCES, 1964–75

The progress that was expected within the independent field of study of HPS, so clear when the department was established in 1960, became increasingly elusive in the late 1960s as faculty turnover and intellectual changes in both the history of science and the philosophy of science pulled the two disciplines in competing directions. During the same period, the department developed a distinctive place in the history of science that was defined by a group of historians who remained together for two decades at Indiana while producing forty Ph.D.'s among them.

Roger Buck, who had been serving as acting chair since Hanson's injuries in a plane crash in 1961, had been named chair in late 1962. Funding sources had stabilized and the university was providing "admirable budgetary support," responding favorably to requests for additional support.[49] Graduate students numbered twenty-three by the fall of 1963. And, by the end of the academic year, the department awarded its first graduate degrees: five M.A.'s. In 1964 the department moved from its first site in the Social Sciences Building to its current location in Goodbody Hall.

The department's success at attracting the best and brightest now presented the challenge of keeping them. As early as March 1961, Hanson had expressed concerns about whether the department could be held together. Most recently, Grant had an offer from Brandeis, the Halls an offer from the University of Pennsylvania, and Hanson himself an offer from Yale. "All this indicates increasing pressure on the new department from outside and will call for clarity and frankness concerning the degree to which Indiana is prepared to support

[47] Grant and Buck, in Oral History.

[48] Norwood R. Hanson to Dr. Harold Wooster, April 10, 1961 (cit. n. 33).

[49] Norwood R. Hanson, Faculty Annual Report, 1961–62, Correspondence and Records, Norwood R. Hanson, Collection no. 8, Indiana University Archives.

the Department's future growth. Every member of the department now has outside offers."[50]

On January 10, 1963, Hanson submitted his letter of resignation to the university in order to accept a professorship in the Philosophy Department at Yale University. In the same year the Halls accepted appointments at Imperial College, London. Suddenly, the Department of History and Logic of Science had lost half its faculty. The department hired Wesley Salmon to replace Hanson, and Richard S. Westfall was hired as the new professor of the history of science. Victor Thoren, who had come to the department as a graduate student from UCLA with the Halls, was hired as lecturer in the history of science. Salmon had received his Ph.D. in philosophy in 1950 from UCLA, having been a student of Hans Reichenbach, and arrived in Bloomington after nine years in the Philosophy Department at Brown University. Westfall began his undergraduate education in engineering at Yale. After serving in the Navy from 1944 to 1946, he returned to New Haven with a new interest in history. He received his B.A. in 1948, his M.A. in 1949, and completed his Ph.D. in 1955 under the direction of Franklin Baumer. Following appointments at the California Institute of Technology and the Iowa State University, Westfall taught at Grinnell College from 1957 to 1963, during which time his doctoral dissertation was published as his first book, *Science and Religion in Seventeenth-Century England.* His early work clearly identified him as a rising young scholar deeply interested in the scientific revolution, one whose journey to the history of science echoed the experiences of Grant and Hanson.

In 1964 the department awarded its first Ph.D.'s to David Hull and Peter Pav. Hull's dissertation, "The Logic of Phylogenetic Taxonomy," had been written under Buck, while Westfall had advised the final stages of Pav's dissertation, "Eighteenth Century Optics: The Age of Unenlightenment," begun under Rupert Hall. The next year Thoren, the new departmental lecturer, completed his dissertation on "Tycho Brahe on the Lunar Theory" under Westfall, and David Lindberg completed his doctorate under Grant with a dissertation on "The *Perpectiva Communis* of John Peckham." These early dissertations displayed a concern with close textual analysis that became the hallmark of the Indiana graduate experience. The centrality of textual scholarship and analysis remained a defining feature of the work of the historians of science and of the dissertations for which they served as advisers for the next two decades. The focus on close textual analysis was common to all the historians on the Indiana faculty during the 1960s, 1970s, and 1980s. The orientation developed in a slightly different way for each of them, but it was so common methodologically that each of them reinforced it in the others.[51]

With Hanson leaving and Newton Stallknecht no longer chair of the Philosophy Department, the Department of the History and Logic of Science quietly changed its name to the Department of History and Philosophy of Science for the 1963–64 academic year. Frederick Churchill was hired in 1965, initially as a lecturer in history of biology, a position the department had been lobbying for since 1960. Churchill was completing his dissertation under the direction of Everett Mendelsohn at Harvard. Hired to bring the history of biology into the department, he also expanded the department's expertise in Continental

[50] Norwood R. Hanson to Ralph L. Collins, VP and Dean of Faculties, March 30, 1961, Records of President Herman B Wells, Indiana University Archives.

[51] While, for the medievalists working under Grant, it was specifically a continuation of the "Clagett program" (see David C. Lindberg, "Medieval Science and Its Religious Context," *Osiris,* 1995, *10*:61–79, on p. 66), this style was a pervasive attitude that graduate students recollected about their experience in the department. The department's style of close textual analysis often marginalized formal discussion of historiography in graduate seminars.

Figure 1. *Frederick Churchill. (Photo by G. E. "Erik" Erikson.)*

science and in science in the nineteenth century. (See Figure 1.) At the end of the 1966–67 academic year, Michael Scriven accepted a position at the University of California, Berkeley, leaving only Grant and Buck from the original six members of the faculty. Ronald Giere, who was finishing his Ph.D. in philosophy at Cornell, was hired when Scriven left Indiana. When Churchill and Thoren were raised to assistant professorships, the configuration of the history faculty in the department would remain unchanged for over twenty years, creating a citadel of stability in the history of science.

The new history faculty quickly began to contribute to the development of the department. Churchill published several articles on August Weismann and developmental biology in the late 1960s, expanding recognition of the department's inclusion of the history of biology. The department's first two dissertations on the history of biology were written shortly thereafter: Paul Farber's "Buffon's Concept of Species," and Lyndsay Farrall's "The Origins and Growth of the English Eugenics Movement, 1865–1925." Thoren published a series of three articles in 1967 that built on his dissertation and established a standard interpretation of Tycho Brahe's lunar theory. Grant and Westfall, the senior historians in the department, were in the midst of a remarkable period of attracting support from the National Science Foundation. By 1967 Grant had received five awards from the NSF and Westfall had received four.[52] This steady support fostered a growing body of research refining the definition and understanding of the scientific revolution.

Grant's work during this period reinforced the uniqueness attributed to the scientific revolution, in opposition to the Duhem thesis, while arguing for the intrinsic value of a richer understanding of medieval natural philosophy. His exploration of medieval natural

[52] Rossiter, "The HPS Program at the NSF" (cit. n. 8), pp. 102–103.

philosophy grew beyond his early concerns with Oresme to broader questions about motion in the absence of material media and to the related subject of medieval concepts of vacuum, space, and place. The persistence of the system of medieval natural philosophy created one side of the scientific revolution's great divide.[53] In 1971 Grant gave his views their most succinct and accessible presentation in his *Physical Science in the Middle Ages,* published as a volume in the Wiley History of Science Series. The final words of *Physical Science in the Middle Ages* take the reader to the far side of the great divide: "By ignoring this essentially pessimistic philosophy and allowing his mind to think anew about the structure of the world, Copernicus devised a simpler cosmological model, the very simplicity of which, for him, was a guarantee of physical reality. This is the stuff of error, fantasy, and scientific revolutions."[54]

Westfall's work during this period began where Grant left off. In *Force in Newton's Physics: The Science of Dynamics in the Seventeenth Century,* for which he won the Pfizer Award, Westfall presented a history of dynamics that allowed for a coherent explanation of Newton's concept of force.[55] In his contribution to the Wiley series, *The Construction of Modern Science: Mechanisms and Mechanics,* which appeared around the time of *Force* and Grant's *Physical Science,* Westfall extended the discussion of dynamics into a general argument about the scientific revolution. He presented his primary claim at the beginning of the introduction: "Two major themes dominated the scientific revolution of the 17th century—the Platonic-Pythagorean tradition, which looked on nature in geometric terms, convinced that the cosmos was constructed according to the principles of mathematical order, and the mechanical philosophy, which conceived of nature as a huge machine and sought to explain the hidden mechanisms behind phenomena."[56] Westfall's most important innovation was articulating a structured process that underlay the scientific revolution, showing that this once-and-for-all intellectual transformation was not static but dynamic. Across natural philosophy, the interaction between the Platonic-Pythagorean tradition and the mechanical philosophy drove the process.

Together, the claims in *Physical Science in the Middle Ages* and *The Construction of Modern Science* are the climax at Indiana of the traditional discontinuous interpretation of the scientific revolution. Grant and Westfall, working from both sides of the great divide, had formulated coherent arguments for the processes that defined the world view on both sides of the divide. Moreover, these two historiographical positions provided clear research programs for graduate students at Indiana that would remain influential for the next fifteen years.

Ironically, these programmatic statements about the nature of the scientific revolution and, hence, of modern science were being developed at a time when the productive dialogue among the historians and philosophers of science at Indiana was at a relatively low point. By the late 1960s, in the midst of the most successful period for producing Ph.D.'s in the philosophy of science at Indiana, the two components of the "independent field of study" that defined the department at the beginning of the decade were heading in separate

[53] Edward Grant, "Late Medieval Thought, Copernicus, and the Scientific Revolution," *Journal of the History of Ideas,* 1962, *23*:197–220; Grant, "Motion in the Void and the Principle of Inertia in the Middle Ages," *Isis,* 1964, *55*:265–292; and Grant, "Medieval and Seventeenth-Century Conceptions of an Infinite Void Space beyond the Cosmos," *ibid.,* 1969, *60*:39–60.

[54] Edward Grant, *Physical Science in the Middle Ages* (New York: Wiley, 1971), p. 90.

[55] Richard S. Westfall, *Force in Newton's Physics: The Science of Dynamics in the Seventeenth Century* (New York: American Elsevier, 1971).

[56] Richard S. Westfall, *The Construction of Modern Science: Mechanisms and Mechanics* (New York: Wiley, 1971), p. 1.

directions. The department was making important original contributions to the historiography of science, but the philosophers in the department had taken an ahistorical turn. The relations between history and philosophy of science were increasingly problematic, as the case-study approach that was integral to Hanson's view of the history and philosophy of science became marginal in the philosophy of science. In a 1973 review of the published proceedings of a 1969 conference on the relations between history and philosophy of science, Indiana's own Ronald Giere described the relations between the history and the philosophy of science as a "marriage of convenience."[57] Stating that his views were representative of the "majority of philosophers outside the historical school," Giere argued that, while criticism that made use of the history of science had certainly provided influential critiques of logical empiricism, it was as science, not as history, that this criticism was effective.[58] Hanson's *Patterns of Discovery* is among the examples of these earlier critiques Giere cited. After reviewing the papers from the 1969 conference, Giere offered his own view of the possibility of a productive union between history of science and philosophy of science, concluding that history might be relevant for problems, such as "the empirical study of research strategies," that were of little interest to philosophers. Giere's comments represented an increasingly common opinion in the philosophy of science: that the union of history and philosophy of science had been a product of the dissatisfaction of both historians of science and philosophers of science with their parent disciplines rather than of a strong common conceptual rationale. Far from growing together as an independent field of study, by the end of the 1960s the history and philosophy of science at Indiana was viewed by some members of the department as a marriage of convenience, but it was a marriage whose continuation was enforced by its departmental status.

During the late 1960s the number of Ph.D.'s awarded by the department reached record levels, reflecting overall trends in both history and philosophy of science. At Indiana the peak year was 1971, when the department awarded ten doctorates. This growth masks a significant pattern of steadiness in the number of Ph.D.'s in the history of science: no more than three historians of science emerged in any one year. The growth in the department from 1969 to 1973 is accounted for by the growing number of philosophers receiving Ph.D.'s. From 1964 to 1968, seven historians and five philosophers received doctorates from the department.[59] Between 1969 and 1973, there were six more history Ph.D.'s but a stunning nineteen in philosophy.[60] During 1971 alone, eight degrees were awarded to philosophers, but only two to historians.

STABILITY, 1975–85

In the early 1970s, as the disciplinary relations within the Department of the History and Philosophy of Science at Indiana seemed most strained, two new appointments strength-

[57] Ronald N. Giere, "History and Philosophy of Science: Intimate Relationship or Marriage of Convenience?" *British Journal for the Philosophy of Science,* 1973, *24*:282–297. Giere was reviewing Roger H. Stuewer, ed., *Historical and Philosophical Perspectives of Science* (Minnesota Studies in the Philosophy of Science, 5) (Minneapolis: Univ. Minnesota Press, 1970). The conference had been held at the University of Minnesota in September 1969 and was sponsored by the United States National Committee for the International Union of History and Philosophy of Science.

[58] Giere, "History and Philosophy of Science," p. 290.

[59] In addition to Pav, Thoren, and Lindberg, the other history Ph.D.'s during the period were James Ruffner, Roderick Home, Robert Snow, and Margaret Osler.

[60] The six historians were Farber, Farrall, Norriss Hetherington, Joan Cadden, Stephen Straker, and James Shaw.

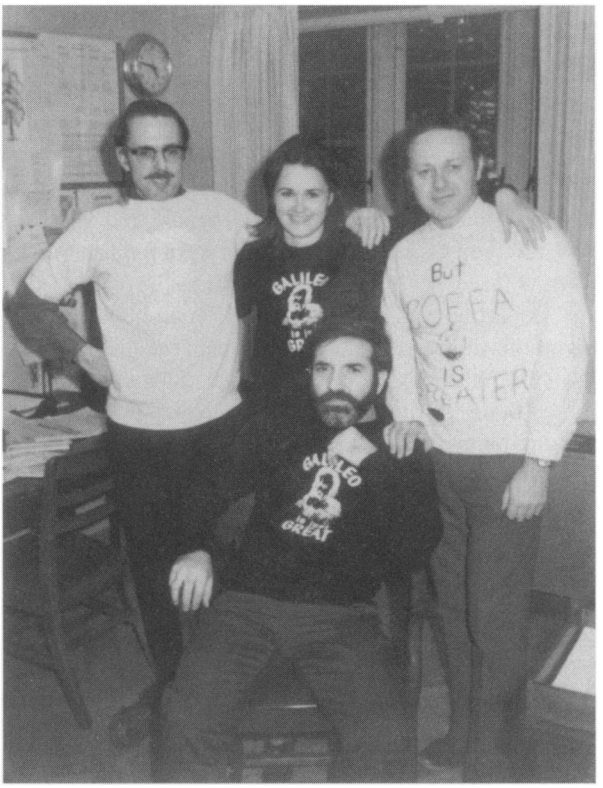

Figure 2. *Frederick Churchill, Lucile Burke, and Edward Grant (standing), and Alberto Coffa (seated) modeling the latest in HPS fashion in the department office circa 1973. (Courtesy of Edward Grant.)*

ened the intellectual connections between the disciplines. Alberto Coffa and Noretta Koertge both brought historical concerns to their philosophy. Koertge had studied under Sir Karl Popper and Imre Lakatos in London, and she combined an interest in the history of chemistry and the social sciences with her work on the philosophy of scientific research programs. Coffa's arrival was the latest chapter in Indiana's close relationship with history and philosophy of science at the University of Pittsburgh. Throughout the 1960s, particularly before 1963, while Hanson was in Bloomington, the department had tried to attract Adolf Grünbaum from Pittsburgh. Now, in hiring Coffa, they attracted one of Grünbaum's most promising students. Coffa was making significant contributions to the philosophy of relativity, but he also had a growing interest in the history of the philosophy of science, particularly the history of logical positivism. Once settled into the department, Coffa fostered a new level of engagement between history and philosophy within the department.[61] (See Figure 2.)

The turn toward closer relations came as the history of science as a whole embraced the approaches of social history and closer relations with the sociology of science. The stability of the history faculty in this period and the improved disciplinary interaction within the department kept new social approaches to the history of science on the margins of the

[61] Buck and Grant, in Oral History.

department: while not necessarily embraced, they were not unrecognized. Beginning in 1973, Westfall corresponded with Arnold Thackray while developing a new graduate seminar on the social history of science.[62]

John Winnie, a student of Herbert Fiegl, was hired by the department after Salmon's departure for the University of Pittsburgh in 1973.[63] In 1976 the department hired Linda Wessels from the University of Wisconsin at Milwaukee, marking only the second time the department had hired one of its own students. Winnie and Wessels added to Coffa's work on modern physics. Ann Carmichael, who had received her M.D. and Ph.D. degrees from Duke in 1978, was hired as a historian of medicine through a split position between HPS and the History Department at Indiana in 1979. With both Carmichael and Churchill on staff, more dissertations in the history of biology and medicine were written throughout the late 1970s and 1980s. While the number of Ph.D.'s awarded each year in the history of science in the United States declined by one-third in the late 1970s, the number awarded by Indiana University remained constant. Westfall, Grant, and Thoren shouldered the administrative responsibilities of the department throughout the period, alternating the chairmanship from 1969 until 1985. Westfall served as president of the History of Science Society in 1977–78, as did Grant in 1985–1986, maintaining the department's high visibility in the discipline.

Between 1980 and 1990, the history faculty made significant contributions to the historiography of science through a series of important monographs. In 1980 Westfall published *Never at Rest: A Biography of Isaac Newton.*[64] Twenty years in the making, *Never at Rest* quickly established itself as the definitive Newton biography and secured Westfall's unprecedented second Pfizer Award. This biographical study, based on a detailed study of the Newton manuscripts, required Westfall to reassess the earlier claims he had made about the scientific revolution in *Force in Newton's Physics* and in *The Construction of Modern Science.* During the 1970s, Westfall and Betty Jo Teeter Dobbs produced new research documenting the fundamental connections between Newton's concept of force and his alchemical works. In writing *Never at Rest* Westfall rewrote not only Newton's life but also his own interpretation of the scientific revolution, an interpretation that now encompassed mathematics and its antipode, alchemy. Alchemy, one of the dark others of unreason, was now an indispensable component in interpreting the scientific revolution. Thoren's biography of Tycho Brahe, *The Lord of Uraniborg,* was the culmination of research Thoren began in the 1960s. Although it was not published until 1991, it established itself as the definitive biography of another significant figure in early modern science and is often mentioned alongside *Never at Rest.*[65] Both works contributed to the development of scientific biography through combining careful analysis of theories, concepts, and techniques with a detailed development of the scientist's social context. In 1981 Grant published *Much Ado About Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution,*[66] capping almost two decades of research on concepts of place,

[62] Richard S. Westfall Papers, Collection no. 139, Indiana University Archives.

[63] In his review of the relations between history and philosophy (cit. n. 57), Ronald Giere specifically cited Winnie as an example of the young philosophers who were moving beyond the historical approach in philosophy of science, an indication that the relationships between the disciplines were not simple.

[64] Richard S. Westfall, *Never at Rest: A Biography of Isaac Newton* (Cambridge: Cambridge Univ. Press, 1980).

[65] Victor E. Thoren, *The Lord of Uraniborg: A Biography of Tycho Brahe* (Cambridge: Cambridge Univ. Press, 1991).

[66] Edward Grant, *Much Ado About Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution* (Cambridge: Cambridge Univ. Press, 1981).

space, and the void in the history of natural philosophy. Like the biographies Thoren and Westfall wrote, *Much Ado About Nothing* was the culmination of an important line of research within the department.

REST, 1985–93

During 1985 the Indiana department marked its twenty-fifth anniversary with alumni events and by once again hosting the History of Science Society Annual Meeting. There were reasons for celebrating. After a quarter century, HPS at Indiana remained a leading center in the discipline. Churchill, Grant, Thoren, and Westfall were leading scholars in the history of science whose students had made important contributions to the discipline. Two former presidents of the History of Science Society, the only historian of science to win the Pfizer Award more than once, important contributions to the historiography of science from the fourteenth to the seventeenth centuries, new interpretations of developmental biology, definitive biographies of Isaac Newton and Tycho Brahe: these were scholars at the height of their careers. In 1973 Warren Van Egmond had penned a theme song for the department. Built around a chorus of "Galileo is just great; he's a lot of fun. He's the one we venerate; he's the only one,"[67] the song included verses for each member of the history faculty circa 1973. At the reunion in 1985, they were all still there to sing their respective parts, as they had been for almost two decades.

In many ways, 1985 was a watershed year in the history of the department. The entire department mourned the loss of Alberto Coffa. The year also opened a period when the history of science at Indiana would pay a price for its peaceful productivity during the past two decades. From 1987 until 1994, no more than one history Ph.D. was awarded in any year, and in four years there were none. The continued stagnation in the growth of the discipline and the limited job opportunities combined to reduce the number of students entering the program and the subsequent number of new scholars. From 1975 to 1982, the entering class size for the program averaged eleven students. Between 1983 and 1989, average class size fell to seven students.[68] Similarly, from 1974 to 1983, the department awarded thirteen history doctorates; from 1984 to 1993, only ten. At its lowest ebb, between 1987 and 1993, HPS at Indiana produced only three historians of science.

The decline in the number of Ph.D.'s both revealed and masked important features of the HPS Department. It was not the consequence of generational change in the history faculty; that began only in 1989. Rather, the decline revealed the department's failure to accommodate changing interests within the discipline and its failure to attract a new generation of students whose interest in the history of science developed under different social and academic conditions. It also reflected the fact that key faculty were wrapping up their productive research programs of the early 1980s. Fundamentally, it revealed the disciplinary changes that had removed the study of the scientific revolution from its unquestioned centrality in the history of science.

Nonetheless, the drop in the number of Ph.D.'s also masked the fruitfulness of new directions within the department. Churchill and Carmichael continued to cultivate the history of biology and medicine. Westfall set off in a new direction in the 1980s by taking

[67] "Department of History and Philosophy of Science Song Book," in departmental files.

[68] Based on admissions statistics for the Department of History and Philosophy of Science, Indiana University, compiled in 1994 by James H. Capshew.

up the question of patronage in the scientific revolution, beginning with his paper "Science and Patronage: Galileo and His Telescope,"[69] delivered at the History of Science Society Annual Meeting in 1983. When he applied for his first NSF grant to pursue this line of research, several of the reviews expressed doubts about the value of this kind of research, which has subsequently developed into an important perspective in the history of science. During this time, Grant's planned revision of *Physical Science in the Middle Ages* evolved into an entirely new text whose title, *The Foundations of Modern Science in the Middle Ages,* marked a radical change in interpretation.[70] Rejecting the interpretation he had helped make standard, and stepping away from a tradition stretching from both Koyré and Kuhn, Grant argued that the status and structure of rationality in medieval Western Europe created an important framework for the development of modern science.

There remained at Indiana through the 1980s a commitment to a now-traditional view of both the history and the philosophy of science in the United States. The differential development of these two disciplines often created tension within the department, but their combined location at one institution maintained a dialogue that ebbed at times but never disappeared. The remarkable continuity and productivity of the history faculty left important legacies to the discipline. The close textual analysis that figured so prominently in the department's scholarship and teaching continued to be influential through the graduate students in the history of science who received their training in the program. The department retained a fundamental commitment, most clearly evident in the work of Westfall and Grant, to the unique value of rationality and its historical importance as modern science emerged. These historians, and many of their generation, were attracted to the history of science because of the commitment to rationality that made science what it was. Grant's reassessment of the status of medieval natural philosophy in *Foundations* elevates the importance of the culture of rationality in shaping the modern scientific attitude. Westfall discussed this issue while reflecting on coming to terms with Newton's alchemy while he was writing *Never at Rest:* "I am not ready to surrender the entire process of investigation, the context of discovery, to psychologizing. This was our figure of darkness, the dominance of irrational psychic drives. . . . I see in the seventeenth century a tradition of rational inquiry accessible to us in books and papers, in terms of which Newton's research makes sense."[71]

RENEWAL, 1993–98

If the central problem in writing the history of science, for much of the last half-century, was the problem of reckoning with revolution, the same problem faces the historian assessing the history of HPS at Indiana since 1989. Indiana University, the history of science, and the world of scholarship lost two of its valued laborers during the 1990s. The death of Vic Thoren in March 1991 came within a week of his completing *The Lord of Uraniborg.* In August 1996, Sam Westfall died in Bloomington. Westfall had retired in 1989, but he remained an active presence in the department and continued to work on his database project on the early modern scientific community, publishing some early results in 1993.

[69] Richard S. Westfall Papers, Collection no. 139, Indiana University Archives.

[70] Edward Grant, *The Foundations of Modern Science in the Middle Ages* (Cambridge: Cambridge Univ. Press, 1996).

[71] Richard S. Westfall, "Newton and His Biographer," in *Introspection in Biography: The Biographer's Quest for Self-Awareness,* ed. Samuel H. Baron and Carl Pletsch (Hillsdale, N.J.: Analytic Press, 1985), pp. 175–189, on pp. 183–184.

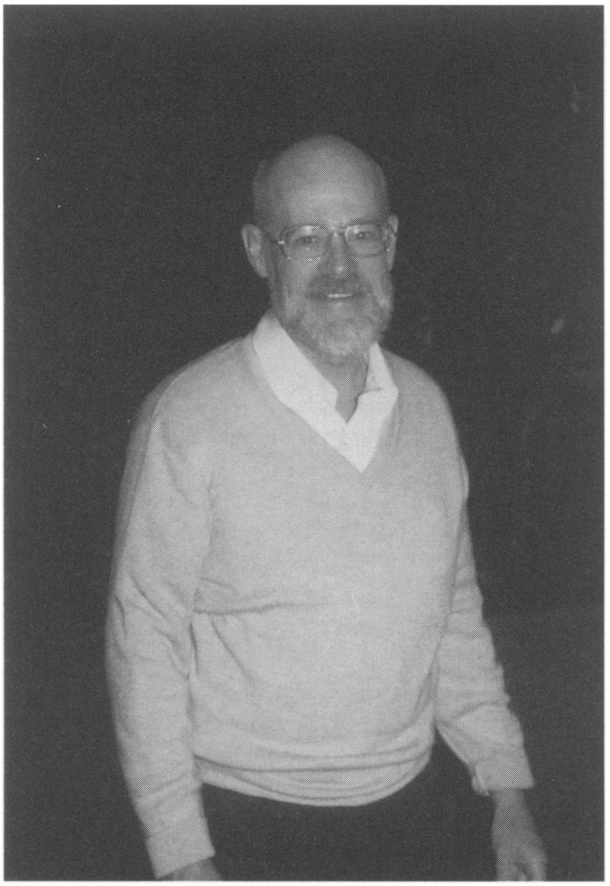

Figure 3. *Richard S. Westfall. (Photo by G. E. "Erik" Erikson.)*

(See Figure 3.) In 1991 Grant retired, although some of his most significant research and revisions would arrive in *Planets, Stars, and Orbs: The Medieval Cosmos, 1200–1687,* and *The Foundations of Modern Science in the Middle Ages.*[72] Churchill retired in 1998, though remaining active as a dissertation advisor and researcher and completing a new volume on August Weismann.[73] Through the work of Churchill's and Carmichael's students, just over 30 percent of the history dissertations written at Indiana have been on topics in biology and medicine. Following Churchill's retirement, the faculty who had advised forty of the forty-three historians of science who had taken their degrees at Indiana University were gone. Beginning with the first history Ph.D. awarded in 1964, research and training within the department had been guided by the same group of historians for three decades. Virtually from the founding of the department, continuity and tradition had been maintained through their work and the work of their students. In a seven-year period, that era in the life of the department came to a close.

[72] Edward Grant, *Planet, Stars, and Orbs: The Medieval Cosmos, 1200–1687* (Cambridge: Cambridge Univ. Press, 1994).

[73] Frederick B. Churchill and Helmut Risler, eds., *August Weismann: Ausgewählte Briefe, Autobiographien und Dokumente, with an Essay by Frederick B. Churchill* (Freiburg: Universitätsbibiliothek, 1999).

Since 1990, a transformation greater than the exodus during the years 1963 to 1967 has taken place. From 1990 until 1995 Churchill served as chairman, shepherding the department through a wholesale revision of the faculty roster and facilitating the adjustment to an era in which undergraduate enrollments were increasingly important to the university's attitude toward the department. In 1990 James Capshew and Richard Sorrenson were hired as historians while Stephen Kellert and Zeno Swijtink were added to the philosophy faculty. Their arrival brought different perspectives and methodologies into the department, including broader interest in sociological and institutional issues in the history of science that reflected broader changes in the discipline. In 1994 Michael Friedman was appointed to the Ruth N. Halls Chair in the Humanities at Indiana University. His presence reinvigorated the relations between the history and the philosophy of science, reinterpreting the goal of an "independent field of study." His decision to accept the Indiana appointment was strongly influenced by the presence of an independent department for the history and philosophy of science. Friedman was interested in the history of the philosophy of science, a growing trend in contemporary philosophy of science, and his interest served to rekindle the relations between the disciplines as a departmental concern. In 1995 he was selected as department chairman and oversaw the hiring of the historians William Newman and Domenico Bertoloni Meli and the philosophers Michael Dickson and Elisabeth Lloyd. The university's renewed commitment to the department has ensured its viability for the foreseeable future. Since 1995, the department has awarded four Ph.D.'s in philosophy and six in history, slightly more than the department's historical record.

At the end of the century, the Department of History and Philosophy of Science is thriving. President Wells considered the department, established in a time of plenty in American higher education, a strategic investment for Indiana University in the esoteric and exotic on a new academic frontier. From its founding, scholars working in the department contributed to the publication of primary sources, identified as the field's most pressing need. These scholars cultivated a style of close textual scholarship that set the standard for historical studies relating to the scientific revolution. Founded upon the perceived importance of the scientific revolution as a guiding problem, the scholarship produced by the department has transformed our understanding of that problem. Through the late 1960s and early 1970s, even as the historians were publishing important reinterpretations of the scientific revolution, changing disciplinary forces in the history of science and the philosophy of science eroded the intellectual consensus on which the department had been founded. After four decades, through their work and that of others, the nature of the historiography of the scientific revolution, which was central to the birth of the discipline, has been transformed. Nowhere in the history of science in the United States have the consequences of the scientific revolution's status as a guiding problem so deeply affected an academic program. With a near obsession with the empirical material of history, the department has nurtured several generations of scholars and students, who have extended, as well as revised, the central assumptions around which the department was built.

Now, as the department is approaching its fortieth anniversary, a new configuration of forces is tangible, evident in both the structure of the philosophy core curriculum, which is more historical in approach, and in recent history dissertations. The transition from the generation that fostered its growth for most of its history to a new, more diverse generation of scholars is nearly complete. The essential tension between disciplinary norms and institutional configuration continues to shape teaching and research within the department. The history of science program at Indiana University has been defined more by the culture of research and writing established by the cadre of historians who anchored the department

for twenty-five years than by the heady aspirations of the department's founders or today's academic fashions.

APPENDIX

Table A. Faculty of the Department of History and Philosophy of Science at Indiana University

History of Science	Years	Philosophy of Science	Years
Edward Grant	1960–92	Norwood Russell Hanson	1960–64
A. Rupert Hall	1961–64	Michael J. Scriven	1960–67
Marie Boas Hall	1961–64	Roger C. Buck	1960–87
Richard S. Westfall	1963–89	Wesley C. Salmon	1963–73
Victor E. Thoren	1964–91	Ronald N. Giere	1966–87
Frederick B. Churchill	1965–98	J. Alberto Coffa	1970–84
Ann G. Carmichael	1979–	Noretta Koertge	1970–
H. Scott Gordon	1985–89	John A. Winnie	1973–95
James H. Capshew	1990–	Linda A. Wessels	1976–95
Richard J. Sorrenson	1993–	Joel M. Smith	1986–89
Domenico Bertoloni Meli	1996–	Stephen H. Kellert	1990–94
William R. Newman	1996–	Zeno G. Swijtink	1990–95
		Michael L. Friedman	1994–
		W. Michael Dickson	1996–
		Elisabeth A. Lloyd	1998–

Table B. Ph.D. recipients from the Department of History and Philosophy of Science at Indiana University

Year	History of Science	Philosophy of Science
1964	Peter Anton Pav	David Lee Hull
1965	David Charles Lindberg	
	Victor Eugene Thoren	
1966	James Alan Ruffner	Hugh Matthew Lacey
1967	Roderick Weir Home	James William Child
	Robert Emerson Snow	Robert Michael McLaughlin
1968	Margaret Jo Osler	Richard Harold Zaffron
1969		Clark Noren Glymour
		Edwin Levy, Jr.
		Clarence Elmer Wright, III
1970	Paul Lawrence Farber	Peter Dean Asquith
	Lyndsay Andrew Farrall	James Henry Fetzer
	Norriss Swigart Hetherington	
1971	Joan Cadden	Rodney Paul Bryne
	Stephen Mory Straker	Ferrel Marvin Christensen
		Neal Kenneth Grossman
		Allen James Harder
		Alberto Cortes Osorio
		John D. Ringen
		Benjamin Freeman Rogers
		Norman Manuel Swartz
1972	James Rochester Shaw	Peter Allyn Bowman
		James Haller Moor
1973		Blanche Wohl Abramov
		Evan Kermit Jobe
		Donald Richard Nilson
		Robert Brown Stewart
1974	Timothy Lenoir	
	Ronald James Overman	

Table B (continued). Ph.D. recipients from the Department of History and Philosophy of Science at Indiana University

Year	History of Science	Philosophy of Science
1975	Inci Altug Bowman	Chaman Lal Jain
	Andrea Parks Van Houweling	Charles Thomas Rogers
		Mark Gustaaf Tamthai
		Linda Ann Wessels
1976	Warren Van Egmond	Laurent A. Beauregard
	Erich Robert Paul	Gary Michael Hardegree
1977	Steven James Dick	
1978	Jane Maienschein	
1979	James W. Llana	John Beatty
		Geoffrey Matthews
1980	Richard Delahide Ferrier	Lewis Gray
	Jeffery Werdinger	Gladys G. Taylor
1981	Ronald Rainger	Anne L. Deckard Hiskes
1982		Susan K. Mills-Isen
		Linda M. Sartorelli
1983	Anita Guerrini	
1984	Edward Bradford Davis, Jr.	
	Peter G. Sobol	
	Joseph M. Tatarewicz	
1985	Gerald Ellis Funk	C. Kenneth Waters
	Ronny S. Millen	
1986	Carol A. Day	Ghrol Irzik
	Marsha Leigh Richmond	
1987		Sergio Martinez
		Frank Pecchioni
		Gordon Robert Steinhoff
1988		
1989	Emerson Thomas McMullen	Joia A. Lewis
		Don Robinson
1990	Eric R. Meyer	Eric C. Barnes
		Thomas Oberdan
		Osvaldo Pessoa, Jr.
1991		
1992	Wallace Edd Hooper	Marco Giunti
		Kevin B. Korb
1993		William J. McKinney
		Peter J. Ramberg
1994	Yan Lu	David Grandy
	James R. Voelkel	
1995	Alice Domurat Dreger	
	Karen A. Rader	
1996		Keiko Ichiye
1997	Matthew Goodrum	Ruth Berger
	William Tammone	
	Wini Mary Edwina Warren	
1998	Mark Kalthoff	Karen D. Snyder
1999	Jordan D. Marché, II	
	Elizabeth Green Musselman	